

**Boeing Plant 2
Seattle/Tukwila, Washington**

**Uplands Corrective Measures Study
Volume III: South Yard Area**

**Data Gap Investigation Work Plan
Section 1: South Yard Description
Section 2: Data Gap Analysis
Section 3: Data Gap Investigation Methods**

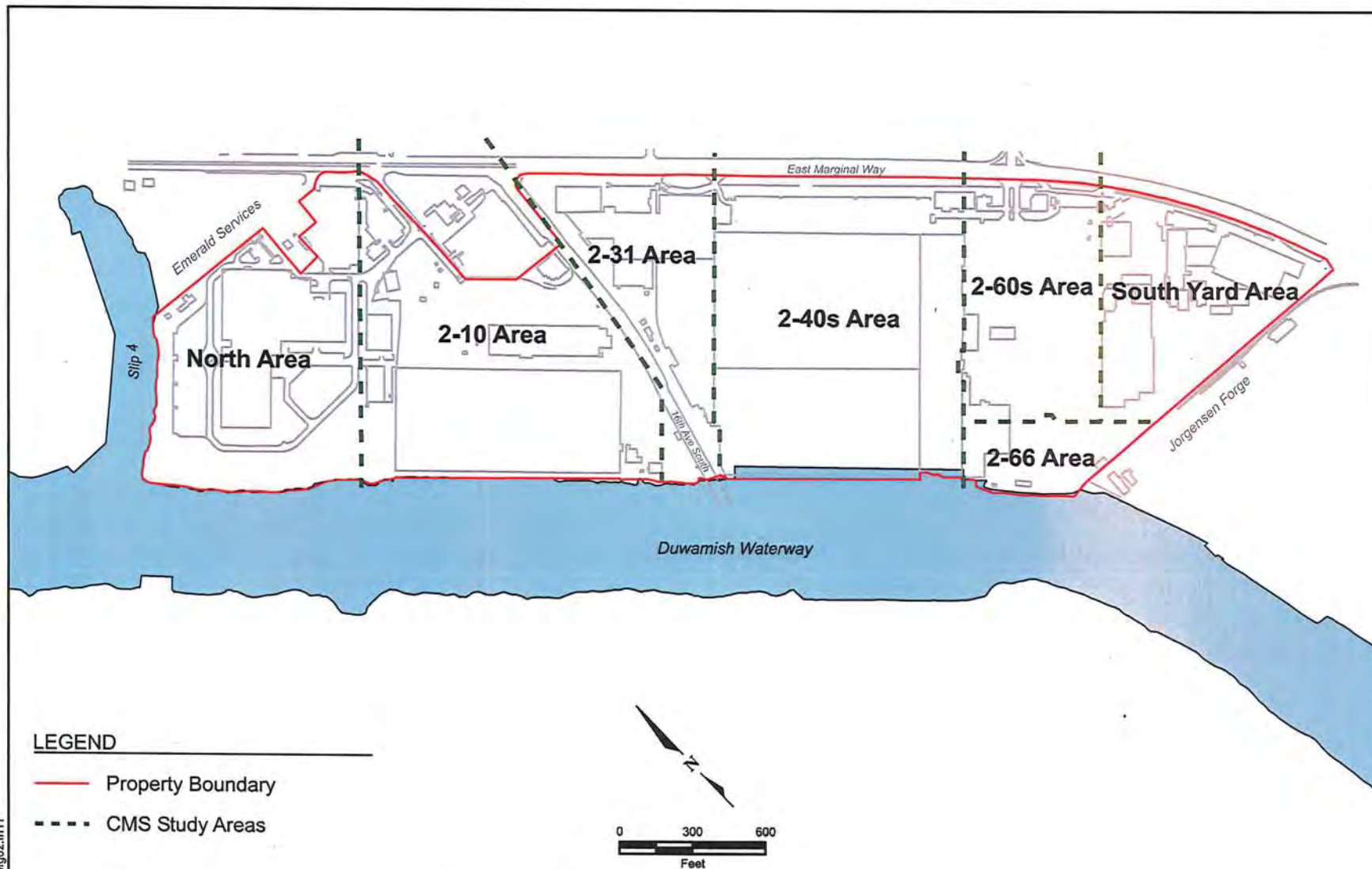
**Data Gap Investigation Report
Section 4: Data Gap Investigation Results
Section 5: Area-specific Constituents of Concern**

Remedy Selection Report

Prepared for
The Boeing Company
Seattle, Washington

Prepared by
Environmental Partners, Inc.
FLOYD | SNIDER
Golder Associates Inc.

**Data Gap Investigation Work Plan Submitted
December 2005**



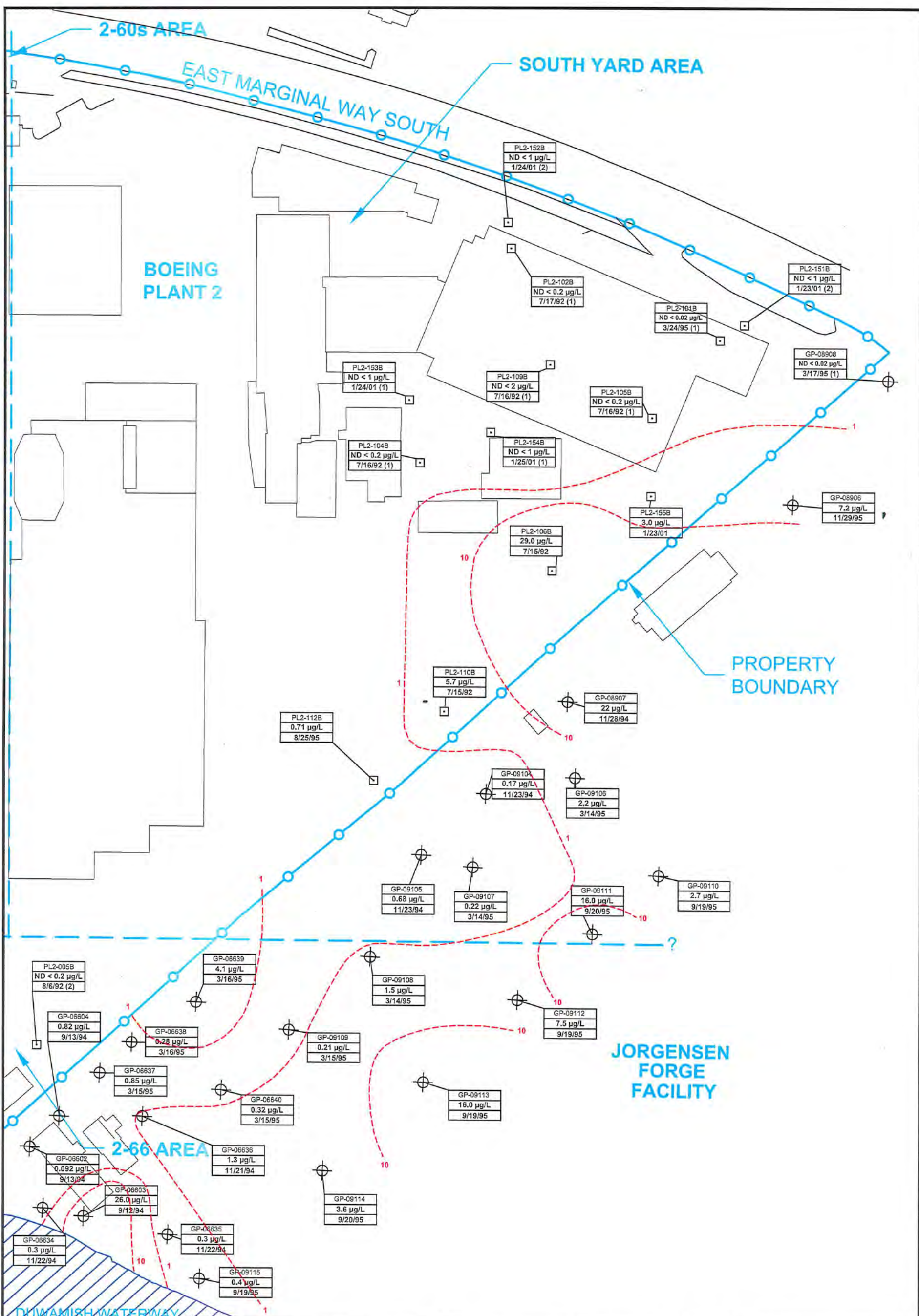
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REVIEWED BY TN	DATE 12/21/05

**Data Gaps Investigation Work Plan
South Yard Area
Boeing Plant 2
Seattle/Tukwila, Washington**

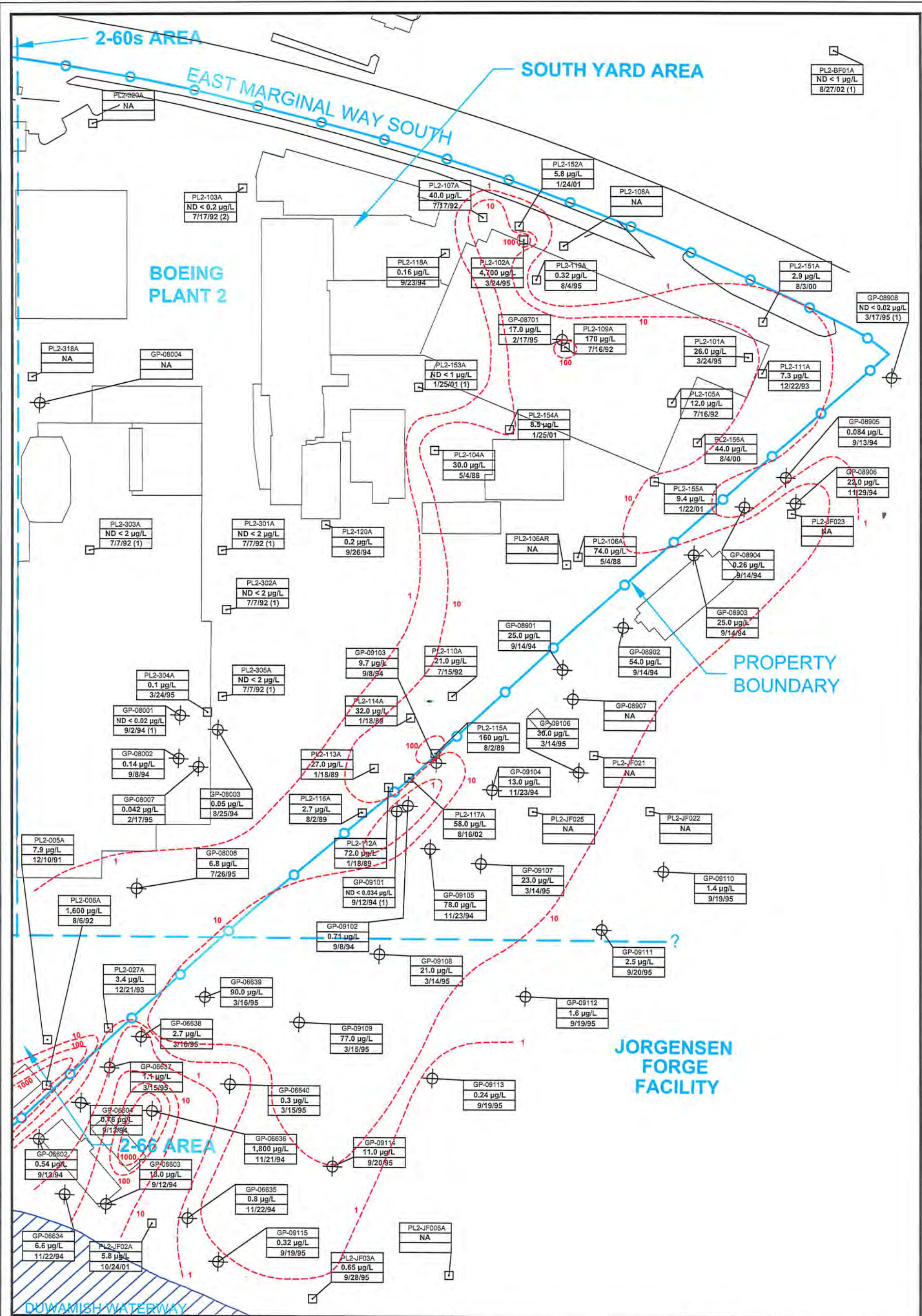
**Figure 1-2
Site Plan with CMS Study Areas**



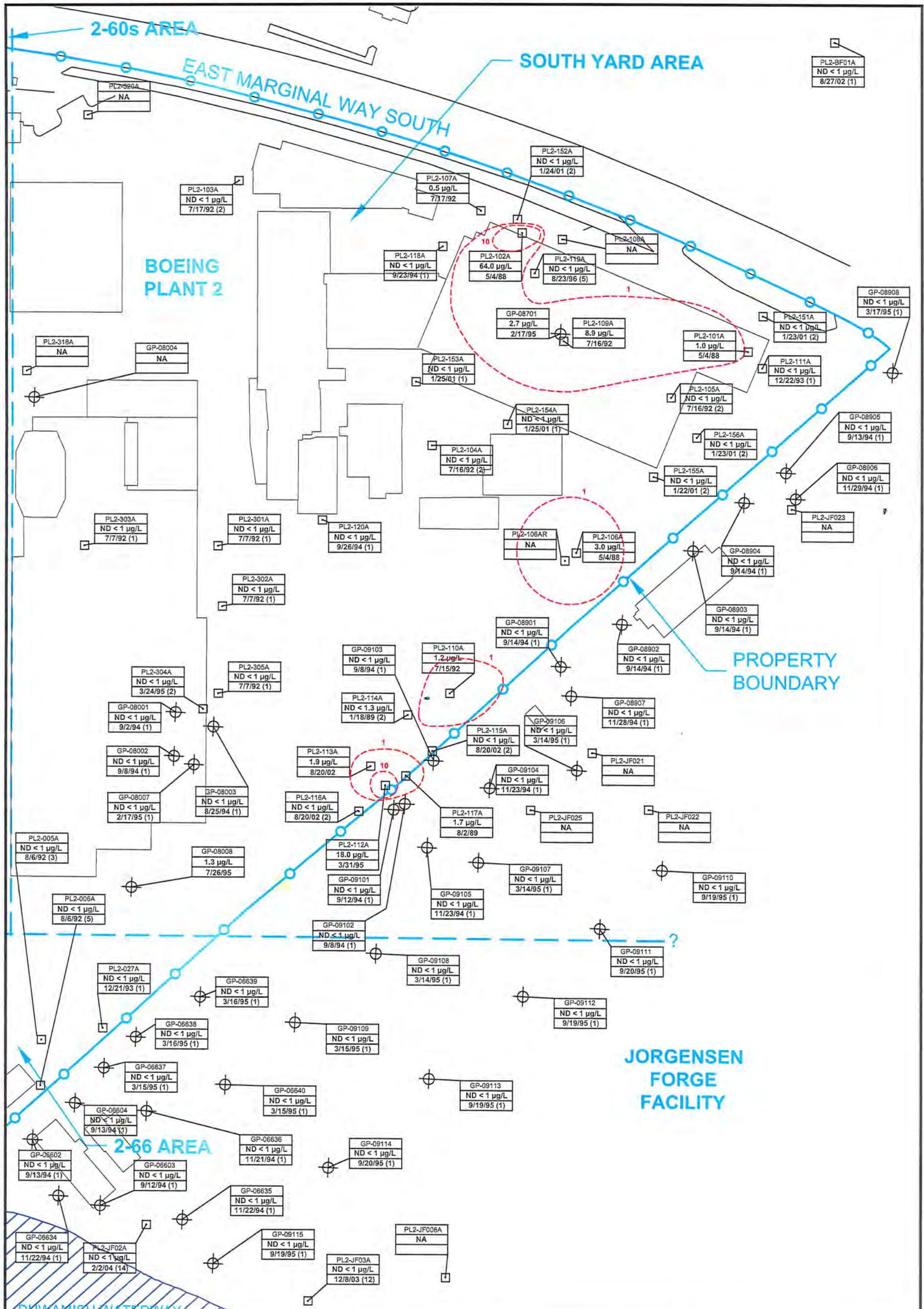
KEY  N  WELL LOCATION  PROBE LOCATION  AREA BOUNDARY  PROPERTY BOUNDARY  ISOCONCENTRATION LINE SCREENING LEVEL (2004) = 0.731 µg/L  SCALE: 1"= 100' <table><tr><td>PL2-005A</td><td>WELL/PROBE NAME</td></tr><tr><td>7.02 µg/L</td><td>MAXIMUM DETECTION OR NON-DETECT WITH DETECTION LIMIT</td></tr><tr><td>4/25/04 (2)</td><td>DATE (NUMBER OF NON-DETECTS)</td></tr></table>	PL2-005A	WELL/PROBE NAME	7.02 µg/L	MAXIMUM DETECTION OR NON-DETECT WITH DETECTION LIMIT	4/25/04 (2)	DATE (NUMBER OF NON-DETECTS)	 ENVIRONMENTAL PARTNERS INC BOEING PLANT 2 SOUTH YARD AREA VINYL CHLORIDE CONCENTRATIONS IN LEVEL B GROUNDWATER	<table><tr><td>PROJECT</td><td colspan="3">BOEING PLANT 2</td></tr><tr><td>PREPARED FOR</td><td colspan="3">THE BOEING COMPANY</td></tr><tr><td>LOCATION</td><td colspan="3">7725 EAST MARGINAL WAY SEATTLE/TUKWILA, WASHINGTON</td></tr><tr><td>SHEET 1 of 1</td><td>DRAWN BY TK</td><td>REVIEWED BY DCK</td><td>DATE 6/9/04</td></tr></table>	PROJECT	BOEING PLANT 2			PREPARED FOR	THE BOEING COMPANY			LOCATION	7725 EAST MARGINAL WAY SEATTLE/TUKWILA, WASHINGTON			SHEET 1 of 1	DRAWN BY TK	REVIEWED BY DCK	DATE 6/9/04
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LOCATION	7725 EAST MARGINAL WAY SEATTLE/TUKWILA, WASHINGTON																							
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epi ENVIRONMENTAL PARTNERS INC

**BOEING PLANT 2
SOUTH YARD AREA
VINYL CHLORIDE CONCENTRATIONS
IN LEVEL B GROUNDWATER**



KEY WELL LOCATION PROBE LOCATION AREA BOUNDARY PROPERTY BOUNDARY ISOCONCENTRATION LINE SCREENING LEVEL (2004) = 0.731 µg/L PL2-005A 7.02 µg/L 4/25/04 (2) WELL/PROBE NAME MAXIMUM DETECTION OR NON-DETECT WITH DETECTION LIMIT DATE (NUMBER OF NON-DETECTS) ← N SCALE: 1"= 100'	ept ENVIRONMENTAL PARTNERS INC BOEING PLANT 2 SOUTH YARD AREA VINYL CHLORIDE CONCENTRATIONS IN LEVEL A GROUNDWATER		PROJECT BOEING PLANT 2
			PREPARED FOR THE BOEING COMPANY
			LOCATION 7725 EAST MARGINAL WAY SEATTLE/TUKWILA, WASHINGTON
			SHEET 1 of 1



KEY

WELL LOCATION

PROBE LOCATION

AREA BOUNDARY

PROPERTY BOUNDARY

ISOCONCENTRATION LINE

SCREENING LEVEL (2004) = 0.382 µg/L

PL2-005A

7.02 µg/L

4/25/04 (2)

WELL/PROBE NAME

MAXIMUM DETECTION OR NON-DETECT WITH DETECTION LIMIT

DATE (NUMBER OF NON-DETECTS)

←

N

SCALE: 1"= 100'

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ENVIRONMENTAL PARTNERS INC

BOEING PLANT 2

SOUTH YARD AREA

1,1-DICHLOROETHENE CONCENTRATIONS

IN LEVEL A GROUNDWATER

PROJECT

BOEING PLANT 2

PREPARED FOR

THE BOEING COMPANY

LOCATION

7725 EAST MARGINAL WAY
SEATTLE/TUKWILA, WASHINGTON

SHEET

1 of 1

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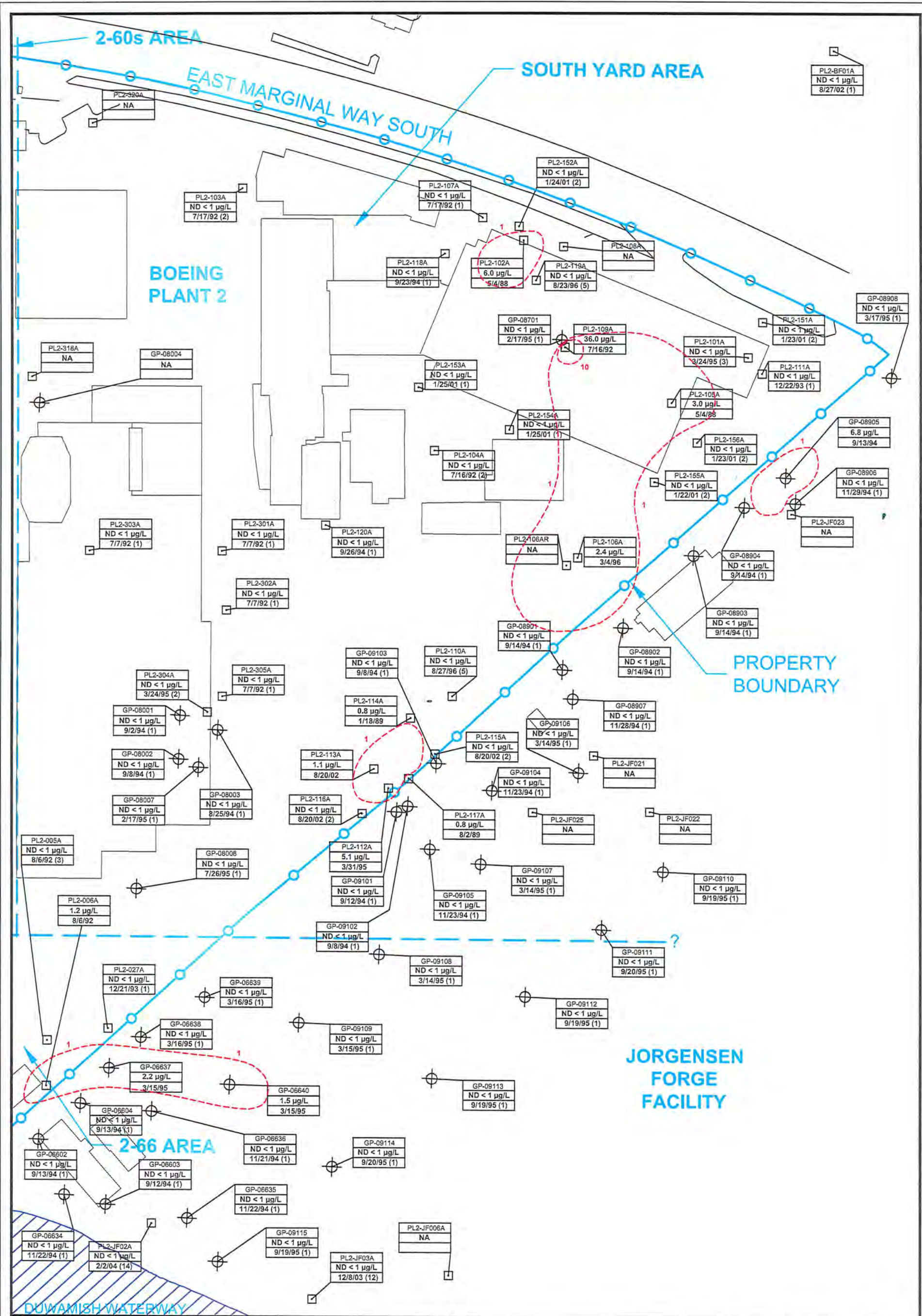
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DCK

DATE

6/10/04



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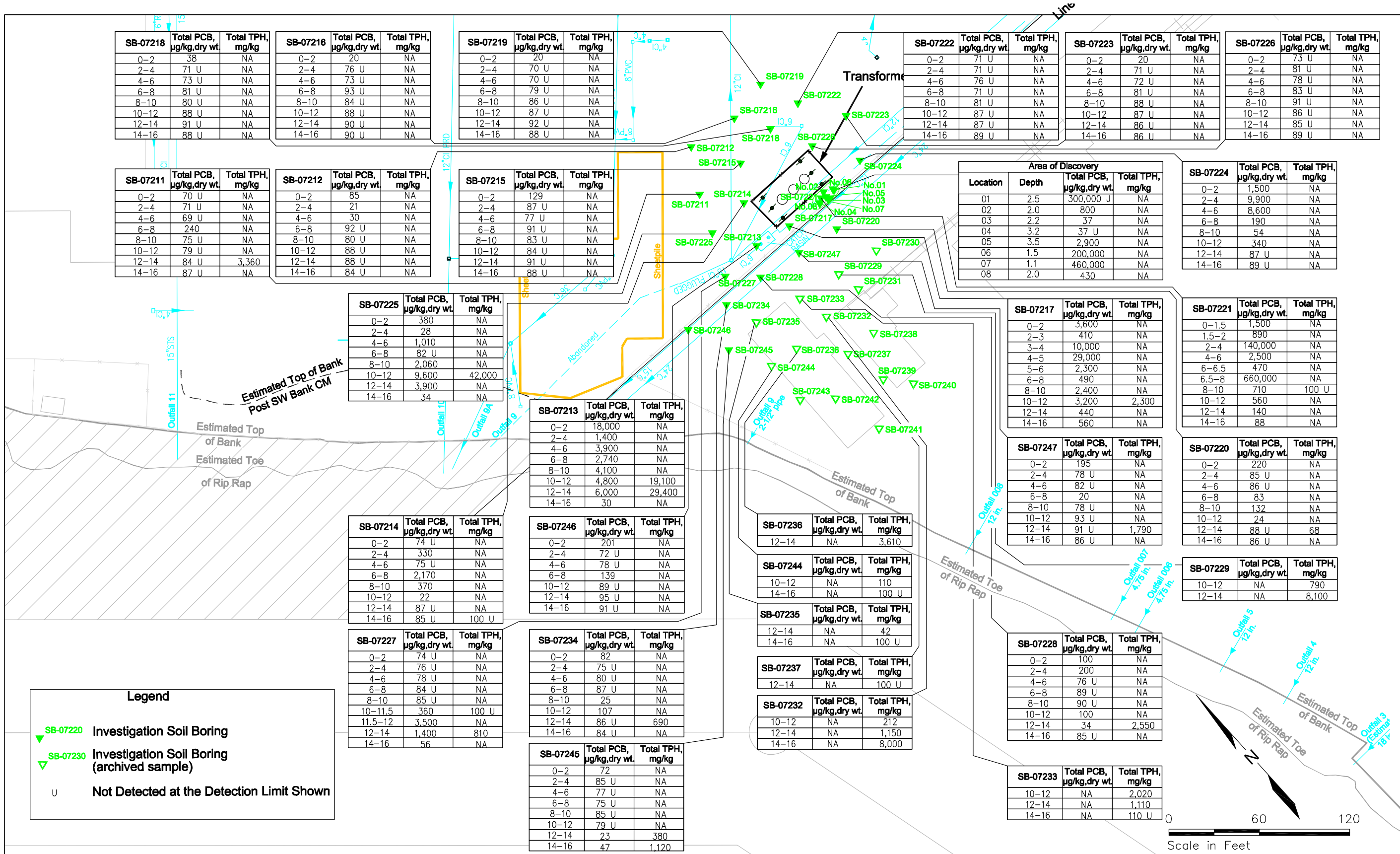


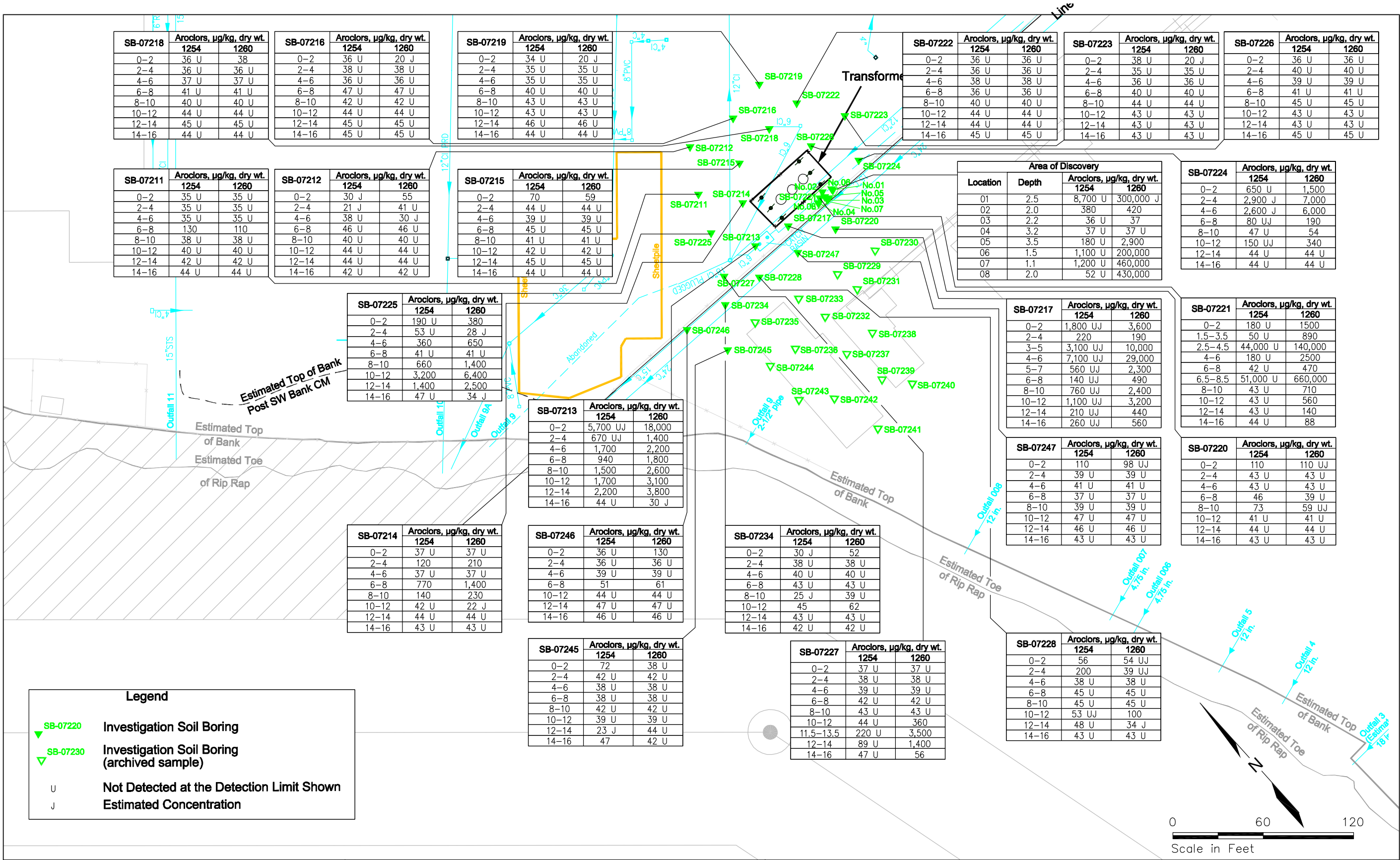
**Boeing Plant 2
Seattle/Tukwila, Washington**

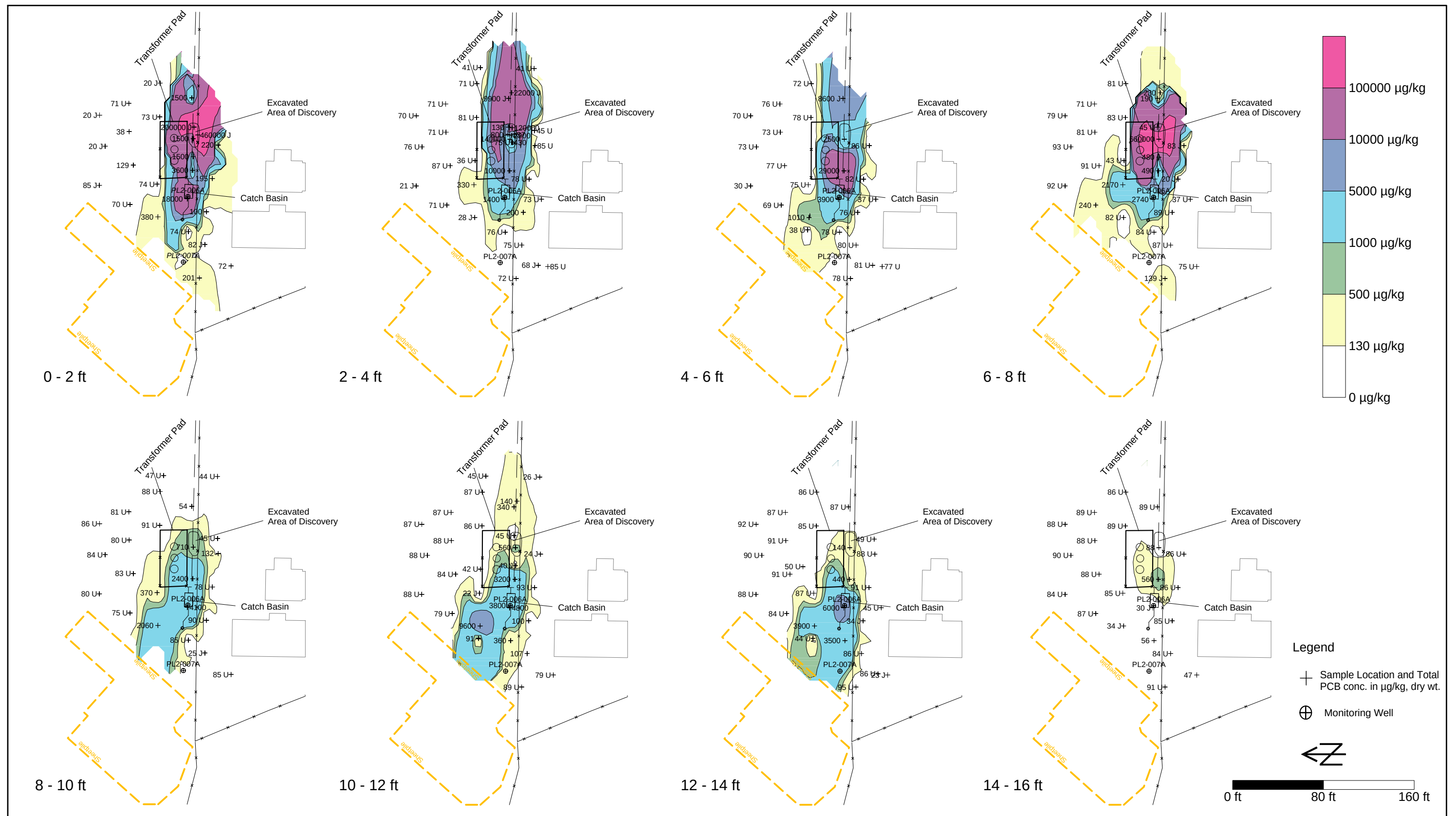
Phase 1 Transformer PCB Investigation Report

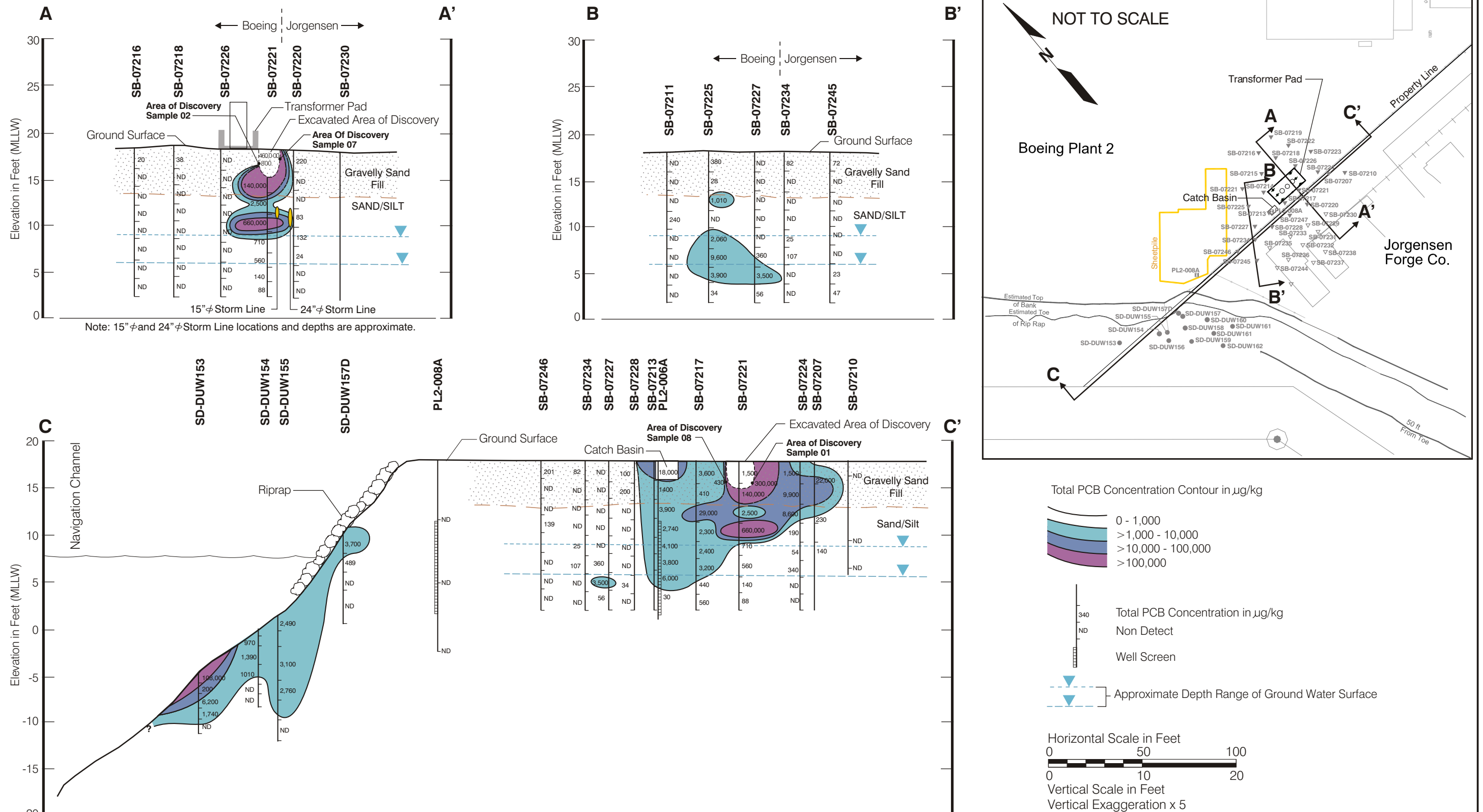
Figures

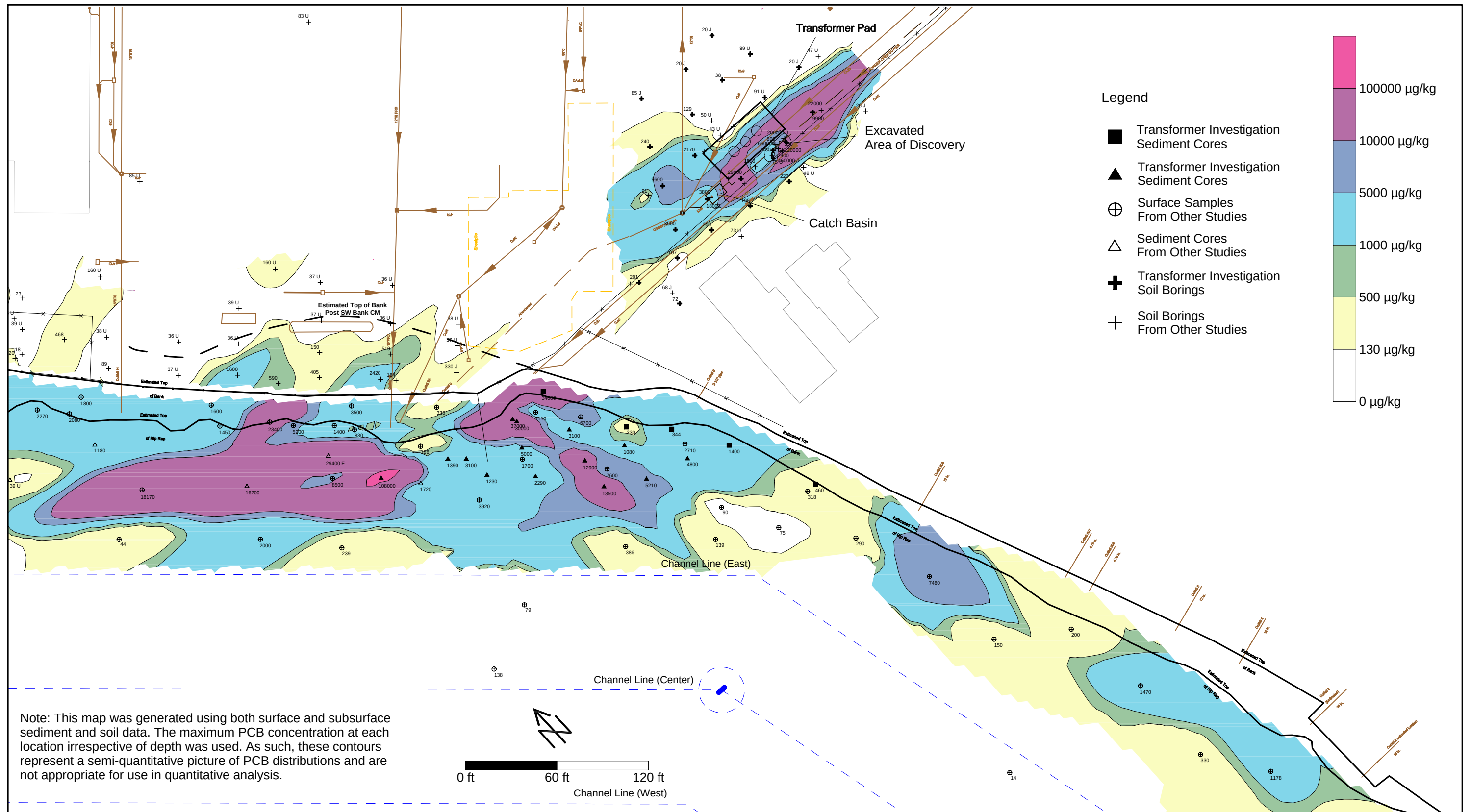
February 24, 2004











Phase 1 Transformer PCB Investigation Report
Boeing Plant 2
Seattle, Washington

Figure 4.2
Isoconcentration Contours of Maximum Total PCB Concentrations
in Soil and Sediment

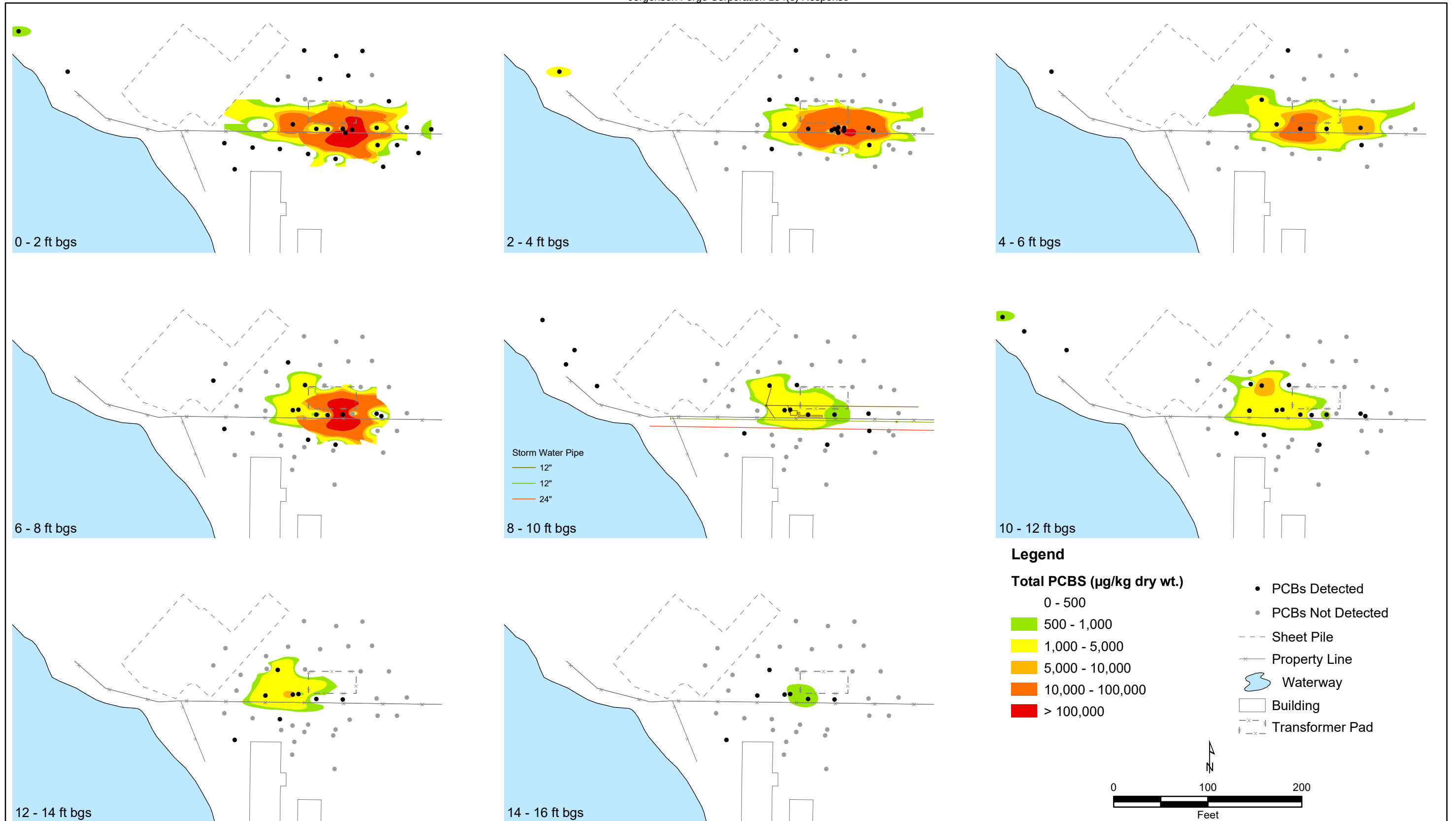


**Boeing Plant 2
Seattle, Washington**

Phase II Transformer PCB Investigation Report

Figures

August 3, 2005

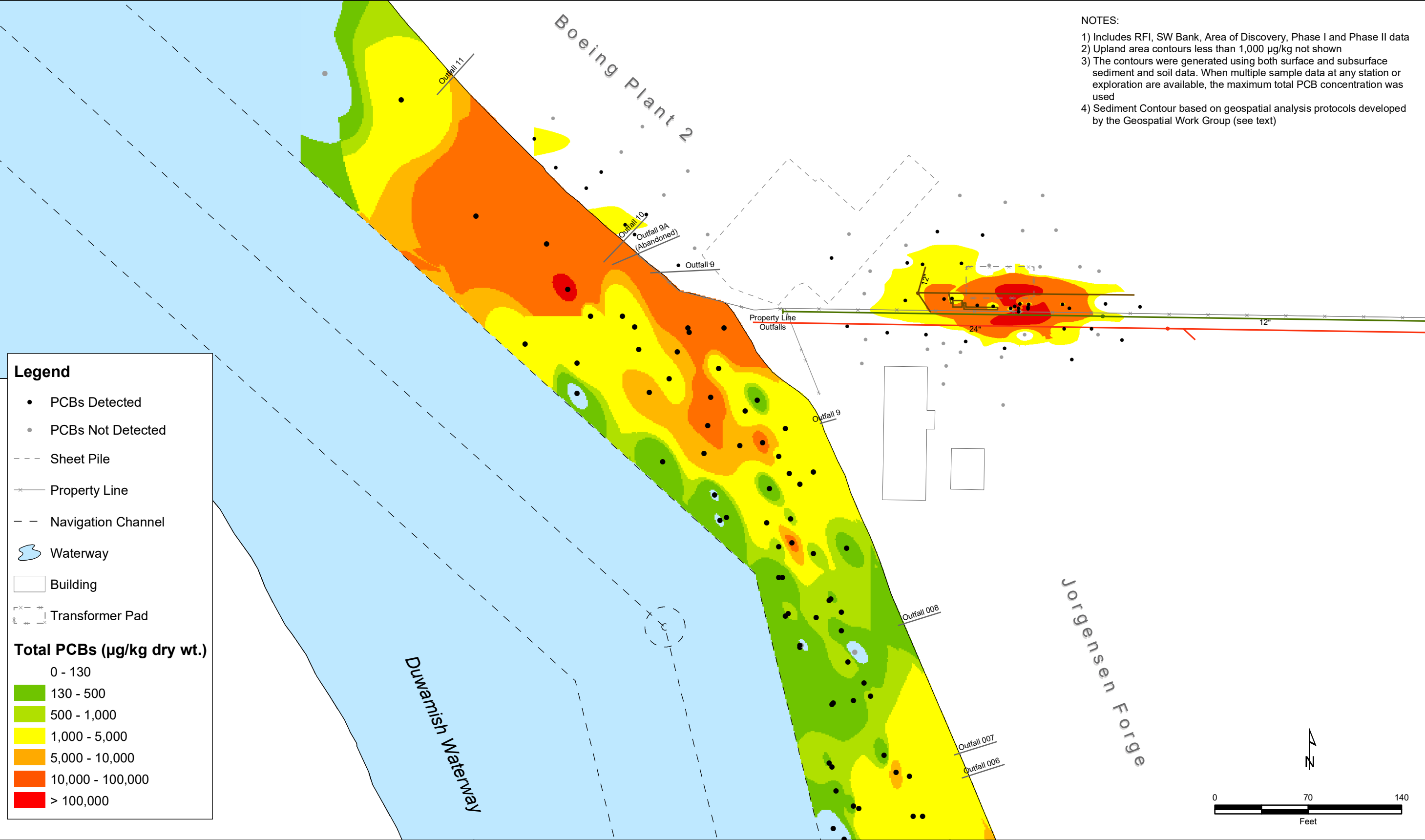


NOTE: Includes RFI, SW Bank, Area of Discovery, Phase I and Phase II data

FLOYD | SNIDER
 strategy ■ science ■ engineering

**Phase II Transformer PCB Investigation
 Boeing Plant 2
 Seattle, Washington**

**Figure 3.3
 Isoconcentration Contours of Total PCBs in Soil
 - Variation with Depth**



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**Phase II Transformer PCB Investigation
Boeing Plant 2
Seattle, Washington**

**Figure 4.2
Isoconcentration Contours of
Maximum Total PCBs in Soil and Sediment**

Boeing Plant 2

Interim Measure Construction Completion Report for OA-11



Prepared for
The Boeing Company
P.O. Box 3707
Seattle, Washington 98124-2207

November 2016

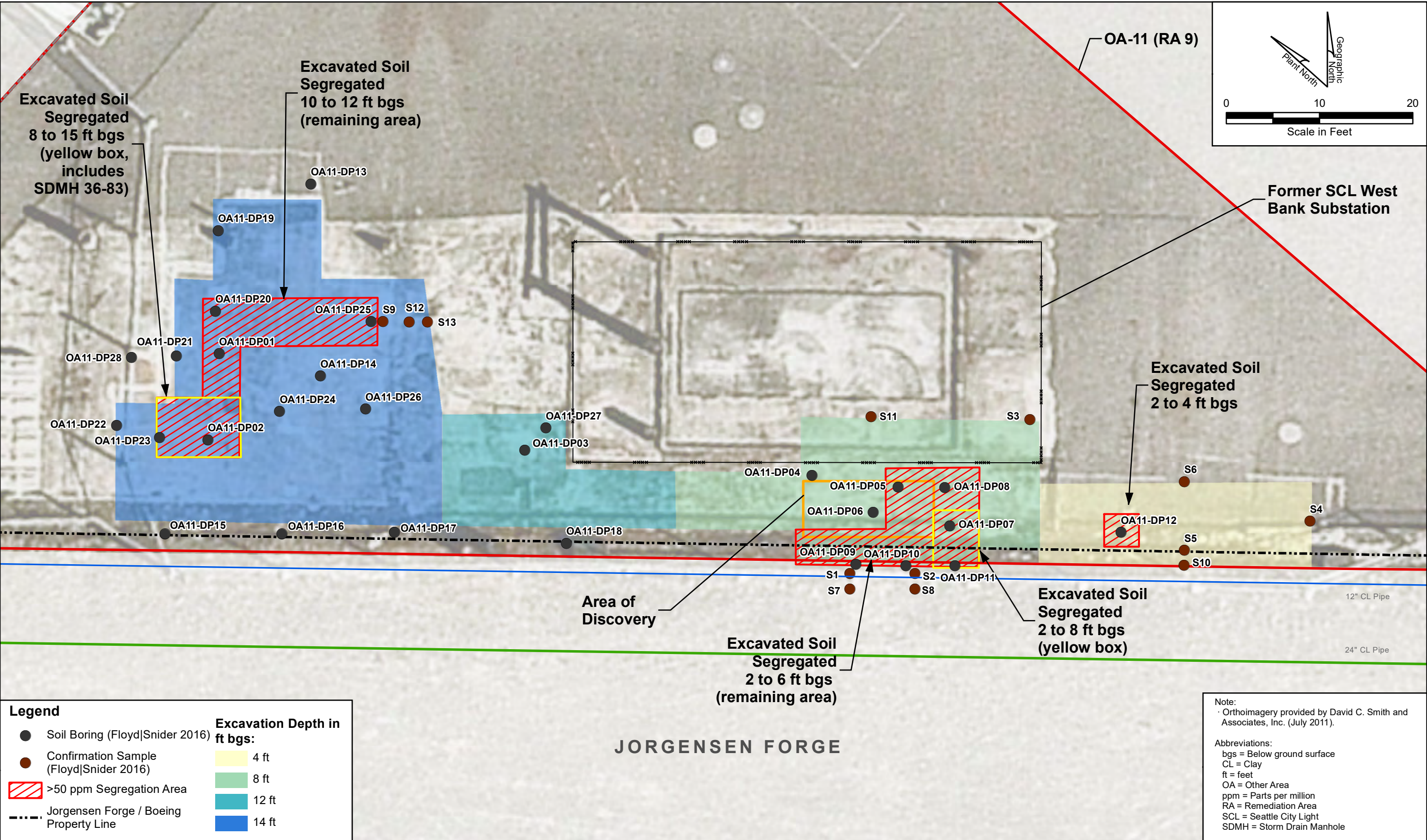


Table 4.1
Summary of PCB Soil Sample Results Collected during Construction

Sample Location ¹	Sample Depth (feet bgs)	Sample ID	Location Description ¹	Sample Date	Total PCB Concentration ² (mg/kg)	Outcome
OA11-ex-S1	4.25	OA11-ex-S1-4.25	8-foot excavation area: SW sidewall, 1.0 ft south of Jorgensen curb	9/6/2016	64.6	Sample to document concentration at extent of excavation to administrative boundary
OA11-ex-S2	4	OA11-ex-S2-4	8-foot excavation area: SE sidewall, 1.0 ft south of Jorgensen curb	9/6/2016	91.4 J	Sample to document concentration at extent of excavation to administrative boundary
OA11-ex-S3	4.2	OA11-ex-S3-4.2	8-foot excavation area: NE sidewall	9/8/2016	0.020 U	Final confirmation sample
OA11-ex-S4	2	OA11-ex-S4-2	4-foot excavation area: E sidewall	9/9/2016	5.62	Final confirmation sample
OA11-ex-S5	2	OA11-ex-S5-2	4-foot excavation area: S sidewall	9/9/2016	38.7	Excavation extended 2 feet to the south; sample removed
OA11-ex-S6	2	OA11-ex-S6-2	4-foot excavation area: N sidewall	9/9/2016	1.24	Final confirmation sample
OA11-ex-S7	3.6	OA11-ex-S7-3.6	8-foot excavation area: 3.0 ft south of Jorgensen curb (SW)	9/12/2016	486	PM (USEPA and Boeing) decision to leave in place, beyond administrative boundary
OA11-ex-S7	6	OA11-ex-S7-6	8-foot excavation area: 3.0 ft south of Jorgensen curb (SW)	9/12/2016	762	PM (USEPA and Boeing) decision to leave in place, beyond administrative boundary
OA11-ex-S8	3	OA11-ex-S8-3	8-foot excavation area: 3.0 ft south of Jorgensen curb (SE)	9/12/2016	21.9	PM (USEPA and Boeing) decision to leave in place, beyond administrative boundary
OA11-ex-S8	6	OA11-ex-S8-6	8-foot excavation area: 3.0 ft south of Jorgensen curb (SE)	9/12/2016	22.4	PM (USEPA and Boeing) decision to leave in place, beyond administrative boundary
OA11-ex-S9	8	OA11-ex-S9-8	14-foot excavation area: NE sidewall	9/13/2016	55.7 J	Excavation extended 2 feet to the east; sample removed
OA11-ex-S9	11	OA11-ex-S9-11	14-foot excavation area: NE sidewall, extent of >50 ppm PCB delineation	9/13/2016	20.9	Excavation extended 2 feet to the east; sample removed
OA11-ex-S10	2	OA11-ex-S10-2	4-foot excavation area: S sidewall	9/13/2016	0.278	Final sidewall confirmation sample
OA11-ex-S11	4	OA11-ex-S11-4	8-foot excavation area: NW sidewall	9/13/2016	0.088	Final confirmation sample
OA11-ex-S12	8	OA11-ex-S12-8	14-foot excavation area: NE sidewall	9/15/2016	2.89	Final confirmation sample, but sidewall cave-in extended final sidewall limits to location OA-11-exS13
OA11-ex-S13	8	OA11-ex-S13-8	14-foot excavation area: NE sidewall, extended sample	9/15/2016	6.87 J	Final confirmation sample

Notes:

Bold/Red Concentration that remains in place beyond the administrative boundary is greater than the Final Media Cleanup Level (FMCL).

~~Strikethrough~~ Indicates that the excavation was extended and the sample was removed.

1 Sample locations are shown on Figures 4.3a and 4.3b.

2 PCB results are presented as total Aroclors in milligrams per kilogram (mg/kg) or parts per million (ppm).

Abbreviations:

bgs Below ground surface

Boeing The Boeing Company

mg/kg Milligrams per kilogram

PCB Polychlorianted biphenyl

PM Project manager

USEPA U.S. Environmental Protection Agency

Qualifiers:

J Not detected at a concentration greater than the laboratory method detection limit.

U Analyte was not detected, concentration is the reporting limit.

Appendix C

Field Methods

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Figure C-60: Log of Geoprobe SB-2021-027

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Figure C-64: Log of Geoprobe SB-2021-038

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Attachments

Attachment C-1: Waste Profiles and Shipping Documentation

Attachment C-2: PFAS Reference Document RD-B74

C.1 INTRODUCTION

The purpose of this appendix is to discuss field methods used for the remedial investigation (RI) and ancillary activities that occurred during 2020 and 2021 at the Jorgensen Forge Corporation (JFC) property.

Field activities were conducted during several mobilizations. An outline of the mobilization dates is provided below.

- 2020 October – Laser-Induced Fluorescence (LIF) Study
- 2020 November – Drilling for soil investigation, pavement samples, and indoor hand-auger samples
- 2021 January – Drilling for soil sampling and well installation
- 2021 February – Q1 groundwater monitoring
- 2021 April – ASTM Light Nonaqueous Phase Liquid (LNAPL) Transmissivity Test
- 2021 May – Q2 groundwater monitoring
- 2021 June – Hydraulic conductivity tests
- 2021 August – Q3 groundwater monitoring
- 2021 October – Drilling for soil investigation at Other Area 11 (OA-11)
- 2021 November – Q4 groundwater monitoring
- 2021 November – Observational LNAPL bail-down test

Field methods, including sample collection, field screening, and documentation procedures, are described in the following sections. Procedures were completed in accordance with Shannon & Wilson's standard operating guidelines and the Sampling and Analysis Plan and Quality Assurance Project Plan (Shannon & Wilson, 2020).

C.2 CONTRACTORS

Contractors used for the RI work described in this report are as follows:

Driller:	Holt Services; Edgewood, Washington
LIF:	Columbia Technologies; Rockville, Maryland
Utility Location:	Applied Professional Services; Issaquah, Washington

Surveyor:	True North Land Surveying; Seattle, Washington
Laboratories:	Analytical Resources, Inc. (ARI); Tukwila, Washington (perfluoroalkyl and polyfluoroalkyl substances [PFAS] testing) Eurofins TestAmerica; West Sacramento, California
Waste Disposal:	Marine Vacuum Service; Seattle, Washington Waste Management; Seattle, Washington
Archeologist:	Stell; Mountlake Terrace, Washington

C.3 PREPARATION

In advance of the fieldwork, various preparations were completed as follows.

C.3.1 Site Access Requirements and Notifications

In accordance with Agreed Order number DE 14143, the Washington State Department of Ecology (Ecology) was provided at least seven days' notice prior to initiation of sampling work activities at the Site.

In accordance with the access agreement (recorded in the real property records of King County on April 24, 2017, under instrument number 20170424000779) between Star Forge, LLC (the property owner) and Earle M. Jorgensen Company, at least 24 hours' notice was provided to the facility representative prior to entering the Site.

C.3.2 Utility Clearance

Exploration locations were placed to avoid known utilities. The proposed exploration locations were marked in advance of the drilling activities and the public One-Call utility check system was notified. Applied Professional Services, a private utility clearance contractor, surveyed exploration locations and the vicinity of exploration locations for indications of utilities. The locations of several boreholes were shifted due to proximity to underground utilities.

C.3.3 Equipment Preparation

Necessary field equipment and documentation materials were prepared prior to mobilization. A checklist of equipment required during sampling activities was reviewed each morning. Laboratory-supplied sample containers were inspected for the proper preservative and inventoried to check that adequate containers were available.

Meters were calibrated at the start of each work period. The calibration was found to be valid for field conditions and was completed in accordance with manufacturer recommendations. Calibration measurements were documented in the field activity log for the project.

A field sampling tablet, in conjunction with a label printer, were used during the groundwater sampling activities. The tablet was charged and setup prior to the start of each work period. Tablet setup included pre-loading the tablet with the wells to be sampled, the analyses to be performed, and the bottles (quantity, type, size, and preservation information) needed for each sample.

C.3.4 Health and Safety

A Site-specific Health and Safety Plan (HASP) was provided in Appendix G of the RI Work Plan (Shannon & Wilson, 2020). The HASP was prepared consistent with the requirements of the Washington State Division of Occupational Safety and Health Hazardous Waste Operations Regulation (Washington Administrative Code 296 843). The HASP included a description of the project team, the scope of work, Site control, Site hazard information, Site hazard control, air monitoring, and emergency response. Information about the nearest hospital, including a map, was also provided. COVID-19 protocols were followed, as prescribed by State or County requirements relevant to the time of the field work.

During fieldwork, planned field activities and relevant health and safety topics were discussed during daily tailgate meetings. Health and safety topics included but were not limited to: action levels and proper use of personal protective equipment, working near heavy equipment, handling contaminated material, decontamination procedures, spill response, and fall protection.

No adverse health and safety events were identified during fieldwork.

C.4 LIGHT NONAQUEOUS PHASE LIQUID INVESTIGATION

Three activities focused on the LNAPL were undertaken during the Remedial Investigation work and are described below. The findings are provided within the body of the RI Report.

C.4.1 Laser-Induced Fluorescence Soil Delineation

Soil delineation was undertaken using direct-push drilling and LIF technology to evaluate the vertical and horizontal extent of nonaqueous phase liquids (NAPL) within the Area 1 and Area 2 LNAPL plumes. Prior to the LIF investigation, LNAPL-containing monitoring

wells were monitored prior to assess whether ceasing operations and the removal of cutting oil had significantly altered LNAPL thicknesses.

LIF delineation was completed prior to well installation activities so that the results could be utilized to inform well placement with the objective of placing wells outside of the LNAPL plumes.

C.4.1.1 Background

LIF utilizes laser light, typically within the ultraviolet spectrum, to identify the presence of NAPLs within the subsurface. The technology uses the phenomenon that polycyclic aromatic hydrocarbons (PAHs), present within most NAPL, fluoresce. Fiber optics are used to emit pulses of laser light from within a transparent window on the side of a direct-push probe (Exhibits C-1 and C-2).



Exhibit C-1: Photo of a Direct-Push Probe with Transparent Window Used for the LIF Investigation



Exhibit C-2: Photo of the Direct-Push Drill Rig Used for the LIF Investigation

When NAPL is present, the emitted light causes a fluorescent response that is logged by the probe. The technology provides a continuous log and enables vertical and lateral mapping of NAPL. Evaluation of the response is completed in the field and can identify the presence of multiple products, can typically identify the NAPL that is present, and can identify type of NAPL in both the vadose and saturated zones.

C.4.1.2 Activities

In September 2018, LNAPL samples were collected from each of the Area 1 and Area 2 LNAPL plumes. The samples were provided to the LIF subcontractor to evaluate whether it would fluoresce. The LIF subcontractor tested the LNAPL and provided test results confirming that the LNAPL does fluoresce, and a response can be measured by their LIF technology.

The LIF study was conducted during October 2020 and consisted of 22 and 18 LIF borings in the Area 1 and Area 2 LNAPL plumes, respectively. For each LNAPL plume, the objectives were to identify the horizontal and vertical extent of LNAPL and residual soil contamination within the subsurface.

Plume-center LIF borings were completed within the anticipated central portion of the Area 1, and Area 2 LNAPL plumes. The objective of these borings was to determine vertical distribution and depth of the LNAPL saturated soil within the body of the plumes.

Plume-perimeter LIF borings were completed to determine the edge of each LNAPL saturated soil using a step-in/step-out approach. Within the vicinity of each proposed groundwater monitoring well, a boring was completed within the anticipated footprint of the LNAPL plume. Depending on whether LNAPL saturated soil was observed within the boring, either a step-in or step-out boring was completed with the goal of completing at least one boring within and one outside of the extent of LNAPL saturated soil. Multiple step-in or step-out LIF borings were required to identify the LNAPL saturated soil edge. Plume-perimeter LIF borings completed within the LNAPL plume were extended to at least 5 feet deeper than observed petroleum-saturated soil. If LNAPL was not encountered within a plume-perimeter boring, it was extended to at least 5 feet below the observed water table.

Approximate LNAPL plume-center and plume-perimeter LIF borings are shown in Figures 16 and 18 of the main report. Boring placement was adjusted in the field as required to avoid utilities and in response to findings from previous points.

The LIF investigations did not recover material for laboratory analysis. During the soil investigation (discussed in Section C.5), direct-push soil borings were completed at the locations of LIF borings A1-02, A2-07, and A2-16 (plume-center borings) for the purpose of collecting soil samples. From each of these borings, four to six samples were collected from the depth corresponding the LIF responses. The samples from Area 1 were analyzed for total petroleum hydrocarbons as diesel-range (TPH-D) and TPH as oil-range (TPH-O) by Method Northwest Total Petroleum Hydrocarbons-Diesel Extended (NWTPH-Dx). The samples from Area 2 were analyzed for TPH-D, TPH-O (by method NWTPH-Dx), and TPH-gasoline (by method NWTPH-G). The analytical results were used to provide an understanding of the relationship between LIF response and concentration.

Three LIF soil borings were completed rather than four borings as stated in the RI Work Plan. The LIF soil borings and sampling approach was selected after reviewing preliminary results with the LIF subcontractor. Rather than collecting two samples per boring, four to six samples were collected from each boring to provide more data for the LIF response interpretation.

C.4.2 ASTM Light Nonaqueous Phase Liquid Transmissivity Test

A bail-down test in accordance with ASTM E2856-13 was used to evaluate LNAPL transmissivity at three monitoring wells on the Site. The monitoring wells were in the

Area 1 and Area 2 LNAPL plumes. The results were used to support evaluation of the transmissivity of the LNAPL. Characteristics of the monitoring wells are shown in Exhibit C-3.

Exhibit C-3: Monitoring Wells Used During LNAPL Transmissivity Test

Well Name	Construction Materials	Screened Interval (feet bgs)	LNAPL Plume
MW-17	6-inch PVC	8 to 23	Area 1
MW-29	6-inch PVC	7 to 22	Area 1
MW-35	2-inch PVC	5 to 20	Area 2

bgs = below ground surface; PVC = polyvinyl chloride

Test and analysis methods included bail-down of LNAPL in the test wells, measurement of LNAPL recovery, and interpretation of results.

Field procedures were conducted during April 27 to 30, 2021. Field procedures consisted of the following sequential steps at each well:

1. The depths to the top of the LNAPL and the LNAPL/water interfaces were measured using an interface probe.
2. A barometric pressure transducer was setup at surface level to measure barometric pressure throughout the test.
3. A pressure transducer was placed in the well in the water interval at a known depth. The transducer measured absolute pressure throughout the test.
4. A polyethylene bailer was used to remove LNAPL from the well. The volume of bailed LNAPL was measured using a graduated 5-gallon bucket.
5. When LNAPL appeared to be mostly removed from the well (i.e., it was impractical to remove additional LNAPL without removing water), the field staff began taking depth measurements of the depth to LNAPL using an interface probe. The measurements were initially recorded at every 0.05 foot of recovery for the first 100 minutes after bail-down. Thereafter, the depth to LNAPL measurements were collected less frequently until the depth to LNAPL appeared to have stabilized.
6. Once the depth to LNAPL appeared to have stabilized, the pressure transducer was removed.

C.4.3 Observational Light Nonaqueous Phase Liquid Bail-Down Test

Since a preliminary evaluation of results from the ASTM LNAPL transmissivity test appeared to be inconclusive, a separate *observational* bail-down test was used to provide additional data for LNAPL recharge at three monitoring wells. The monitoring wells were

in Area 1 and Area 2 LNAPL plumes. Characteristics of the monitoring wells are shown in Exhibit C-4.

Exhibit C-4: Monitoring Wells Used During LNAPL Transmissivity Test

Well Name	Construction Materials	Screened Interval (feet bgs)	LNAPL Plume	Notes
MW-19	2-inch PVC	6 to 16	Area 1	Observation only. No bail-down.
MW-29	6-inch PVC	7 to 22	Area 1	
MW-35	2-inch PVC	5 to 20	Area 2	

bgs = below ground surface; PVC = polyvinyl chloride

Field procedures were conducted during November 9 through 24, 2021. Field procedures were performed daily, excluding weekends, at approximately midday for nine days and consisted of the following sequential steps at wells MW-29 and MW-35:

1. The depths to LNAPL and LNAPL/water interfaces were measured using an interface probe.
2. A polyethylene bailer was used to remove LNAPL from the well. The volume of bailed LNAPL was measured using a graduated 5-gallon bucket.
3. When the LNAPL appeared to be mostly removed from the well (i.e., it was impractical to remove additional LNAPL without removing water), the depths to LNAPL and LNAPL/water interfaces were measured.
4. The depth to LNAPL and LNAPL/water interfaces were also measured at MW-19 due to its proximity to MW-29 to evaluate lateral influence of bail-down activities from MW-29. MW-19 is approximately 24 lateral feet to the northeast from MW-29.

C.5 SOIL INVESTIGATION

The soil investigation included sample collection at 96 locations on the Site. Prior to drilling, concrete and asphalt pavement was cored, as needed. Water used during the coring process was vacuumed and placed into 55-gallon drums for offsite disposal.

The selected locations and depths for the soil investigation are discussed in Section C.5.1.

Drilling was completed using one of several methods: direct-push, hollow-stem auger (HSA), hand-auger, or vacuum boring. The drilling methods are discussed in more detail in Section C.5.2.

Soil obtained from explorations was visually described using Shannon & Wilson's soil identification system, which is a modified version of the Unified Soil Classification System.

The soil description key and boring logs are provided in Figures C-1 through C-87 of this appendix.

Soil was collected from boreholes for analytical testing as discussed in Section 5.3. After soil samples were collected, the borings were either immediately backfilled with hydrated bentonite chips or a monitoring well was installed as described in Section C.6.1.

C.5.1 Locations and Depths

In general, direct-push drilling was used for soil investigation borings, except HSA was used for borings where a monitoring well would be installed. The exploration depths were selected based on the location and intended purpose of each boring. Investigation activities were sequenced with deeper borings completed (and samples analyzed) prior to shallow borings. This allowed for the shallow boring depths to be adjusted based on the initial findings to target vertical delineation. If apparent contamination was observed at the base of a boring, the boring depth was increased in the field.

In the absence of apparent contamination or lithology changes, the following sampling approach was employed.

- In general, borings for the soil investigation only (no monitoring well installation) were advanced to 15 feet below ground surface (bgs) using direct-push drilling methods. Up to three samples were collected, including samples taken from within the top 2 feet below surface or below subbase if present, from between 2 and 7 feet bgs, and from just above the water table.
- If slag or swarf is noted within a boring, the soil near the material was sampled. The soil was analyzed for TPH-D, TPH-O, metals, and compounds detected within groundwater samples collected within the vicinity of the boring in which the slag or swarf was observed. Slag was noted in surface soil at boring SB-2020-015 from 0 to 0.7 foot bgs. Since slag was noted, a soil sample was collected at 1 foot bgs and was analyzed for the constituent listed above.

Exceptions to the above sampling approach are discussed below.

- The three LIF soil borings (A1-02A, A2-07A, and A2-16A) were discussed in Section C.4.1.2.
- Borings completed at the Tote Storage Area (TSA-2020-001 through -007) are discussed in Section C.5.4.
- Direct-push boring SB-2020-004 were completed to 30 feet bgs due to the depth of the adjacent vault (Q1/Q2/Q3 Quench Tank Vault). Six samples were collected, including from the same intervals as the 25-foot borings and an additional 30 feet bgs sample. All samples from boring SB-2020-004 were analyzed.

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- Seven direct-push borings (SB-2021-005, -007, -008, -013, -014, and -015) in the northwest corner of the Site were completed to 25 feet bgs and SB-2021-016 was completed to 30 feet bgs. Up to five samples were collected from 25-foot borings, including the same intervals sampled at 15-foot borings and samples taken from 20 and 25 feet bgs. The 20- and 25-foot samples were held for potential analysis. All samples were collected at approximately 30 feet bgs and held for potential analysis.
- Boring SB-2021-041 was completed using direct-push drilling methods to a depth of 25 feet bgs. Within the final RI Work Plan, this boring was intended to be completed to 15 feet bgs; however, the boring depth was increased to obtain data from greater depths due to the hold time issues encountered (resulting from slow laboratory turnaround times) during the first phase drilling mobilization.
- Eight hand-auger borings were completed in the Heat Treat and Forge Shop. The borings were designated HA-2020-001 through HA-2020-008. Locations were selected that had exposed soil and did not appear to overlie concrete. Up to three samples were collected: loose surface dust, upper soil (below loose surface dust), and lower soil (up to 6 inches below the upper soil). The surface dust was collected as a grab sample. The upper soil and lower soil samples were collected using a hand-auger.
- Three direct-push borings (SB-2021-042 through SB-2021-044) were completed adjacent to the decommissioned 24-inch property line pipe. The pipe was not located using ground-penetrating radar; therefore, a vacuum truck was used to pot several locations to locate the pipe. Vacuum borings methods (Section C.5.2.4) and a hand-auger (Section C.5.2.3) were used to collect soil samples prevent damaging the pipe. The top of the pipe was encountered at 8 to 8.5 feet bgs. The pipe bedding material was indistinguishable from the fill material encountered above the pipe to ground surface. No odor was noted within the borings. One sample was collected at each boring from within 1 foot of the bottom depth of the pipe, except for sample SB-2021-043. SB-2021-043 was collected adjacent to the pipe at approximately 1 foot from the top of pipe. Gravel and cobbles prevented further advancement of the hand-auger. Of note, the pipe at SB-2021-042 appeared to have yellow paint.
- Five direct-push borings (SB-2020-001, SB-2021-002, SB-2020-028, SB-2020-029, and SB-2020-045) were completed to 10 feet bgs. Samples were collected from between 2 to 5 feet and 6 to 10 feet. The locations and depths were selected to evaluate specific features within the main building.
- Nineteen (19) direct-push borings (SB-2021-018 through SB-2021-026 and SB-2021-048 through SB-2021-057) were completed adjacent to Boeing's OA-11 to depths of up to 12 feet bgs. Six soil samples, including depth-discrete samples taken from between 0 to 2, 2 to 4, 4 to 6, 6 to 8, 8 to 10, and 10 to 12 feet bgs, were collected at each boring. The samples taken from between 8 to 10 and 10 to 12 feet bgs were held for potential analysis and analyzed if exceedances were detected in shallow samples.
- Three direct-push borings (SB-2021-033 through SB-2021-035) were completed to evaluate the former Area 3 underground storage tanks. The borings were completed to

depths of at least 15 feet bgs. Borings SB-2021-033 and SB-2021-034 were extended to 20 and 25 feet bgs, respectively, due to encountering field indications of contamination (petroleum odor). The borings were completed to a depth where field indications of contamination were no longer observed.

- Refusal was encountered at direct-push boring MW-65 and HSA boring MW-68 prior to reaching the target depth. Concrete was encountered in both borings and is suspected as the cause of refusal. The borings were backfilled immediately and re-designated as borings SB-2021-065 and SB-2021-068, respectively, since monitoring wells were not installed. New HSA borings several feet from the original location were advanced to the target depth and designated borings MW-65 and MW-68. Monitoring wells were installed in the relocated borings.
- Boring SB-2021-006 was completed using direct-push drilling methods to a depth of 20 feet bgs. Within the final RI Work Plan, this boring was intended to be completed to 15 feet bgs; however, the boring depth was increased due to encountering field indications of contamination (petroleum odor). The boring was completed to a depth of 20 feet bgs where field indications of contamination were no longer observed.
- Due to noted petroleum odor at boring SB-2021-006, an additional boring (SB-2021-047) was completed outside and south of the main building to a depth of 15 feet bgs. No unusual odor was noted within boring SB-2021-047.

Exploration locations are shown in Figures 15A, 15B, and 15C of the main report. Table 3 of the main report includes a summary of each soil investigation location, including the rationale, sample IDs and depth, and the analyses performed.

C.5.2 Drilling Methods

A description of the drilling methods used at the Site is provided below.

C.5.2.1 Direct-Push

At direct-push locations, the static weight of the hydraulic probe rig combined with percussive energy were used to advance a series of hollow metal rods. A 2-inch-diameter, 5-foot-long probe sampler fitted with removable plastic sampling (sleeve) tubes were driven into undisturbed soil continuously from the ground surface to the desired depth of the boring. The bottom of the core tube had a plastic soil catcher used to retain soil when the tube was pushed into the subsurface. Upon retrieval of the sample sleeve, the plastic tube was sliced open and the soil was field-screened for contaminants and samples collected and logged. Photos of the direct-push drill rig and plastic tube with soil are provided below (see Exhibits C-5 and C-6).

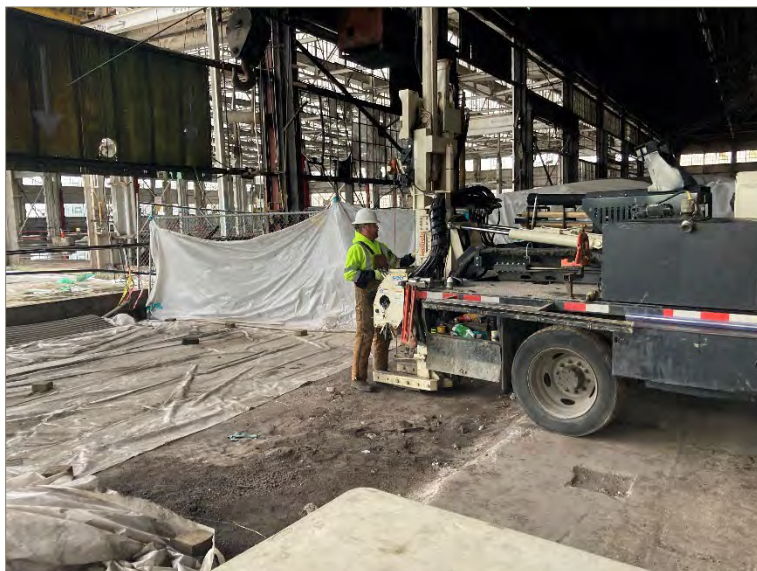


Exhibit C-5: Photo of Direct-Push Drill Rig at Boring SB-2020-004 (View Direction is Northeast)

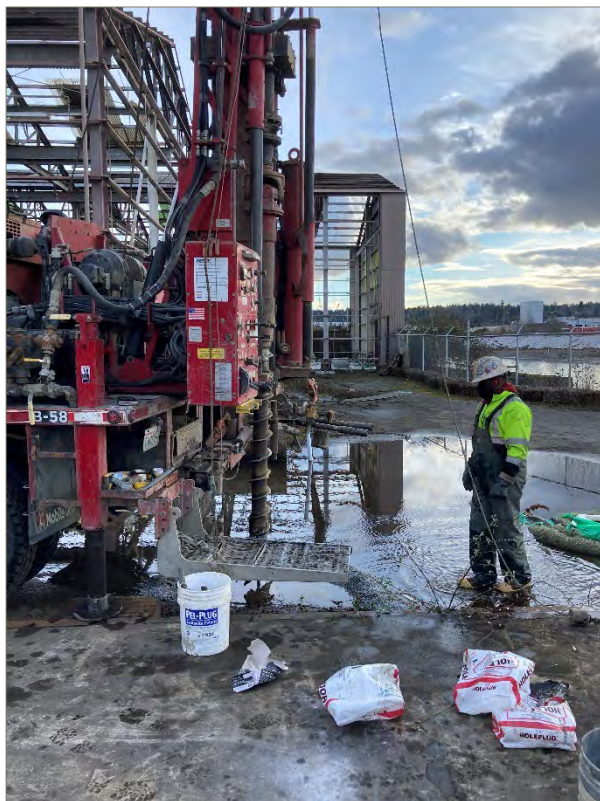


Exhibit C-6: Photo of a Soil Core at Boring SB-2020-004

C.5.2.2 Hollow-Stem Auger

Soil samples from the HSA borings were collected using a standard 2-inch-outside-diameter, split-spoon sampler used in conjunction with the Standard Penetration Test. At each sample depth, the drill bit was removed from the hole and the sampler was attached to the end of the drill rods. The sampler was then be lowered down to the bottom of the hole. The sampler was typically be driven 1.5 feet or less into the soil at the bottom of the borehole, depending upon density. A second sampler was driven at about the same interval if not enough soil was initially retrieved. After removed from the borehole, a Shannon &

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C.5.2.3 Hand-Auger

At hand-auger locations, a metal hand-auger was advanced into the subsurface by rotating the auger around the vertical axis, allowing the blades to cut into the soil. Soil cuttings were retained in a metal cylinder that was immediately above the blades. When the cylinder was full, the auger was brought to the surface and the cylinder was emptied. Soil cuttings were then screened for visual observations and odors that may indicate contamination and samples were collected. A photo of a typical hand-auger is provided below (see Exhibit C-9).



Exhibit C-9: Photo of a Hand-Auger Used for Boring HA-2020-001 (View Direction is Northwest)

C.5.2.4 Vacuum Boring

A vacuor truck was used to remove soil above the 24-inch stormwater pipe on the north property boundary for samples SB-2021-042 through SB-2020-044. First, pressurized air was used to loosen soil. The loosened soil was then vacuumed into a rigid hose connected to the vacuum vessel. The vacuumed soil was retained in the vacuum tank and later transferred to a drum and temporarily stored on site. When the desired depth was reached, a hand-auger was used to collect a soil sample. A photo of the typical vacuum boring equipment is provided below (see Exhibit C-10).



Exhibit C-10: Photo of Pressurized Air Wand and Vacuum Hose Used for Boring SB-2021-042 (View Direction is South)

C.5.3 Soil Sample Collection

Field personnel collected soil samples by first donning a new pair of disposable nitrile gloves. Dedicated stainless-steel spoons were used to transfer soil to the appropriate laboratory-supplied sample containers. Samples for volatile analyses were collected using disposable syringes and placed in methanol-preserved vials or pre-weighed vials in accordance with U.S. Environmental Protection Agency (EPA) Method 5035.

Once filled, the sample containers were placed in a cooler with ice to maintain the samples within the acceptable temperature range of between 0 degree Celsius (°C) and 6 °C. The samples were transported under standard chain-of-custody (COC) procedures to the laboratory. Sample handling and field quality assurance (QA) sample collection procedures are discussed in Section C.8. The selected analytical methods are discussed in Section C.9.

C.5.4 Tote Storage Area Investigation

Seven borings were advanced at the TSA to collect soil samples and pavement samples. Three locations were inside of the Former Etch House and four locations were adjacent to the four exterior walls. Exploration locations are shown in Figure 15A of the main report.

Direct-push drilling methods were used where the rig was able to access (TSA-2021-004, -005, and -006). The direct-push probe was advanced to 10 feet bgs. In the remaining

locations, a pavement coring saw and hand-auger were used to collect soil samples from up to 3 feet bgs.

Pavement samples were collected at four locations and are summarized below (see Exhibit C-11).

Exhibit C-11: Pavement Samples Collected at the Tote Storage Area

Sample ID	Location Description
Asphalt-001	Sample of asphalt from the surface of asphalt pavement. Location is to the east of the Former Etch House.
Asphalt-002	Sample of asphalt from the surface of asphalt pavement. Location is to the west of the Former Etch House.
TSA-Concrete-001	Concrete pavement was cored inside of the Former Etch House for soil explorations TSA-2020-001. The concrete core was broken in half mid-way down the vertical thickness. A concrete sample was collected from the broken edge.
TSA-Concrete-002	Concrete pavement was cored inside of the Former Etch House for soil explorations TSA-2020-002. The concrete core was broken in half mid-way down the vertical thickness. A concrete sample was collected from the broken edge.

Pavement sampling methods are described in Section C.7.

C.5.5 Cultural Resources Monitoring

A Cultural Resources Monitoring and Inadvertent Discovery Plan (MIDP) was approved by the Washington Department of Archaeology and Historic Preservation and was included in the RI Work Plan (Shannon & Wilson, 2020).

Archeological monitoring of ground-disturbing activities, such as drilling, was undertaken by professional archeologists from Stell in accordance with the approved MIDP. The archeologists reviewed subsurface material for indications of potential archeological materials and prepared a monitoring report summarizing their findings, which is attached as Appendix D of the main report. No significant cultural resources were identified during site work.

C.6 GROUNDWATER INVESTIGATION

The groundwater investigation included measurement of groundwater levels, installation of 27 groundwater monitoring wells, and collection of groundwater samples at 59 new and historical wells. Additionally, the groundwater hydraulic conductivity, natural source zone depletion (NSZD) of the LNAPL plumes, and extent of PFAS-impacted groundwater were

evaluated. Methods for the groundwater investigation are discussed in the following sections.

C.6.1 Monitoring Well Installation

Twenty-seven (27) monitoring wells were installed on the Site: MW-53 through MW-76 and MW-10R, MW-13R, and MW-22R. Wells with the suffix “R” were installed to replace wells that were previously decommissioned or could not be located. Wells were installed in HSA borings, except for MW-73. MW-73 was located inside of the Aluminum Heat Treat Building. The mast of the HSA drill rig was taller than the vertical clearance; therefore, MW-73 was installed in a direct-push boring, which required less vertical clearance.

A Shannon & Wilson representative was on site to observe drilling activities and collect soil samples, log soil, and select screened intervals for the monitoring wells. Soil samples were collected in the borings used for well installation and was conducted in accordance with Section C.5. Monitoring wells were screened across the interpreted water table at depth. The screened intervals were approximately 5 to 20 feet bgs, except for wells MW-64 and MW-70, which were screened at 45 to 60 feet bgs.

Monitoring wells consisted of 2-inch-diameter, Schedule 40 polyvinyl chloride. The screen was 0.010-inch slot. Grade 10/20 sand was placed in the borehole adjacent to the screen and the remainder of the borehole was sealed with hydrated bentonite chips. The well was covered with a flush-mounted traffic-rated metal lid cased in concrete from surface to approximately 2 bgs. A summary of well construction characteristics is provided in Table 1 of the main report.

C.6.2 Monitoring Well Development

Newly installed monitoring wells were developed by Holt Services under the supervision of Shannon & Wilson. Development was completed using the overpumping method. Water was purged using a submersible pump until the visual turbidity appeared consistently clear.

Of note, after two hours of overpumping, the purge water at MW-65 appeared to have high turbidity and an organic odor. Shannon & Wilson returned to the well during the following week and conducted a second development cycle using a check valve and Waterra motor. The check valve had a slightly smaller diameter than the well casing and was connected to a polyethylene pipe. The check valve and pipe were lowered to the screened interval and attached to the Waterra motor. The Waterra motor lifted and lowered the check valve and pipe approximately 6 inches in a reciprocating fashion to draw water into the well casing from the sandpack. Development started at the top of the screened interval and the

assembly was lowered 6 inches after approximately 5 minutes of development at each depth. Purge water was pumped from the well via the check valve and reciprocating action. MW-65 was developed using this technique for approximately five hours. At completion of development activities, the purge water appeared clear and without an unusual odor.

C.6.3 Groundwater Monitoring and Sampling

After the new wells were installed, four quarterly groundwater monitoring and sampling events were completed in 2021. The monitoring program included 59 historical and new monitoring wells, listed in the groundwater analysis summary (Table 4 of the main report). Groundwater monitoring and sampling included groundwater level measurements and groundwater sampling for laboratory analysis.

C.6.3.1 Groundwater Level Measurements

The collection of measurements of the depth-to-water, depth-to-LNAPL, and depth to LNAPL-groundwater interface was completed at Site wells prior to groundwater sampling during the Quarter 1 through Quarter 4 monitoring events. To account for potential tidal influence at the Site, groundwater level measurements (at wells without LNAPL) were completed within a two-hour timeframe by multiple teams working concurrently from west to east (toward East Marginal Way). If possible, the events were scheduled to coincide with periods of minimal tidal exchange. Wells containing LNAPL were measured after the completion of measurement from other wells on the Site.

The March 2021 (Quarter 1) groundwater level monitoring event was not completed prior to the collection of groundwater samples because some of the newly installed monitoring wells had not been developed prior to the start of the sampling event. The groundwater level monitoring event was completed following completion of the sample collection activities in March 2021.

The following sections outline the procedures for collecting water level measurements.

Well Venting

Steps 1, 2, and 3, below, were completed for monitoring wells included in the study. Each well was allowed to equilibrate for at least 15 minutes prior to proceeding to the appropriate step 4.

1. The well monument lid was opened. A photoionization detector (PID) was used to screen the space within the monument for volatiles. Standing water and debris (i.e., sediment, vegetation, or refuse) were cleaned out of the monument prior to removing the well cap. PID readings were written on the Water Level Measurements Form.

2. The cap was removed carefully and any pressure or vacuum allowed to vent. The time that the well cap was removed and the initial conditions (i.e., well over-pressurized or under-pressurized relative to the atmosphere) were recorded on the Water Level Measurements Form. A PID was used to screen the space within the casing for volatiles.
3. The well cap was left ajar and the lid was replaced. If warranted (based on location), a cone was placed on each location to prevent the well from being blocked.

Wells Without Light Nonaqueous Phase Liquid

1. The initial water level was measured to the nearest 0.01 foot from the surveyed location (typically the north side of the top of well casing) using an electronic water level probe.
2. The water level measurement in each well was duplicated to ensure that the reading was accurate. The results were recorded (times, measured values, etc.) on the Water Level Measurements Form. The duplicate depth to water measurement was recorded if it was different than the original measurement.
3. The probe was inspected to determine if LNAPL was present in the well before it was decontaminated in accordance with procedures discussed in Section C.8.3.
4. The well cap was replaced and the monument lid was sealed tightly upon completing the water level measurement.

Wells with Light Nonaqueous Phase Liquid

1. The initial depth to LNAPL was measured to the nearest 0.01 foot from the surveyed location (typically the north side of the top of well casing) using an electronic oil-water interface probe. The probe would emit an audible alarm when product was encountered.
2. The measurement was duplicated by lifting the probe from the surface until the alarm was silenced and re-lowering the probe to verify the depth to LNAPL. The results were recorded on the Water Level Measurements Form. Duplicate measurements were recorded if they differ from the original measurement.
3. The depth to the LNAPL-groundwater interface was measured by lowering the probe to the LNAPL (audible alarm sounded) and then continuing to lower the probe. At the interface, the alarm tone changed when the equipment detected water. The probe was slowly lifted and lowered to identify the point at which the alarm tone changed and this depth was measured to the nearest 0.01 foot from the surveyed location (typically the north of the top of well casing).
4. The measurement was duplicated to verify the reading. The results were recorded on the Water Level Measurements Form. Duplicate measurements were recorded if they are different from the original measurement.
5. The probe tip and the length of probe wire that was in contact with the LNAPL was decontaminated in accordance with procedures discussed within Section C.8.3.

6. The well cap was replaced and the monument lid was sealed tightly upon completing the measurements.

C.6.3.2 Groundwater Sampling

Groundwater sampling took place over approximately two weeks for each quarterly event. The sampling sequence consisted of purging the well while collecting field parameter measurements followed by the collection of samples into laboratory-supplied and appropriately preserved containers. The selected analyses for monitoring wells are summarized in Table 4 of the main report.

Sampling of wells within the likely zone of tidal influence near the shoreline (MW-6, MW-39, MW-42, MW-43, MW-44, MW-47, MW-50, MW-51, MW-52, MW-53, MW-54, MW-65, MW-69, and MW-70) was scheduled such that sample collection time occurred within one hour before low tide and no later than three hours after low tide.

Monitoring well MW-68 was observed to be dry during low tide during the first two quarters of sampling. A transducer was placed in MW-68 from June 30 to July 8, 2021, to measure water levels and evaluate for connection with the adjacent river. The transducer data indicated that water levels in MW-68 closely mirrored the tidal fluctuations of the river with minimal lag, suggesting close connectivity between MW-68 and the adjacent river. The results were discussed with the Ecology Project Manager during July 2021 and it was agreed that MW-68 would be sampled during high tide during the following quarterly sampling events.

Due to the use of aqueous film forming foam (AFFF) fire suppression systems at the Site during the first and fourth quarterly groundwater sampling event, select wells (MW-8, MW-36, MW-43, MW-60, MW-63, MW-64, MW-68, MW-71, MW-72, and MW-74) were sampled for PFAS, an emerging contaminant. PFAS-specific sampling and handling techniques, necessary to limit the potential for cross-contamination, are provided within Attachment A-2.

Low-Flow Purging

At wells without LNAPL, a peristaltic sampling pump fitted with disposable polyethylene and silicon tubing (at the pump head and water quality instrument connections) was used to sample each monitoring well. At each location:

1. Dedicated tubing was slowly lowered into the well until the intake was placed mid-screen. At wells downgradient of the Area 1 and Area 2 LNAPL plumes, the intake was placed 2 to 3 feet below the water table or mid-screen (for B zone wells). The time was recorded on the field tablet and the pump was started.

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2. Pumping rates were measured with a stopwatch and container of known volume to adjust the flow rate to between 150 milliliters per minute (mL/min) and 1 liter per minute (L/min). The water level was measured, and field parameters were recorded every three to five minutes. The pumping rate was adjusted to maintain a steady water level. If possible, a drawdown of 0.3 foot or less was maintained in the well and the water level was maintained above the intake. The pumping rate was lowered to a minimum of 150 mL/min, if necessary, to maintain the desired drawdown.
3. Field parameters, including pH, specific conductivity, temperature, dissolved oxygen (DO), oxidation reduction potential (ORP), turbidity (NTU), salinity, and total dissolved solids (TDS), were measured approximately every three to five minutes during purging. Measurements were recorded to the following standards:
 - pH to plus or minus ($\pm$)0.01 pH units,
 - Specific conductivity to $\pm$ 0.01 mmhos per centimeter,
 - Temperature to $\pm$ 0.1 °C,
 - DO to $\pm$ 0.01 milligrams per liter (mg/L),
 - ORP to $\pm$ 1 millivolt,
 - Turbidity to $\pm$ 0.1 NTU,
 - Salinity to $\pm$ 0.01%, and
 - TDS to $\pm$ 0.001 gram per liter.
4. Samples were collected following parameter stabilization. Stabilization occurred when three consecutive readings were within a specified tolerance from each other. The following criteria were monitored for stabilization:
 - pH $\pm$ 0.1 pH units (i.e., readings within 0.1 of each other),
 - Specific conductivity $\pm$ 3%,
 - Temperature $\pm$ 3%,
 - DO $\pm$ 10% for values greater than 0.5 mg/L, if three consecutive DO values are less than 0.5 mg/L, the parameter was considered to be stabilized,
 - ORP $\pm$ 10 millivolts, and
 - Turbidity $\pm$ 10% for values greater than 5 NTU; if three consecutive turbidity values are less than 5 NTU, the parameter was considered to be stabilized.
5. If field parameters did not stabilize after one hour of pumping, the sample was collected. Well purging data (including a notation when stabilization did not occur) was be recorded on the field tablet.
6. If the well yield is poor and the water level drops to the level of the intake, the pump was stopped until the water level recovered to near the pre-pumping level. The process

was then be repeated until the field parameters stabilized. Measured water levels and pumping rate changes were recorded on the field tablet.

Groundwater Sample Collection

Upon completion of purging and parameter stabilization, samples were collected from the discharge end of the pump tubing into the laboratory-supplied containers. If the pump rate at the end of well purging was at or below 0.5 L/min, the same pump rate was used during sample collection. If the pump rate at the end of well purging was greater than 0.5 L/min, the pump rate was reduced to less than 0.5 L/min during sample collection. A photo of a typical setup of sampling equipment is provided below (see Exhibit C-12).



Exhibit C-12: Photo of Groundwater Sampling Equipment (Photo Taken on February 10, 2021)

Sample containers were filled in order from most to least volatile analysis. Sample handling and field QA sample collection procedures are outlined within Section C.8.1.

Volatile organic analyte (VOA) vials were filled by allowing the sample water to pour down the inside wall of the vials without splashing onto the base. VOAs were filled to eliminate headspace and the seal/lid was secured. Samples for dissolved metals analysis were not field-filtered or preserved. We requested laboratory filtering on the COC.

After sample collection was complete, the tubing/hose was removed, the well cap was replaced, and the monument lid was secured.

C.6.4 Hydraulic Conductivity Testing

Rising head slug tests were performed during June 2021 at three monitoring wells (MW-25, MW-60, and MW-69) to evaluate hydraulic conductivity. Rising head slug tests involve rapidly (as close to instantaneous as possible) dropping the water level within the well and recording the recovery as the water level returns to equilibrium. These tests can be accomplished by adding an object of known size to the well to raise the water level. Once equilibrium has returned, the object can be removed to drop the water level.

The slug tests included the following steps:

1. A pressure transducer was placed within the well at a sufficient depth to avoid interference with the slug. The depth to water was recorded. The datalogger was set to record several readings per second for the first two minutes with gradually increasing reading intervals over time.
2. A slug, consisting of a polyethylene bailer, was lowered beneath the water table. The water level increased as a result of this placement and then lower to return to equilibrium.
3. The slug was then removed from the well, which dropped the water level, and initiated the rising head test.
4. Readings, from the pressure transducer, were collected until the water level returned to equilibrium.
5. A separate pressure transducer was used to collect barometric pressure during the test. The readings from the pressure transducer placed in the well were corrected for changes in barometric pressure using this data.

Three tests were performed within each well. The resulting data was analyzed using standard methods developed by Bouwer and Rice (1976) and Hvorslev (1951) to estimate the hydraulic conductivity.

The RI Work Plan called for completion of falling head/rising head slug tests at each selected location with 24 hours between tests. However, for many of the monitoring wells selected for the aquifer testing, the well screen extended above the water table (to assess whether product is accumulating on the water surface). When the well screen is above the water table level, a falling head test (initiated by a rise in water level in the well) results in raising the water level into the unsaturated conditions where it can drain into the filter pack and unsaturated aquifer; thus, skewing the data set. Therefore, rising head tests are more suitable for this site and were used to collect the hydraulic conductivity data at each selected location.

In addition, the water level rebounded quickly after the slug removal such that an extended wait time of 24 hours between tests was deemed unnecessary.

A summary of calculation data for the slug testing is provided in Table C-1.

C.6.5 Natural Source Zone Depletion Evaluation

Within the subsurface, LNAPL acts as a potential long-term “source zone” of contamination to soil, groundwater, and soil gas. NSZD refers to the natural loss of chemicals from the source zone through three main processes:

- Dissolution of LNAPL into groundwater and biodegradation within the saturated zone.
- Volatilization of LNAPL and biodegradation within the vadose zone.
- Biodegradation of LNAPL within the source zone.

An evaluation of the NSZD for the LNAPL plumes was completed for the first of these processes. To evaluate NSZD within the saturated zone, groundwater samples were collected from wells located upgradient and downgradient of the Area 1 and Area 2 LNAPL plumes to confirm source zone dissolution to groundwater and to evaluate whether biodegradation is occurring. The selected wells are listed in Exhibit C-13.

Exhibit C-13: Monitoring Wells Analyzed for NSZD Evaluation

LNAPL Plume Area	Upgradient Wells	Downgradient Wells
Area 1	MW-23	MW-30
	MW-58	MW-56
Area 2	MW-14	MW-36
	MW-15	MW-60

Dissolution to groundwater was evaluated by comparing dissolved-phase hydrocarbon concentrations detected within upgradient and downgradient wells. Increased concentrations detected within downgradient wells would indicate that dissolution is occurring.

Evaluation of whether biodegradation is occurring was completed by comparing biodegradation indicator compounds detected within upgradient and downgradient wells. Decreased concentrations of dissolved-phase electron acceptors such as oxygen (O_2), nitrate (NO_3^-), sulfate (SO_4^{2-}), and increased concentrations of ferrous iron (Fe^{2+}) and manganese (Mn^{2+}) within downgradient wells would indicate that biodegradation is occurring. If dissolved methane (CH_4) was present at higher concentrations within downgradient wells, anaerobic biodegradation by methanogenesis may be occurring.

For each LNAPL plume (Areas 1 and 2), the wells listed above were sampled for the following parameters:

- TPH-D
- TPH-O
- Dissolved O₂ (field reading), NO₃⁻, nitrite (NO₂⁻), SO₄²⁻, sulfite (SO₃²⁻), Fe²⁺, Mn²⁺, and CH₄

The results from upgradient wells and downgradient wells were compared to evaluate dissolution and degradation within the saturated zone for each LNAPL plume.

C.6.6 Groundwater Perfluoroalkyl and Polyfluoroalkyl Substances Investigation

Limited groundwater sampling for PFAS was completed during the first and fourth quarter 2021 groundwater monitoring events to evaluate for the presence of PFAS within groundwater at the Site.

During February 2021, samples were collected from upgradient wells MW-8, MW-71, and MW-72 (to establish whether there is migration onto the Site); the vicinity of the AFFF fire suppression systems using wells MW-60, MW-63, and MW-64; and downgradient wells MW-43 and MW-68.

Based on the analytical results from the February 2021 groundwater samples, the same monitoring wells and an additional two monitoring wells were sampled and analyzed in November/December 2021. The additional wells included MW-36 (south of the 660- and 1,250-ton press pump rooms) and MW-74 (southwest of the 660- and 1,250-ton press pump rooms).

Of the ten sampled wells, eight were screened within the shallower A zone (screened from approximately 5 to 20 feet bgs) and two were screened within the deeper B zone (MW-43 was screened from 30 to 40 feet bgs and MW-64 from 45 to 60 feet bgs).

During sampling activities conducted at wells selected for PFAS analysis, laboratory-supplied "PFAS-free" water was used for equipment decontamination since screening levels and detection limits are low. Equipment blank samples of the laboratory-supplied water were collected and analyzed for PFAS.

The groundwater and equipment blank samples were analyzed for the Unregulated Contaminant Monitoring Rule 3 (UCMR 3) list of six perfluorinated compounds.

- perfluorooctanesulfonic acid (PFOS)
- perfluorooctanoic acid (PFOA)

- perfluorobutanesulfonic acid (PFBS)
- perfluorohexanesulfonic acid (PFHxS)
- perfluoroheptanoic acid (PFHpA)
- perfluorononanoic acid (PFNA)

The UCMR 3 list was selected for analysis because PFOS, PFOA, PFBS, PFHxS, PFHpA, and PFNA are the most frequently detected compounds observed in groundwater at AFFF-affected sites; and because PFOS and PFOA are the compounds for which the EPA has set a lifetime Health Advisory Level for drinking water at the time of sampling.

C.7 PAVEMENT INVESTIGATION

The pavement investigation consisted of collection and analysis of ten samples of concrete and asphalt pavement. The pavement samples were analyzed for polychlorinated biphenyl (PCB) aroclors. The results were used to evaluate for the presence of PCBs absorbed in the pavement. Samples were collected either via rotohammer or concrete coring. Methods are discussed below.

Asphalt samples were collected from throughout the Site where stained and unstained asphalt pavement were observed. Samples Asphalt-001 and Asphalt-002 were collected from the direct-push sampling sleeve during direct-push drilling. A roto hammer was used to collect asphalt samples from the surface of the pavement locations Asphalt-003, -004, and -005 and Stain-001 through -003. The samples labeled “Asphalt” targeted unstained pavement and the samples labeled “Stain” targeted stained pavement. The origin of the stains is unknown. A photo of the location of sample Stain-001 is provided below (see Exhibit C-14).



Exhibit C-14: Photo of Location of Sample Stain-001 (Photo Taken on January 26, 2021)

Two concrete pavement samples were collected from inside the Former Acid Etch House (also known as the Tote Storage Area). At the two locations, a concrete saw was used to core concrete pavement. The concrete core was broken in half midway down the vertical thickness. A concrete sample was collected from the broken edge.

C.8 FIELD QUALITY ASSURANCE/QUALITY CONTROL REQUIREMENTS

Laboratory QA/quality control (QC) protocols are discussed within the Quality Assurance Project Plan (QAPP), Appendix F of the work plan (Shannon & Wilson, 2020). Field QA/QC procedures, discussed below, were established to ensure that samples were tracked from collection through analysis, evaluate the efficiency and reproducibility of sampling procedures; and ensure that sampling activities did not result in cross-contamination.

C.8.1 Sample Handling, Chain-of-Custody, and Transportation Procedures

Environmental samples collected during the project were labeled, stored, and transported using standard Shannon & Wilson protocols. These protocols are summarized below.

C.8.1.1 Sample Labeling

Sample container labels were completed immediately before or immediately following sample collection. Labels were completed using indelible ink. At a minimum, container labels included the following information:

- Date and time of collection,
- Location of the sample,
- Name or initials of sample collector,
- Unique sample identification,
- Analysis requested, and
- Chemical preservative used.

The nomenclature for soil samples was:

Boring Name:Sample Depth-Date

For example, a soil sample collected from 5.5 feet bgs from boring SB-2020-001 on February 1, 2020, would be identified as:

SB-2020-001:5.5-02012020

The established nomenclature for groundwater samples was:

Well Name-Date

For example, a groundwater sample from well MW-53 collected on February 1, 2020, would be identified as:

MW-53-02012020

Duplicate samples were labeled with a discrete well/boring name commencing at numeral 100. For example:

MW-100-02012020 or SB-2020-100:5.5-02012020

Equipment blanks had the initials EB, were numbered sequentially, and dated:

EB-1-02012020

Trip blanks had the initials TB, were numbered sequentially, and dated:

TB-1-02012020

Matrix spike/matrix spike duplicate (MS/MSD) samples were identified with the initials MS/MSD, with the identification of the well or boring from which it was collected, and

dated. For example, an MS/MSD sample collected from MW-43 on February 1, 2020, would be labeled:

MS/MSD-MW-43-02012020

C.8.1.2 Chain-of-Custody

Once a sample was collected, it was placed within a cooler with ice and remained in the custody of the sampler until shipment, pick-up, or delivery to the laboratory, or until the sample possession was transferred to another party. Sample information was entered onto a COC form along with the requested analyses.

Upon transfer of sample possession to subsequent parties, the COC form was signed and time stamped by the person(s) transferring and receiving custody of the sample container. Upon receipt of samples at the laboratory, the condition of the samples was recorded by the receiver. COC records were included in the analytical report prepared by the laboratory.

Upon receipt of samples (which were accompanied by a completed COC record detailing requested analyses), the Laboratory Coordinator(s) or his/her delegate:

- Verified all paperwork, COC records, and similar documentation;
- Logged in samples, assign unique laboratory sample numbers, and attach the numbers to the sample container(s);
- Performed any requested laboratory filtration and preservation;
- Opened a project file and enter data into the file;
- Stored samples in a refrigerated sample bank; and
- Emailed a record of the sample receipt and log-in form to the Shannon & Wilson Project Manager noting any problems with the samples.

C.8.1.3 Sample Transportation

Samples were transported by field personnel to the analytical laboratory within a cooler. The cooler contained ice to ensure that samples were maintained within the appropriate temperature range (between 0 °C and 6 °C).

C.8.2 Quality Assurance/Quality Control Samples

QA/QC samples were collected during the event to evaluate the reproducibility of the sampling technique and the subsequent laboratory analysis. These included field duplicate samples, trip blank samples, equipment blank samples, MS/MSD samples, and temperature

blank samples. Evaluation of QA/QC samples is discussed in the Data Quality Summary Report (Appendix E of the main report).

C.8.2.1 Field Duplicate Samples

Field duplicate samples are a second sample collected from a location. These samples were submitted to the laboratory with a “dummy” sample number and time as a regular sample. It was analyzed for the same suite as the original sample to allow for evaluation of the reproducibility of the sampling technique and the subsequent laboratory analysis. One field duplicate sample was collected for at least every 20 groundwater and 20 soil samples. The field team noted in the field log where each duplicate sample was collected. A list of field duplicate samples associated primary samples is provided in Table 6 of the main report.

The analytics results of the field duplicates were compared to primary samples to assess laboratory precision and the reproducibility of the sampling technique. Field duplicates were evaluated as part of the data validation procedure and findings are discussed in Appendix E of the main report.

C.8.2.2 Trip Blank Samples

The purpose of a trip blank is to ensure that any compounds detected in the primary samples were not the results of contamination during the handling and sampling process. One trip blank was submitted with each cooler that contained samples for volatile analytes (halogenated volatile organic compounds or TPH as gasoline/benzene, toluene, ethylbenzene, and xylenes). Samples for volatile analyses were grouped into as few coolers as possible to minimize trip blanks. The trip blank sample was analyzed for the same set of volatile constituents that were contained within the cooler. A list of trip blank samples and requested analyses is provided in Table 7 of the main report.

Trip blanks were evaluated as part of the data validation procedure and findings are discussed in Appendix E of the main report.

C.8.2.3 Equipment Blank Samples

The purpose of equipment blank samples was to evaluate the potential for cross contamination from the sampling equipment. During the field activities, the samples were collected by pumping water through new disposable peristaltic pump tubing and by pouring water over decontaminated reusable stainless-steel spoons, used for soil sampling.

In November 2020, during the first field sampling event, two equipment blank samples were collected after decontamination of reusable stainless steel sampling spoons. The first sample was collected following the first distilled water rinse and the second sample was

collected following the final distilled water rinse. The purpose of the pair was to determine if there was an ongoing need to perform two rinses with distilled water.

Because some of the screening levels for this project are significantly lower than drinking water standards, additional equipment blank samples were collected directly from the water source used to perform equipment decontamination. Water sources used during the project included the driller's water tank, distilled water purchased locally, and laboratory-supplied water.

A list of equipment blank samples, the sample source, and requested analyses is provided in Table 8 of the main report.

Equipment blanks were evaluated as part of the data validation procedure, and findings are discussed in Appendix E of the main report.

C.8.2.4 Matrix Spike/Matrix Spike Duplicate Samples

MS/MSD samples are used by the laboratory to evaluate potential matrix interference and evaluate analytical accuracy. One soil MS/MSD sample was collected for every week of soil sampling and one groundwater MS/MSD sample was collected during each groundwater sampling event. MS/MSD samples were evaluated as part of the data validation procedure, and findings are discussed in Appendix E of the main report.

C.8.2.5 Temperature Blank Samples

Temperature blank samples are used to determine whether the samples in the cooler had been maintained within the appropriate temperature range. The trip blanks are provided by the laboratory and are not analyzed for chemical constituents.

C.8.3 Equipment Decontamination

Non-disposable and non-dedicated sampling and monitoring equipment was decontaminated prior to initial use, between sampling locations, and at the completion of the Site-specific sampling. The procedure included:

- Tap water initial rinse (if needed),
- Tap water and non-phosphate detergent (Alconox™) mixture wash,
- Tap water rinse,
- Distilled water rinse, and
- Distilled water final rinse.

Additional decontamination steps were incorporated as needed. Oil-absorbent pads were used to aid in wiping product from equipment.

During sampling activities conducted at wells selected for PFAS analysis, laboratory-supplied "PFAS-free" water was used for equipment decontamination since screening levels and detection limits are low.

Decontamination of personnel involved in sampling activities was accomplished as described in a Site-specific HASP.

C.9 LABORATORY ANALYSES

Samples were submitted to ARI for chemical analysis, except for PFAS analysis. PFAS analyses were performed by Eurofins TestAmerica of Sacramento, California. The reported analytical methods are listed in Exhibit C-15 (shown below).

Exhibit C-15: Analytical Methods Used During the Remedial Investigation

Analyte	Method
TPH-G	NWTPH-Gx
TPH-D TPH-O	NWTPH-Dx with the silica-gel cleanup preparation method
BTEX HVOCs ¹	EPA Method 8260D
PAHs Limited SVOCs ² Full List SVOCs	EPA Method 8270E (standard, low-level, and selective ion monitoring)
PCB Aroclors	EPA Method 8082A
PFAS ³	EPA Method 537 (modified)
Metals (total and dissolved) ⁴	EPA Method 200.8
Mercury (total and dissolved)	EPA Method 7470A (water) EPA Method 7471B (soil)
Hexavalent chromium (dissolved)	EPA Standard Method 3500 (water) EPA Standard Method 7196A (soil)
Ferrous iron	EPA Standard Method 3500
Nitrate, Nitrite, Sulfate	EPA Method 300.0
Sulfite	EPA Standard Method 4500
Methane	RSK-175
Total Organic Carbon	EPA Method 9060AM

NOTES:

- 1 HVOC compounds included 1,1-dichloroethene (1,1 DCE), cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), tetrachloroethene (PCE), trichloroethene (TCE), vinyl chloride, and methyl tert butyl ether.
- 2 Limited SVOCs, included bis(2-ethylhexyl phthalate), dibutyl phthalate, 1,2-dichlorobenzene, 1,4-dichlorobenzene, 2,4-dimethylphenol, benzoic acid, butyl benzyl phthalate, n-nitrosodiphenylamine, and pentachlorophenol.
- 3 The PFAS compounds included EPA's UCMR 3 list of six perfluorinated compounds: PFOS, PFOA, PFBS, PFHxS, PFHpA, and PFNA.
- 4 Metals included arsenic, barium, cadmium, total chromium, cobalt, copper, iron, lead, manganese, nickel, selenium, silver, vanadium, and zinc.

BTEX = benzene, toluene, ethylbenzene, and xylenes; NWTPH-Gx = Northwest Total Petroleum Hydrocarbons as Gasoline Extended Range; SVOCs = semi-volatile organic compounds; TPH-G = total petroleum hydrocarbons as gasoline range

Semivolatile organic compounds and PAHs were analyzed using EPA Method 8270E. Method 8270E includes the standard method, a low-level (LL) version, and selective ion monitoring (SIM). SIM, which provides the lowest detection limits, is not available for the full suite of analytes on the EPA 8270E analyte list; the available SIM analyte list mainly includes PAHs. Similarly, the LL method does not include the full suite of analytes on the EPA 8270E analyte list. For the included analytes, the LL method provides lower detection limits than the standard method but less stringent than the SIM method. The standard method was selected when the reporting limits were sufficient to meet the screening level requirements or if the analyte is not included within the SIM or LL methods. The LL

method was selected when it was required to achieve the screening level requirements, or when it could get closer to the screening levels and SIM was not available. SIM was selected when it was available and required to achieve or get closer to the screening levels.

C.10 INVESTIGATION-DERIVED WASTE MANAGEMENT

Investigation-derived waste (IDW) was generated during Site activities. IDW generated during this effort included soil cuttings, groundwater, and LNAPL purged from wells during development and sampling, and decontamination water generated during probing and drilling activities. Soil, water, and LNAPL were placed into separate drums, sealed, labeled, and temporarily stored on site.

The Former Acid Etch House was used to temporarily store soil drums during soil investigations and were removed within several weeks of completing the soil investigation. The Diesel Fuel and Used Oil Storage Building, located in the northwest corner of the Site, was used to store groundwater, LNAPL, and some soil drums generated during this investigation and were removed during several mobilizations.

Following receipt of analytical results and disposal facility acceptance, the IDW was removed by an appropriately licensed waste transporter and disposed of offsite at the appropriate accepting disposal facility.

IDW soil and groundwater was accepted as non-hazardous waste under the following profiles:

- Marine Vacuum Service profile "Shan 020518" for water and oil
- Marine Vacuum Service profile "Shannon 112718" for soil
- Waste Management's profile "OR349654" for water
- Waste Management profile "OR349655" for soil

The soil and waste disposed by Marine Vacuum Service was transported to their Seattle facility and treated onsite for disposal under their permit.

The soil and water disposed by Waste Management was transported to Waste Management's Duwamish Reload Facility at 7400 8th Avenue S., Seattle, WA 98108. The soil was then transported by rail for final disposition as non-hazardous waste at Waste Management's Columbia Ridge Landfill at 17629 Cedar Springs Lane, Arlington, OR 97812. The approved waste profiles and manifests are provided in Attachment A-1 of this appendix.

Miscellaneous IDW consists of used personal protective equipment (PPE), disposable sampling equipment (spoons, tubing, etc.), and other wastes that originated from Site activities. This IDW was placed in doubled, heavy-duty plastic bags. The waste PPE and disposable sampling equipment was disposed of in a dumpster at the Shannon & Wilson office.

C.11 SURVEYING

Surveys were undertaken by True North Land Surveying Inc. Newly installed monitoring wells were surveyed to obtain the horizontal coordinates and elevations. Additionally, the lateral extent of belowground features were surveyed to obtain more accurate location data. Surveyors did not enter vaults or pits due to safety considerations. The surveyed features are incorporated into the figures and tables in the main report.

C.12 DEVIATIONS

Several deviations from the RI Work Plan occurred during the investigation and are summarized below. In our opinion, the deviations did not materially impact the ability to achieve the objectives of the RI.

- New wells were developed using overpumping rather than pump-and-surge-block method.
- The LIF investigation soil borings were analyzed for NWTPH-Dx rather than NWTPH-Dx and PAHs by EPA Method 8270D SIM. The samples were not analyzed for PAHs since elevated petroleum hydrocarbon concentrations would interfere with PAH analysis.
- Three LIF soil borings were completed rather than four borings. The LIF soil borings and sampling approach was selected after reviewing preliminary results with the LIF subcontractor. Rather than collecting two samples per boring, four to six samples were collected from each boring to provide more data for the LIF response interpretation.
- Samples were collected from eight hand-auger locations (rather than nine locations) within the main building, where exposed soil was encountered. Sampling was not conducted at HA-2020-009 since concrete was encountered at approximately 3 inches bgs and a suitable alternative was not identified.
- Refusal was encountered at HSA borings MW-65 and MW-68 prior to reaching the target depth. Concrete was encountered in both borings and is suspected as the cause of refusal. The borings were backfilled immediately and re-designated as borings SB-2021-065 and SB-2021-068, respectively, since monitoring wells were not installed. New borings several feet from the original location were advanced to the target depth and

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designated borings MW-65 and MW-68. Monitoring wells were installed in the re-located borings.

- Monitoring wells were installed in HSA borings except for MW-73. MW-73 was located inside of the Aluminum Heat Treat Building. The mast of the HSA drill rig was taller than the vertical clearance; therefore, MW-73 was installed in a direct-push boring, which required less vertical clearance.
- Due to the availability of drill rigs and time required for soil sampling, soil samples were collected at MW-72 and MW-74 using a direct-push probe instead of an HSA. HSA was originally selected for these borings since monitoring wells were to be installed. After the soil samples were collected using a direct-push probe, the borings were over-drilled using an HSA, which had a wider diameter than a direct-push probe, and monitoring wells were installed. The use of direct-push drilling at these locations provided increased ability to log the borings and is not expected to have negatively impacted the quality of the data obtained during the investigation.
- Within the RI Work Plan, optional borings SB-2020-030, SB-2020-031, SB-2020-032, SB-2020-036, and SB-2020-037 were proposed to investigate the Decommissioned Oil Storage Area vault and Decommissioned Diesel Storage Area vault and fill ports. Upon discussion with Ecology, it was decided that these optional borings would not be completed.
- The March 2021 (Quarter 1) groundwater level monitoring event was not completed prior to the collection of groundwater samples because some of the newly installed monitoring wells had not been developed prior to the start of the sampling event. Some wells were developed concurrent with sampling at other wells during the March 2021 monitoring event. The developed wells were sampled later in the monitoring event at least 48 hours after development. The groundwater level monitoring event was completed following completion of the sample collection activities in March 2021.
- The RI Work Plan called for completion of falling head/rising head slug tests at each selected location with 24 hours between tests. However, for many of the monitoring wells selected for the aquifer testing, the well screen extended above the water table (to assess whether product is accumulating on the water surface). When the well screen is above the water table level, a falling head test (initiated by a rise in water level in the well) results in raising the water level into the unsaturated conditions where it can drain into the filter pack and unsaturated aquifer; thus, skewing the data set. Therefore, rising head tests are more suitable for this site and were used to collect the hydraulic conductivity data at each selected location. In addition, the water level rebounded quickly after the slug removal such that an extended wait time of 24 hours between tests was deemed unnecessary.
- During the second quarterly groundwater monitoring event, monitoring well MW-68, adjacent to the Lower Duwamish Waterway, was dry during attempt to sampling the well during low tide and was not sampled.

- Soil samples from boring MW-53 (rather than boring MW-65) were selected for grain-size analysis. MW-53 was selected due to low recovery of soil at MW-65.
- Groundwater at monitoring well MW-68 was sampled during high tide (instead of low tide) during the third and fourth quarter monitoring events. MW-68 was observed to be dry during low tide during the first two quarters of monitoring. A transducer was placed in MW-68 from June 30, 2021, to July 8, 2021, to measure water levels and evaluate for connection with the adjacent river. The transducer data indicated that water levels in MW-68 closely mirrored the tidal fluctuations of the river with minimal lag, suggesting close connectivity between MW-68 and the adjacent river. The results were discussed with the Ecology Project Manager during July 2021, and it was agreed that MW-68 would be sampled during high tide during the following quarterly sampling events.

C.13 REFERENCES

- Bouwer, H. and Rice, R.C., 1976, A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells: *Water Resources Research*, v. 12, no. 3, p. 423-428.
- Hvorslev, M.J., 1951, Time lag and soil permeability in ground-water observations: *Bull. No. 36, Waterways Exper. Sta. Corps of Engrs, U.S. Army, Vicksburg, Mississippi*, p. 1-50.
- Shannon & Wilson, 2020, Remedial investigation work plan, Jorgensen Forge Corporation Property, Tukwila, Washington: Report prepared by Shannon & Wilson, Seattle, Wash., project 21-1-12596-013, for Earle M. Jorgensen Company, Lynwood, Cali., April 15.

Table C-1: Summary of Slug Testing Results

Monitoring Well Designation	Rising Head Test: Hydraulic Conductivity (ft sec ⁻¹) ^(a)		Mean Hydraulic Conductivity (K) (ft sec ⁻¹)	Mean Hydraulic Conductivity (K) (ft day ⁻¹)	Mean Hydraulic Conductivity (K) (cm sec ⁻¹)
	Hvorslev ^(b)	Bouwer-Rice ^(c)			
MW-25 Test 1	1.13E-04	6.23E-05	8.39E-05	7.25E+00	2.56E-03
MW-25 Test 2	1.19E-04	5.78E-05	8.29E-05	7.17E+00	2.53E-03
MW-25 Test 3	1.07E-04	5.82E-05	7.89E-05	6.82E+00	2.41E-03
MW-60 Test 1	1.48E-04	7.55E-05	1.06E-04	9.13E+00	3.22E-03
MW-60 Test 2	2.96E-04	1.50E-04	2.11E-04	1.82E+01	6.42E-03
MW-60 Test 3	1.68E-04	8.37E-05	1.19E-04	1.02E+01	3.61E-03
MW-69 Test 1	5.65E-04	2.84E-04	4.01E-04	3.46E+01	1.22E-02
MW-69 Test 2	6.45E-04	3.03E-04	4.42E-04	3.82E+01	1.35E-02
MW-69 Test 3	6.32E-04	3.08E-04	4.41E-04	3.81E+01	1.34E-02
AVERAGE (ALL TESTS)			1.69E-04	1.46E+01	5.16E-03

NOTES:

(a) Rising head tests from non-vented pressure transducer compensated for barometric pressure

(b) AQTESOLV analysis. Hvorslev, M.J., 1951. Time Lag and Soil Permeability in Ground-Water Observations, Bull. No. 36, Waterways Exper. Sta. Corps of Engrs, U.S. Army, Vicksburg, Mississippi, pp. 1-50.

(c) AQTESOLV analysis. Bouwer, H. and R.C. Rice, 1976. A slug test method for determining hydraulic conductivity of unconfined aquifers with completely or partially penetrating wells, Water Resources Research, vol. 12, no. 3, pp. 423-428.

cm sec⁻¹ = centimeters per second; ft day⁻¹ = feet per day; ft sec⁻¹ = feet per day

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Shannon & Wilson uses a soil identification system modified from the Unified Soil Classification System (USCS). Elements of the USCS and other definitions are provided on this and the following page. Soil descriptions are based on visual-manual procedures (ASTM D2488) and laboratory testing procedures (ASTM D2487), if performed.

Structure¹

Interbedded	Alternating layers of varying material or color with layers at least 1/4-inch-thick; singular: bed.
Laminated	Alternating layers of varying material or color with layers less than 1/4-inch-thick; singular: lamination.
Fissured	Breaks along definite planes or fractures with little resistance.
Slickensided	Fracture planes appear polished or glossy; sometimes striated.
Blocky	Cohesive soil that can be broken down into small angular lumps that resist further breakdown.
Lensed	Inclusion of small pockets of different soils, such as small lenses of sand scattered through a mass of clay.
Homogeneous	Same color and appearance throughout.

Angularity and Shape¹

Angular	Sharp edges and unpolished planar surfaces.
Subangular	Similar to angular, but with rounded edges.
Subrounded	Nearly planar sides with well-rounded edges.
Rounded	Smoothly curved sides with no edges.
Flat	Width/thickness ratio > 3.
Elongated	Length/width ratio > 3.

Standard Penetration Test (SPT)³

Hammer	140 pounds with a 30-inch free fall. Rope on 6- to 10-inch-diameter cathead 2-1/4 rope turns, > 100 rpm. If automatic hammers are used, blow counts shown on boring logs should be adjusted to account for efficiency of hammer.
Sampler	10 to 30 inches long Shoe I.D. = 1.375 inches Barrel I.D. = 1.5 inches Barrel O.D. = 2 inches
N-Value	Sum blow counts for second and third 6-inch increments. Refusal: 50 blows for 6 inches or less or 10 blows for 0 inch.

Moisture Content

Dry	Absence of moisture, dusty, dry to the touch.
Moist	Damp but no visible water.
Wet	Visible free water, from below water table.

Gradation

Poorly Graded	Narrow range of grain sizes present or, within the range of grain sizes present, one or more sizes are missing (Gap Graded). Meets criteria in ASTM D2487, if tested.
Well-Graded	Full range and even distribution of grain sizes present. Meets criteria in ASTM D2487, if tested.

Cementation¹

Weak	Crumbles/breaks with handling or slight finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

Plasticity²

Nonplastic	Cannot roll a 1/8-in. thread at any water content.	PI < 4
Low	A thread can barely be rolled and a lump cannot be formed when drier than the plastic limit.	4 < PI < 10
Medium	A thread is easy to roll and not much time is required to reach the plastic limit. The thread cannot be rerolled after reaching the plastic limit. A lump crumbles when drier than the plastic limit.	10 < PI < 20
High	It takes considerable time rolling and kneading to reach the plastic limit. A thread can be rerolled several times after reaching the plastic limit. A lump can be formed without crumbling when drier than the plastic limit.	PI > 21

Additional Terms

Mottled	Irregular patches of different colors.
Bioturbated	Soil disturbance or mixing by plants or animals.
Diamict	Nonsorted sediment; sand and gravel in silt and/or clay matrix.
Cuttings	Material brought to surface by drilling.
Slough	Material that caved from sides of borehole.
Sheared	Disturbed texture, mix of strengths.

Notes:

¹Reprinted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

²Adapted, with permission, from ASTM D2488 - 09a Standard Practice for Description and Identification of Soils (Visual-Manual Procedure), copyright ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428. A copy of the complete standard may be obtained from ASTM International, www.astm.org.

³Penetration resistances (N-values) shown on boring logs are as recorded in the field and have not been corrected for hammer efficiency, overburden, or other factors.

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Unified Soil Classification System (USCS)
 Modified From USACE Tech Memo 3-357, ASTM D2487, and ASTM D2488

Major Divisions		Symbol	Typical Identifications	
Coarse-Grained Soils (more than 50% retained on No. 200 sieve)	Gravels (more than 50% of coarse fraction retained on No. 4 sieve)	Gravel (less than 5% fines)	GW 	Well-graded Gravel; Well-graded Gravel with Sand
			GP 	Poorly Graded Gravel; Poorly Graded Gravel with Sand
		Silty or Clayey Gravel (more than 12% fines)	GM 	Silty Gravel; Silty Gravel with Sand
			GC 	Clayey Gravel; Clayey Gravel with Sand
	Sands (50% or more of coarse fraction passes the No. 4 sieve)	Sand (less than 5% fines)	SW 	Well-graded Sand; Well-graded Sand with Gravel
			SP 	Poorly Graded Sand; Poorly Graded Sand with Gravel
		Silty or Clayey Sand (more than 12% fines)	SM 	Silty Sand; Silty Sand with Gravel
			SC 	Clayey Sand; Clayey Sand with Gravel
Fine-Grained Soils (50% or more passes the No. 200 sieve)	Silts and Clays (liquid limit less than 50)	Inorganic	ML 	Silt; Silt with Sand or Gravel; Sandy or Gravelly Silt
			CL 	Lean Clay; Lean Clay with Sand or Gravel; Sandy or Gravelly Lean Clay
	Silts and Clays (liquid limit 50 or more)	Organic	OL 	Organic Silt or Clay; Organic Silt or Clay with Sand or Gravel; Sandy or Gravelly Organic Silt or Clay
		Inorganic	MH 	Elastic Silt; Elastic Silt with Sand or Gravel; Sandy or Gravelly Elastic Silt
			CH 	Fat Clay; Fat Clay with Sand or Gravel; Sandy or Gravelly Fat Clay
			Organic	OH 
Highly Organic Soils	Primarily organic matter, dark in color, and organic odor	PT 	Peat or other highly organic soils (see ASTM D4427)	

Acronyms and Abbreviations

ATD At Time of Drilling	MgO Magnesium Oxide	psi Pounds per Square Inch
Diam. Diameter	mm Millimeter	PVC Polyvinyl Chloride
Elev. Elevation	MnO Manganese Oxide	rpm Rotations per Minute
ft Feet	NA Not Applicable or Not Available	SPT Standard Penetration Test
FeO Iron Oxide	NP Nonplastic	USCS Unified Soil Classification System
gal Gallons	O.D. Outside Diameter	q_u Unconfined Compressive Strength
Horiz. Horizontal	OW Observation Well	VWP Vibrating Wire Piezometer
HSA Hollow-Stem Auger	pcf Pounds per Cubic Foot	Vert. Vertical
I.D. Inside Diameter	PID Photoionization Detector	WOH Weight of Hammer
in Inches	PMT Pressuremeter Test	WOR Weight of Rods
lbs Pounds	ppm Parts per Million	Wt Weight

Relative Density
Cohesionless Soils

N, SPT, Blows/ft	Relative Density
< 4	Very loose
4 - 10	Loose
10 - 30	Medium dense
30 - 50	Dense
> 50	Very dense

Relative Consistency
Cohesive Soils

N, SPT, Blows/ft	Relative Consistency
< 2	Very soft
2 - 4	Soft
4 - 8	Medium stiff
8 - 15	Stiff
15 - 30	Very stiff
> 30	Hard

Percentages^{1, 2}

Trace	< 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

Well and Backfill Symbols

	Bentonite Cement Grout
	Bentonite Grout
	Bentonite Chips
	Silica Sand
	Perforated or Screened Casing
	Surface Cement Seal
	Asphalt or Cap
	Slough
	Inclinometer or Non-perforated Casing
	Instrumentation Riser or Electrical Lead
	Vibrating Wire Piezometer with Designation

Notes:

Dual symbols (symbols separated by a hyphen, i.e., SP-SM, Sand with Silt) are used for soils with between 5% and 12% fines or when the liquid limit and plasticity index values plot in the CL-ML area of the plasticity chart. Graphics shown on the logs for these soil types are a combination of the two graphic symbols (e.g., SP and SM).

Borderline symbols (symbols separated by a slash, i.e., CL/ML, Lean Clay to Silt; SP-SM/SM, Sand with Silt to Silty Sand) indicate that the soil properties are close to the defining boundary between two groups.

No. 4 size = 4.75 mm = 0.187 in.; No. 200 size = 0.075 mm = 0.003 in.

LOG OF GEOPROBE

Date Started	11/3/20	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	11/3/20			Typical Run Length	5 feet
Total Depth (ft)	25.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
		Concrete slab.	0.7					
		Gray, Silty Sand (SM); moist; predominantly fine sand, some medium sand; petroleum odor.			10.2			
5	R-2	- At 5 feet and deeper: same as before, except dark gray to black and increased medium sand.			3.7		A1-02A:5-11032020 A1-100:5-11032020	5
10	R-3	Gray to dark gray, Sandy Silt (SM); moist; strong petroleum odor; medium to coarse sand with up to 30% fine sand.	10.8		2.8		A1-02A:10-11032020	10
15	R-4	- NAPL observed at 10.8 feet based on sheen on soil.			1		A1-02A:12.8-11032020	15
20	R-5	- NAPL observed at 18 to 23.6 feet based on sheen on soil.			1.2		A1-02A:18-11032020	20
25	R-6	- Little silt from 22.7 to 23.6 feet.			11.8			
		BOTTOM OF GEOPROBE COMPLETED 11/3/2020	25.0				A1-02A:25-11032020	25

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND



2" Plastic Tube - No Soil Recovery

2" Plastic Tube with Soil Recovery

Run No.

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LOG OF GEOPROBE A1-02A

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SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-1

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

LOG OF GEOPROBE

Date Started	11/5/20	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	11/5/20			Typical Run Length	5 feet
Total Depth (ft)	30.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Concrete slab.	1.3					
		Brown, <i>Sandy Silt (ML)</i> ; moist; fine sand.	2.6		0			
5	R-1	Dark brown, <i>Poorly Graded Sand (SP)</i> ; moist; fine to medium sand.			0.6			5
10	R-2		8.0		12.6			10
	R-3	Dark gray with black staining, <i>Silt (ML)</i> ; moist; trace fine sand; strong petroleum odor.			33.5		A2-07A:12-11052020 A2-07A:13.5-11052020	15
15	R-4	- Transitions to lighter brown at 8.2 feet. - Transitions to dark gray to black at 8.6 feet. - NAPL observed as sheen on saturated soil from approximately 12 to 17 feet.			5.6		A2-07A:18-11052020	20
20	R-5		18.5		0.9			25
25	R-6	Gray to dark gray, no black staining, <i>Poorly Graded Sand (SP)</i> ; wet; slight petroleum odor decreasing with depth.			0.8		A2-07A:25-11052020	30
30	R-7		30.0					35
		BOTTOM OF GEOPROBE COMPLETED 11/5/2020						40
								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

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LOG OF GEOPROBE A2-07A

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FIG. C-2

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/19/22 Typ: LKN Rev: JXS Log: RBP

LOG OF GEOPROBE

Date Started	11/6/20	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	11/6/20			Typical Run Length	5 feet
Total Depth (ft)	22.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Asphalt slab.	0.2		2.3			
		Gray-brown, <i>Poorly Graded Sand with Silt (SP-SM)</i> ; moist; predominantly fine to medium sand, trace coarse sand.	2.2					
5	R-2	Gray, <i>Silty Sand (SM)</i> ; moist; fine sand; few iron oxide staining.	5.0		0.2			5
		Gray to dark grayish-brown, <i>Poorly Graded Sand with Sand with Silt (SP-SM)</i> ; moist; predominantly fine to medium sand, few coarse sand.	8.0					
10	R-3	Gray <i>Silt with Sand (ML)</i> ; moist; black staining with petroleum odor.	12.5		8.9		A2-16A:9.5-11062020	10
	R-4	Dark gray to dark greenish-gray, <i>Poorly Graded Sand with Silt (SM)</i> ; wet; predominantly fine to medium sand, trace coarse sand.	20.6		4.5		A2-16A:12.5-11062020	15
20	R-5	No recovery.	22.0		0		A2-16A:18-11062020	20
		BOTTOM OF GEOPROBE COMPLETED 11/6/2020						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

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LOG OF GEOPROBE A2-16A

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FIG. C-3

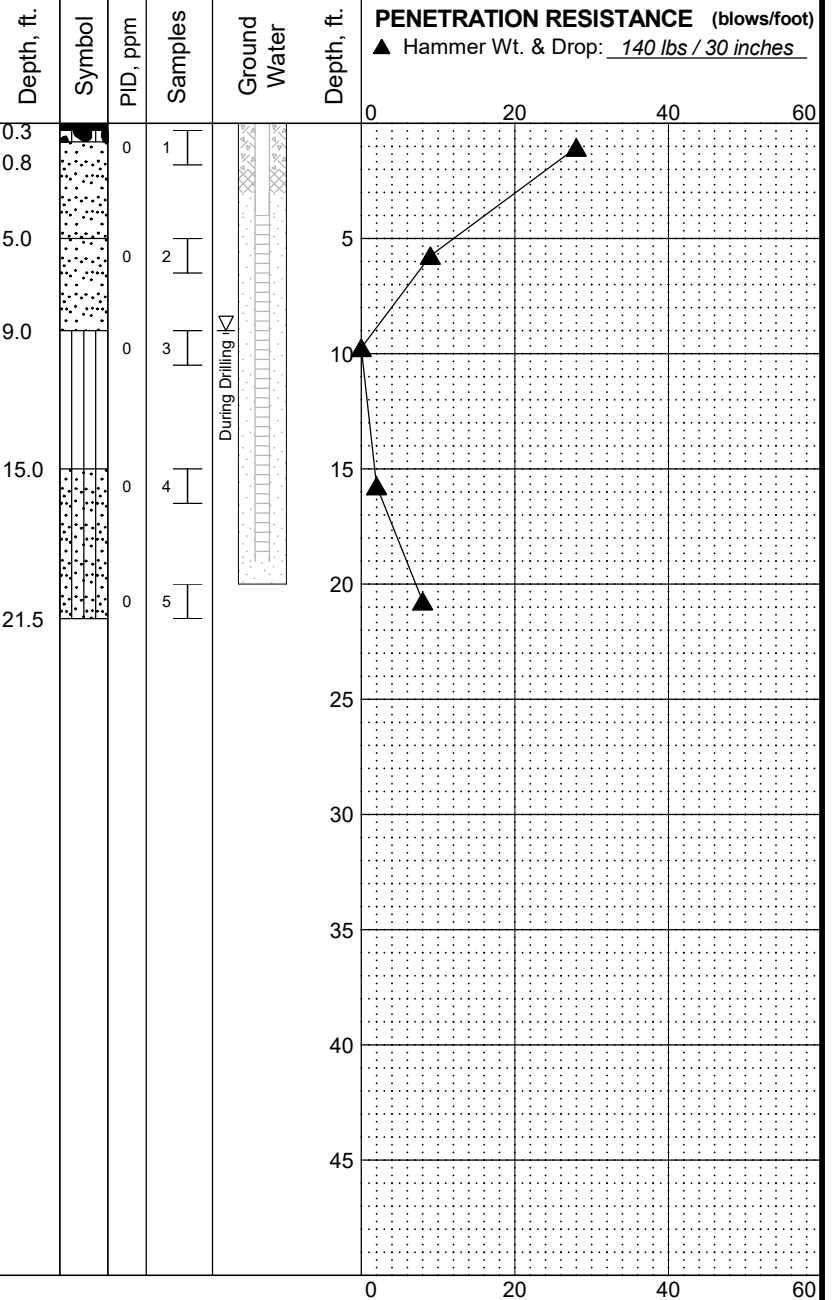
GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/19/22 Log: CTC Rev: JXS Typ: LKN

Total Depth: 21.5 ft. Northing: 195,473 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 10 in.
Top Elevation: 17.4 ft. Easting: 1,277,058 ft. Drilling Company: Holt Services Rod Diam.: NWJ
Vert. Datum: NAVD 88 Station: N/A Drill Rig Equipment: Truck Mobile Drill B57 Hammer Type: Automatic
Horiz. Datum: WA-N NAD83/11 Offset: N/A Other Comments: Ecology well tag ID BMP095.

SOIL DESCRIPTION
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

Asphalt slab.
Brown, *Silty Gravel with Sand (GM)*; dry.
Brown, *Poorly Graded Sand (SP)*; moist; predominantly fine to medium sand.
Brown, *Poorly Graded Sand (SP)*; moist; predominantly fine to medium sand.
Brown to gray *Silt (ML)*; wet; predominantly fine to medium sand, trace coarse sand; some black discolorations.
Gray, *Silty Sand (SM)*; wet; predominantly fine sand.

BOTTOM OF BORING COMPLETED 2/5/2021
Well casing is 2-inch PVC. The well cover is metal and is flush with the ground surface.



* Sample Not Recovered
E Environmental Sample Obtained
┤ 2.0" O.D. Split Spoon Sample

LEGEND
Well Screen and Sand Filter
Bentonite-Cement Grout
Bentonite Chips/Pellets
Bentonite Grout
Ground Water Level ATD

◇ % Fines (<0.075mm)
● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-10R

June 2022

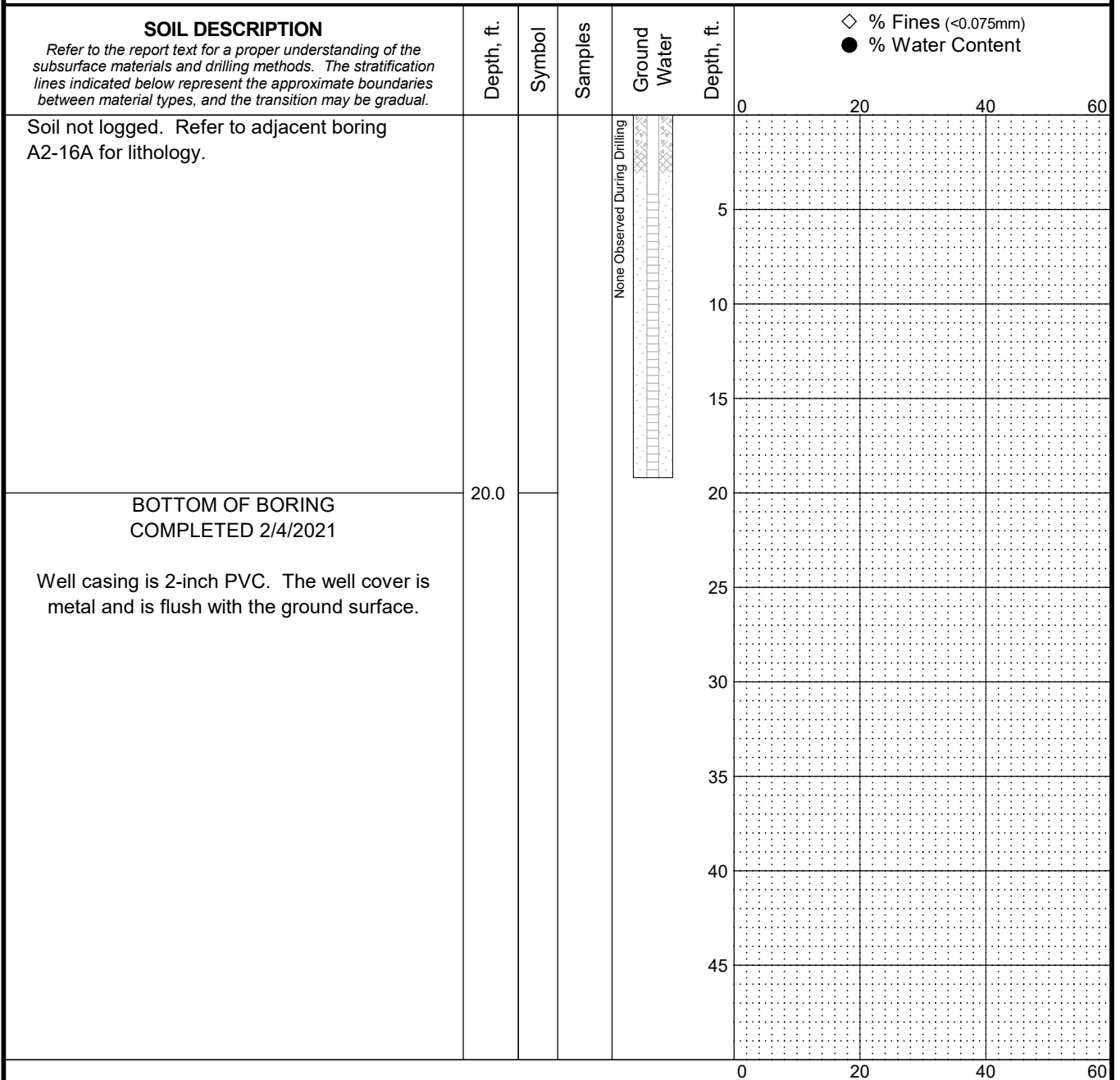
21-1-12596-030

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FIG. C-4

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: RBP Rev: JXS Typ: LKN

Total Depth: 20 ft. Northing: 195,340 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 10 in.
 Top Elevation: 17.4 ft. Easting: 1,277,074 ft. Drilling Company: Holt Services Rod Diam.: NWJ
 Vert. Datum: NAVD 88 Station: N/A Drill Rig Equipment: Truck Mobile Drill B57 Hammer Type: Automatic
 Horiz. Datum: WA-N NAD83/11 Offset: N/A Other Comments: Ecology well tag ID BMP094.



- LEGEND**
- * Sample Not Recovered
 - Well Screen and Sand Filter
 - Bentonite-Cement Grout
 - Bentonite Chips/Pellets
 - Bentonite Grout

- NOTES**
- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
 - Groundwater level, if indicated above, is for the date specified and may vary.
 - USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-13R

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FIG. C-5

MASTER LOG E 21-12596.GPJ SHAN WIL GDT 5/17/22 Log: CTC Rev: JXS Typ: LKN

Total Depth: <u>21.5 ft.</u>	Northing: <u>195,620 ft.</u>	Drilling Method: <u>Hollow Stem Auger</u>	Hole Diam.: <u>10 in.</u>
Top Elevation: <u>17.4 ft.</u>	Easting: <u>1,276,621 ft.</u>	Drilling Company: <u>Holt Services</u>	Rod Diam.: <u>NWJ</u>
Vert. Datum: <u>NAVD 88</u>	Station: <u>N/A</u>	Drill Rig Equipment: <u>Truck Mobile Drill B57</u>	Hammer Type: <u>Automatic</u>
Horiz. Datum: <u>WA-N NAD83/11</u>	Offset: <u>N/A</u>	Other Comments: <u>Ecology well tag ID BMP097.</u>	

SOIL DESCRIPTION
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

Asphalt slab.

Medium dense, brown, *Poorly Graded Sand with Silt and Gravel (SP-SM)*; moist; fine to coarse sand; fine, subangular gravel.

Very soft, dark gray, *Sandy Silt (ML)*; moist; fine sand; petroleum odor and black staining from 9 to 9.5 feet.

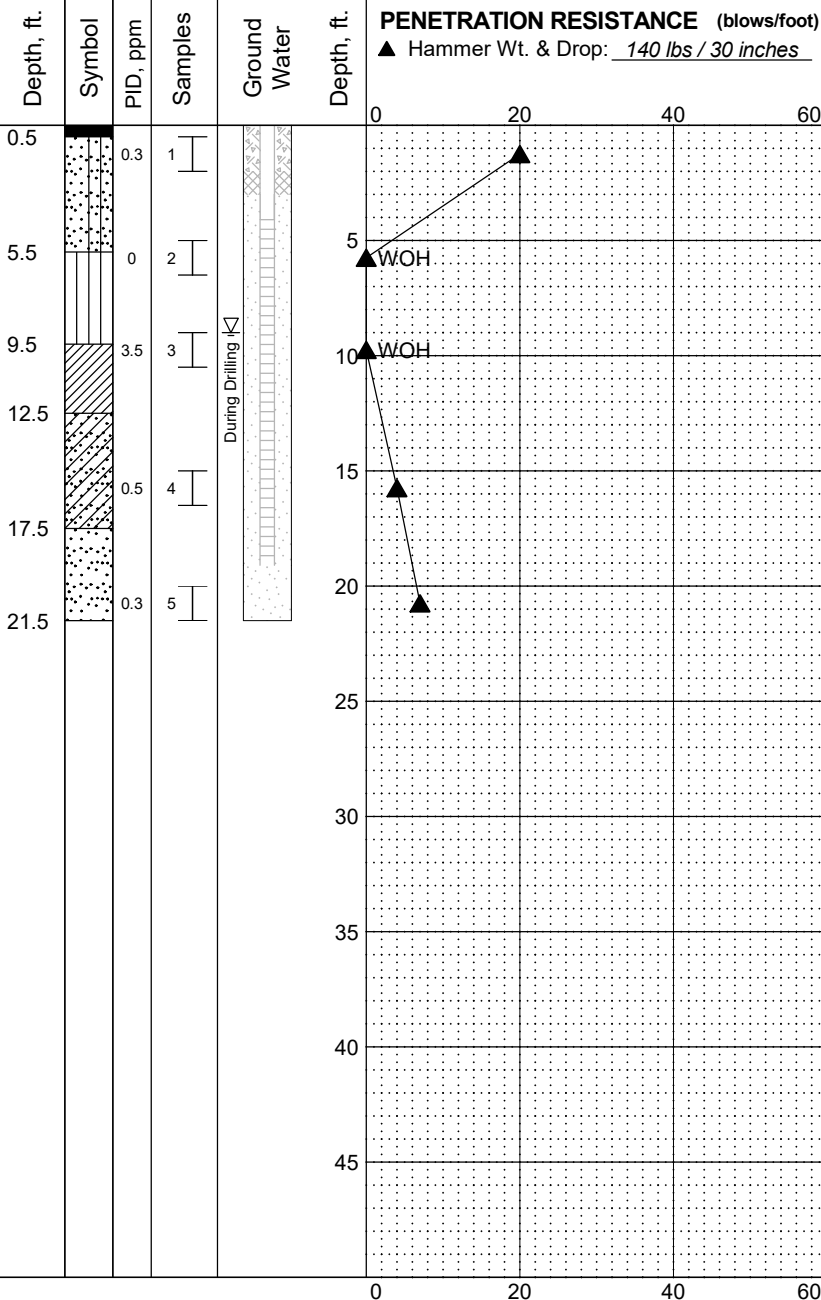
Soft, dark gray, *Lean Clay (CL)*; moist to wet; some black staining.

Loose, dark gray, *Clayey Sand (SC)* to *Silty Sand (SM)*; wet; strong oil smell.

Loose, dark gray, *Poorly Graded Sand (SP)*; wet; strong petroleum odor.

BOTTOM OF BORING COMPLETED 2/3/2021

Well casing is 2-inch PVC. The well cover is metal and is flush with the ground surface.



LEGEND

* Sample Not Recovered	[Symbol]	Well Screen and Sand Filter
E Environmental Sample Obtained	[Symbol]	Bentonite-Cement Grout
┤ 2.0" O.D. Split Spoon Sample	[Symbol]	Bentonite Chips/Pellets
	[Symbol]	Bentonite Grout
	[Symbol]	Ground Water Level ATD

NOTES

- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-22R

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FIG. C-6

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: CTC Rev: JXS Typ: LKN

Total Depth: <u>21.5 ft.</u>	Northing: <u>195,523 ft.</u>	Drilling Method: <u>Hollow Stem Auger</u>	Hole Diam.: <u>10 in.</u>
Top Elevation: <u>17.2 ft.</u>	Easting: <u>1,275,979 ft.</u>	Drilling Company: <u>Holt Services</u>	Rod Diam.: <u>NWJ</u>
Vert. Datum: <u>NAVD 88</u>	Station: <u>N/A</u>	Drill Rig Equipment: <u>Truck Mobile Drill B57</u>	Hammer Type: <u>Automatic</u>
Horiz. Datum: <u>WA-N NAD83/11</u>	Offset: <u>N/A</u>	Other Comments: <u>Ecology well tag ID BMP499.</u>	

SOIL DESCRIPTION
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

Concrete slab.

Loose, brown, *Silty Sand (SM)*; moist; fine to coarse sand; trace iron oxide staining; trace fine gravel in places; 1-inch-thick gray, *Sandy Silt (ML)* lense at 9.5 feet.

Gray, *Silty Sand (SM)*; wet; fine to medium sand; trace fine gravel in places.

Medium dense, brown, *Poorly-Graded Sand with Silt (SP-SM)* to *Silty Sand (SM)*; wet; fine to coarse sand.

Gray to dark gray, *Sandy Silt (ML)*; wet; fine sand; trace organics.

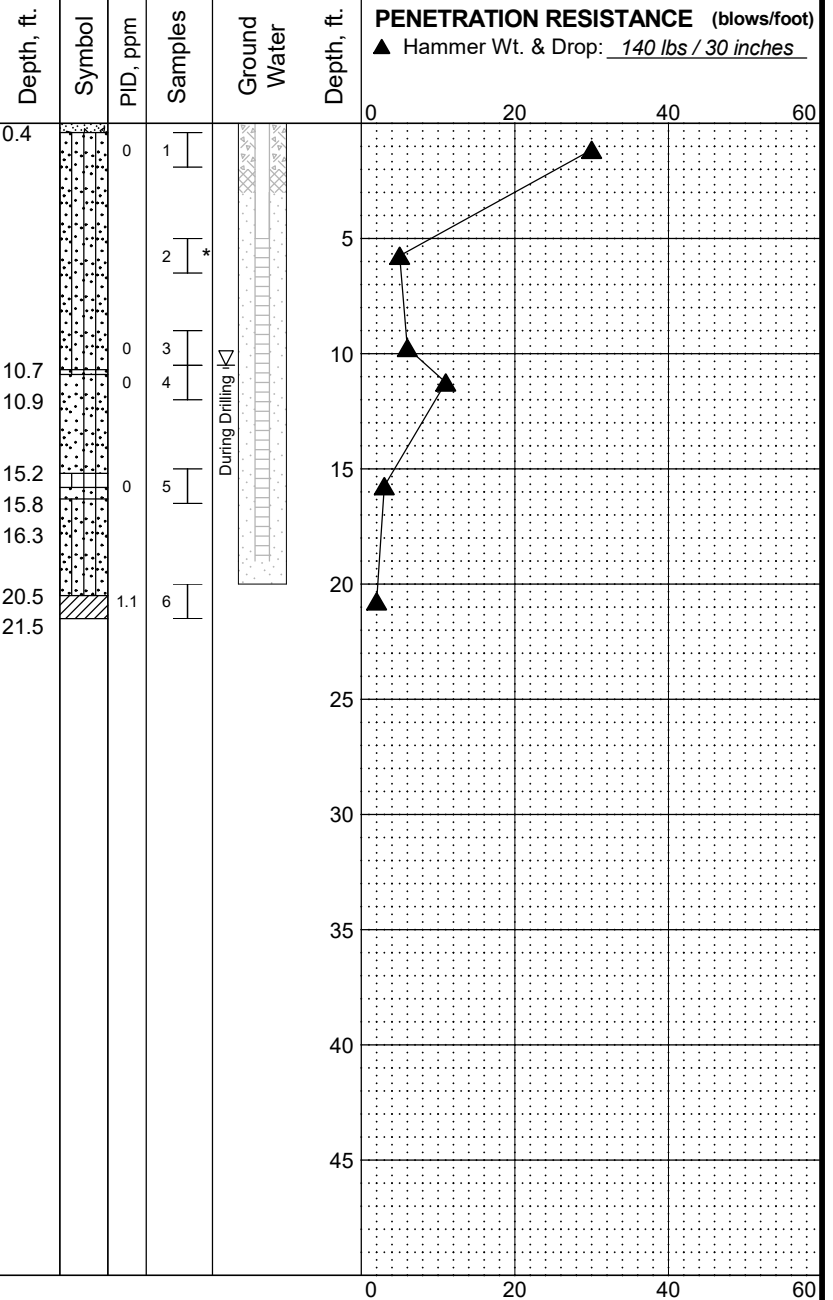
Loose, gray, *Sand with Silt (SP-SM)*; wet; fine to medium sand; trace woody debris.

Gray, *Silty Sand to Sandy Silt (SM/ML)*; wet; fine sand.

Soft, dark gray, *Sandy Clay (CL)*; moist to wet; fine sand; trace black organics; trace woody debris; trace 1/4- to 1/2-inch-thick layers of dark gray, *Silty Sand (SM)*.

BOTTOM OF BORING
COMPLETED 2/3/2021

Well casing is 2-inch PVC. The well cover is metal and is flush with the ground surface.



- * Sample Not Recovered
- E Environmental Sample Obtained
- ┌ 2.0" O.D. Split Spoon Sample

- LEGEND**
- Well Screen and Sand Filter
 - Bentonite-Cement Grout
 - Bentonite Chips/Pellets
 - Bentonite Grout
 - Ground Water Level ATD

- ◇ % Fines (<0.075mm)
- % Water Content

NOTES

- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-53

June 2022

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FIG. C-7

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: MRH Rev: JXS Typ: LKN

Total Depth: <u>21.5 ft.</u>	Northing: <u>195,387 ft.</u>	Drilling Method: <u>Hollow Stem Auger</u>	Hole Diam.: <u>10 in.</u>
Top Elevation: <u>17.3 ft.</u>	Easting: <u>1,276,041 ft.</u>	Drilling Company: <u>Holt Services</u>	Rod Diam.: <u>NWJ</u>
Vert. Datum: <u>NAVD 88</u>	Station: <u>N/A</u>	Drill Rig Equipment: <u>Truck Mobile Drill B57</u>	Hammer Type: <u>Automatic</u>
Horiz. Datum: <u>WA-N NAD83/11</u>	Offset: <u>N/A</u>	Other Comments: <u>Ecology well tag ID BMP093.</u>	

SOIL DESCRIPTION
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

Asphalt slab.

Medium dense, brown, *Silty Sand (SM)*; moist; fine to medium sand; trace oxidation; orange and yellow brick fragments from 0.4 to 0.7 foot; laminated gray silt at 1.2 feet.

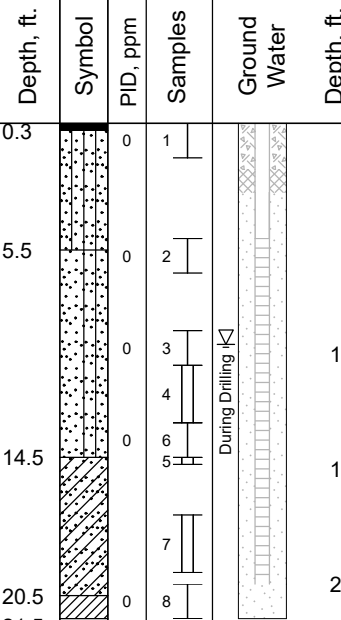
Loose, brown, *Poorly Graded Sand with Silt (SP-SM)*; moist to wet; fine to medium sand; homogeneous.

Hard, dark gray, *Sandy Clay (SC)* to *Sandy Silt (SM)*; wet; fine sand; homogeneous.

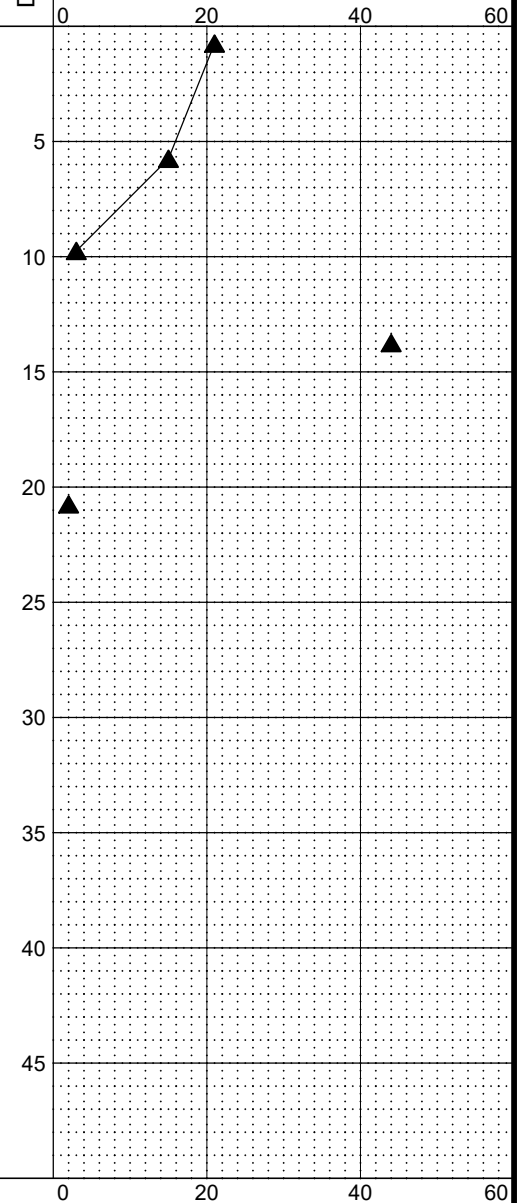
Soft, black, *Lean Clay (CL)*; wet; trace fine sand.

BOTTOM OF BORING
COMPLETED 2/4/2021

Well casing is 2-inch PVC. The well cover is metal and is flush with the ground surface.



PENETRATION RESISTANCE (blows/foot)
▲ Hammer Wt. & Drop: 140 lbs / 30 inches



LEGEND

- | | |
|---------------------------------|-----------------------------|
| * Sample Not Recovered | Well Screen and Sand Filter |
| E Environmental Sample Obtained | Bentonite-Cement Grout |
| 2.0" O.D. Split Spoon Sample | Bentonite Chips/Pellets |
| Thin Wall Sample | Bentonite Grout |
| | Ground Water Level ATD |

NOTES

- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-54

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FIG. C-8

MASTER LOG E 21-12596.GPJ SHAN WIL GDT 5/17/22 Log: MRH/CT Rev: JXS Typ: LKN

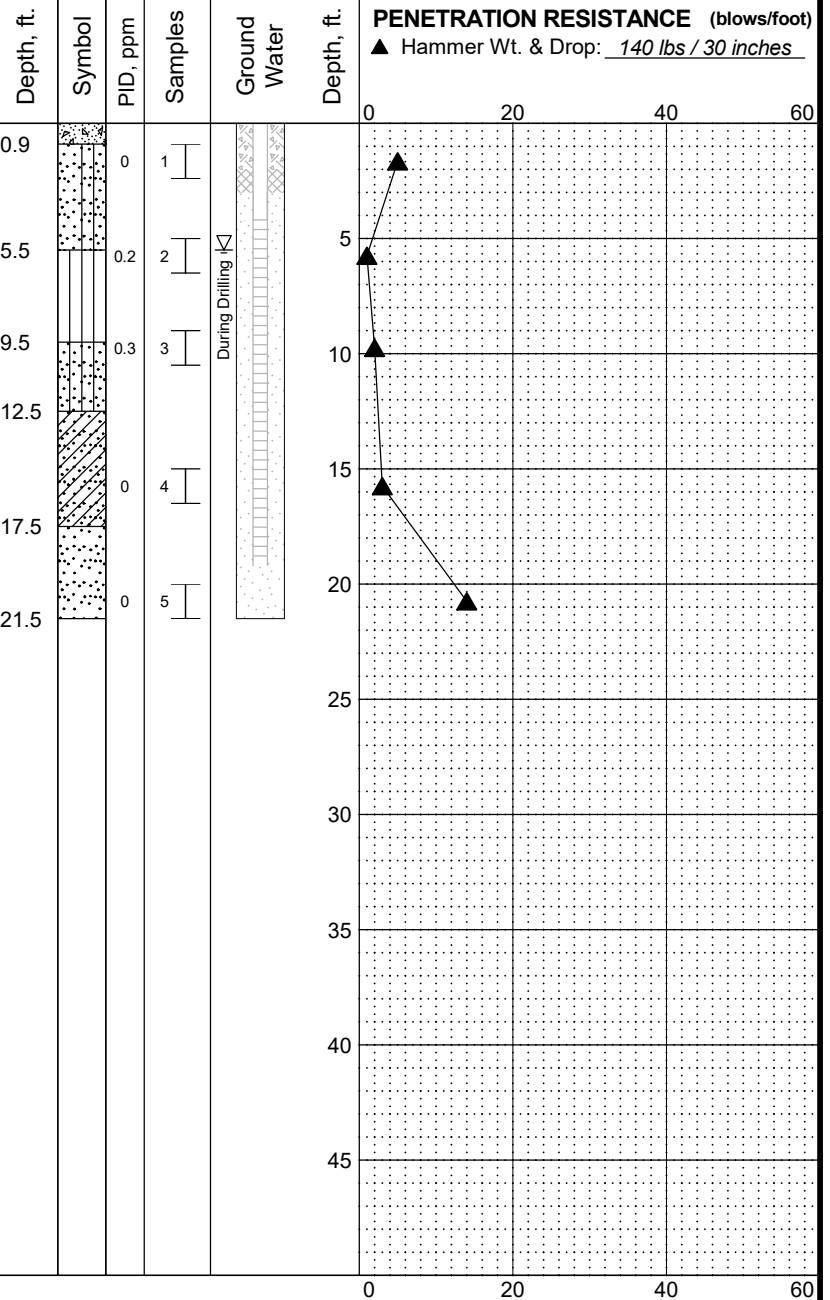
Total Depth: 21.5 ft. Northing: ~ 195,726 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 10 in.
Top Elevation: ~ 17.75 ft. Easting: ~ 1,276,603 ft. Drilling Company: Holt Services Rod Diam.: NWJ
Vert. Datum: NAVD 88 Station: ~ N/A Drill Rig Equipment: Truck Mobile Drill B57 Hammer Type: Automatic
Horiz. Datum: WA-N NAD83/11 Offset: ~ N/A Other Comments: Ecology well tag ID BMP091.

SOIL DESCRIPTION
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

Concrete slab.
Loose, dark brown, *Poorly-Graded Sand with Silt (SP-SM)* to *Silty Sand (SM)*; moist; fine to medium sand.
Very soft, dark gray, *Sandy Silt (ML)*; wet; fine sand.
Soft, dark gray with black staining, *Silty Sand (SM)*; wet; trace fine sand; some black wood organics.
Very loose, dark gray, *Clayey Sand (SC)* to *Silty Sand (SM)*; wet; fine sand; homogeneous.
Medium dense, dark gray, *Poorly Graded Sand (SP)*; wet; fine to medium sand; homogeneous.

BOTTOM OF BORING
COMPLETED 2/3/2021

Well casing is 2-inch PVC. The well cover is metal and is flush with the ground surface.



- LEGEND**
- * Sample Not Recovered
 - E Environmental Sample Obtained
 - 2.0" O.D. Split Spoon Sample
 - Well Screen and Sand Filter
 - Bentonite-Cement Grout
 - Bentonite Chips/Pellets
 - Bentonite Grout
 - Ground Water Level ATD
 - ◇ % Fines (<0.075mm)
 - % Water Content

NOTES

- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- USCS designation is based on visual-manual classification and selected lab testing.
- The hole location was measured from existing site features and should be considered approximate.

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LOG OF BORING MW-55

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FIG. C-9

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: CTC Rev: JXS Typ: LKN

Total Depth: <u>21.5 ft.</u>	Northing: <u>195,597 ft.</u>	Drilling Method: <u>Hollow Stem Auger</u>	Hole Diam.: <u>10 in.</u>
Top Elevation: <u>17.6 ft.</u>	Easting: <u>1,276,589 ft.</u>	Drilling Company: <u>Holt Services</u>	Rod Diam.: <u>NWJ</u>
Vert. Datum: <u>NAVD 88</u>	Station: <u>N/A</u>	Drill Rig Equipment: <u>Truck Mobile Drill B57</u>	Hammer Type: <u>Automatic</u>
Horiz. Datum: <u>WA-N NAD83/11</u>	Offset: <u>N/A</u>	Other Comments: <u>Ecology well tag ID BMP454</u>	

SOIL DESCRIPTION
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

Asphalt slab.

Medium dense, dark brown to red brown, *Silty Sand (SM)*; moist; fine to medium sand; homogeneous.

Soft, dark gray, *Sandy Silt (ML)*; moist; fine sand; trace wood organics.

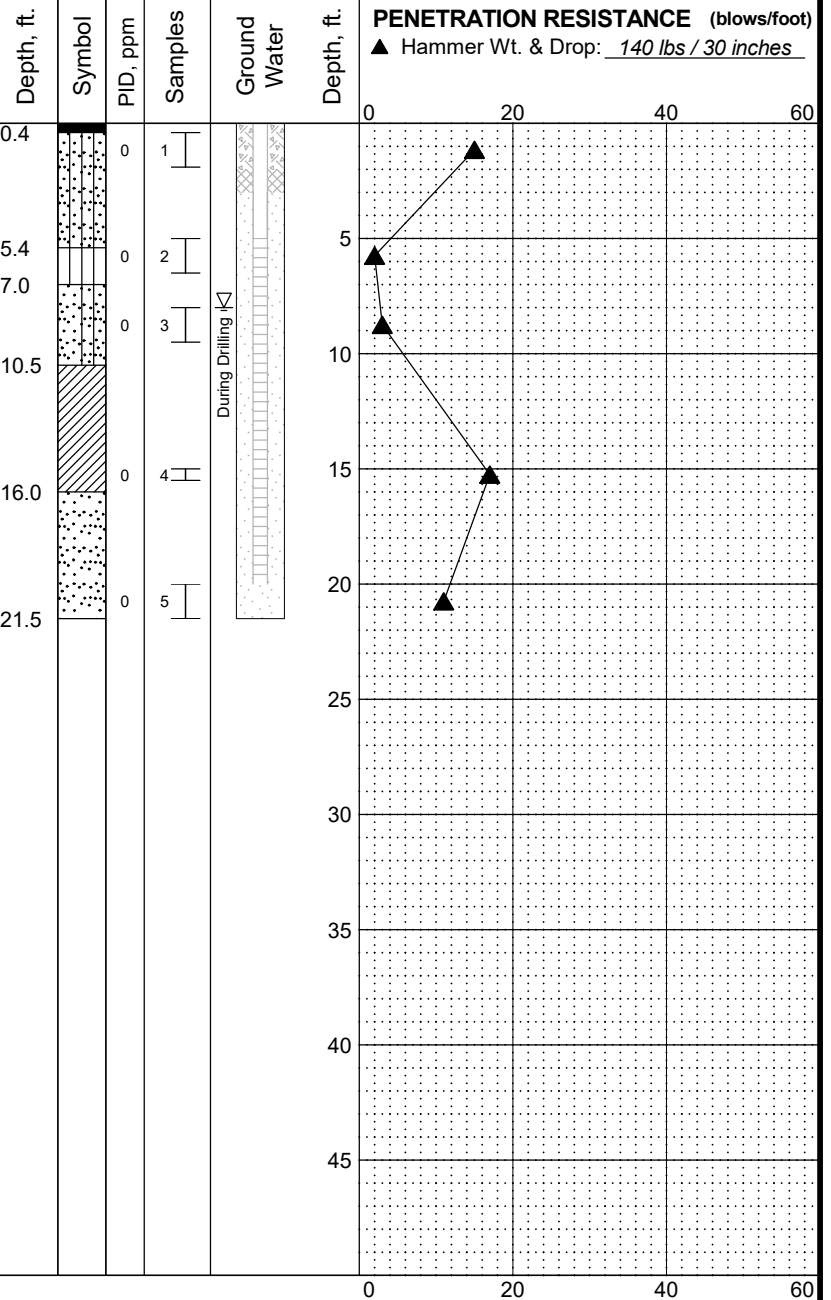
Very loose, dark gray, *Poorly Graded Sand with Silt (SP-SM)*; wet; fine to medium sand.

Very stiff, dark gray, *Lean Clay (CL)*; wet; homogeneous.

Medium dense, dark gray, *Poorly Graded Sand (SP)*; wet; fine to coarse sand; trace silt.

BOTTOM OF BORING COMPLETED 2/2/2021

Well casing is 2-inch PVC. The well cover is metal and is flush with the ground surface.



- LEGEND**
- | | | |
|---------------------------------|--|-----------------------------|
| * Sample Not Recovered | | Well Screen and Sand Filter |
| E Environmental Sample Obtained | | Bentonite-Cement Grout |
| ┳ 2.0" O.D. Split Spoon Sample | | Bentonite Chips/Pellets |
| | | Bentonite Grout |
| | | Ground Water Level ATD |

- NOTES**
- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
 - Groundwater level, if indicated above, is for the date specified and may vary.
 - USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-56

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FIG. C-10

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: CTC Rev: JXS Typ: LKN

Total Depth: 21.5 ft. Northing: 195,556 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 10 in.
Top Elevation: 17.4 ft. Easting: 1,276,842 ft. Drilling Company: Holt Services Rod Diam.: NWJ
Vert. Datum: NAVD 88 Station: N/A Drill Rig Equipment: Truck Mobile Drill B57 Hammer Type: Automatic
Horiz. Datum: WA-N NAD83/11 Offset: N/A Other Comments: Ecology well tag ID BMP462.

SOIL DESCRIPTION
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

Concrete slab.

Medium stiff, gray-brown, *Silt to Clay (ML/CL)*; moist; petroleum odor; some fine to medium sand from 4.5 to 4.6 feet.

Loose, brown to dark brownish gray, *Sand with Silt (SP-SM)*; moist; fine to medium sand.

Gray-brown, *Silty Sand (SM)*; wet; petroleum odor.

Medium stiff, gray-brown, *Clay (CL)*; moist to wet; petroleum odor; trace black organics throughout.

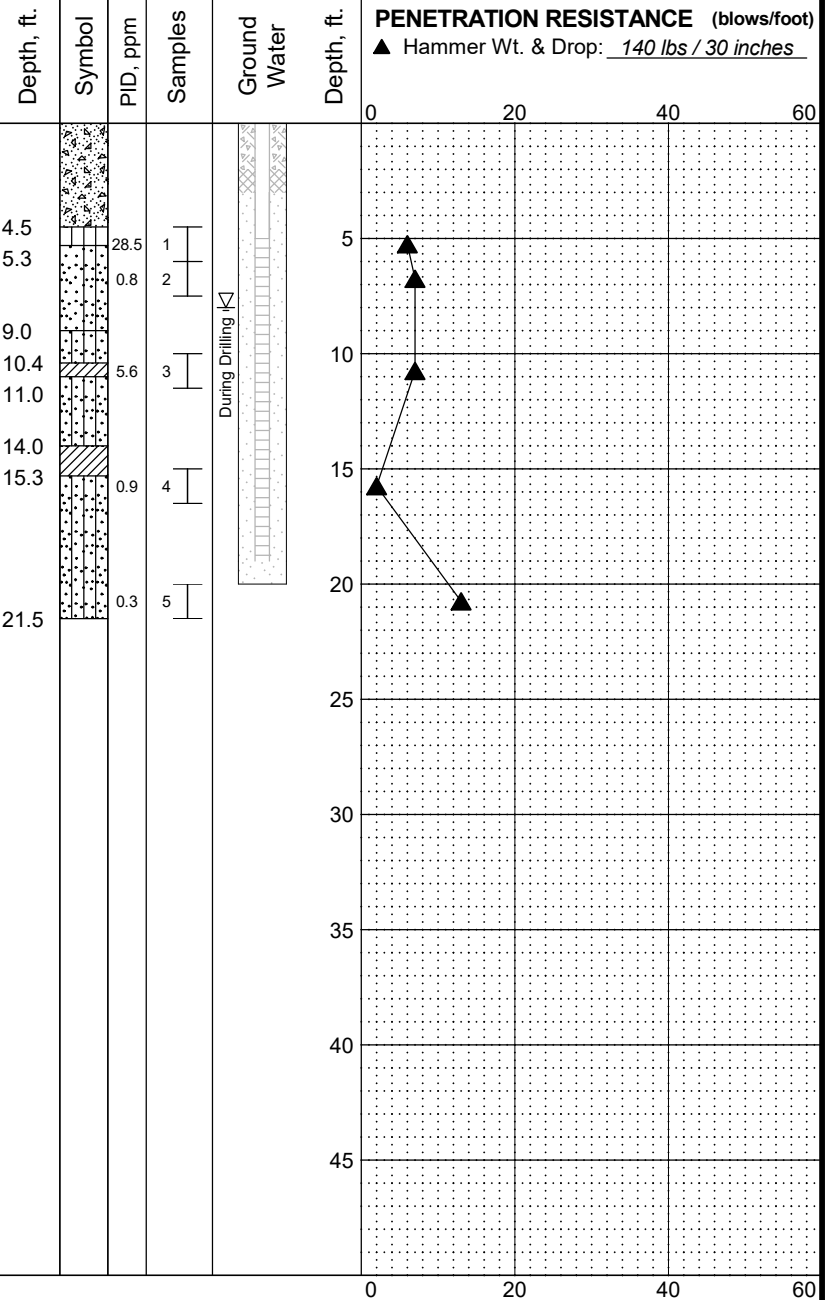
Gray-brown, *Silty Sand (SM)*; moist; homogeneous.

Soft, gray-brown, *Sandy Clay (CL)*; wet; fine sand; trace black organics throughout.

Very stiff, gray-brown, *Silty Sand (SM)*; wet; 2-inch-thick *Sandy Silt (ML)* layer at 20.9 feet.

BOTTOM OF BORING
COMPLETED 1/27/2021

Well casing is 2-inch PVC. The well cover is metal and is flush with the ground surface.



LEGEND

- * Sample Not Recovered
- E Environmental Sample Obtained
- 2.0" O.D. Split Spoon Sample
- Well Screen and Sand Filter
- Bentonite-Cement Grout
- Bentonite Chips/Pellets
- Bentonite Grout
- Ground Water Level ATD

- ◇ % Fines (<0.075mm)
- % Water Content

NOTES

- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-57

June 2022

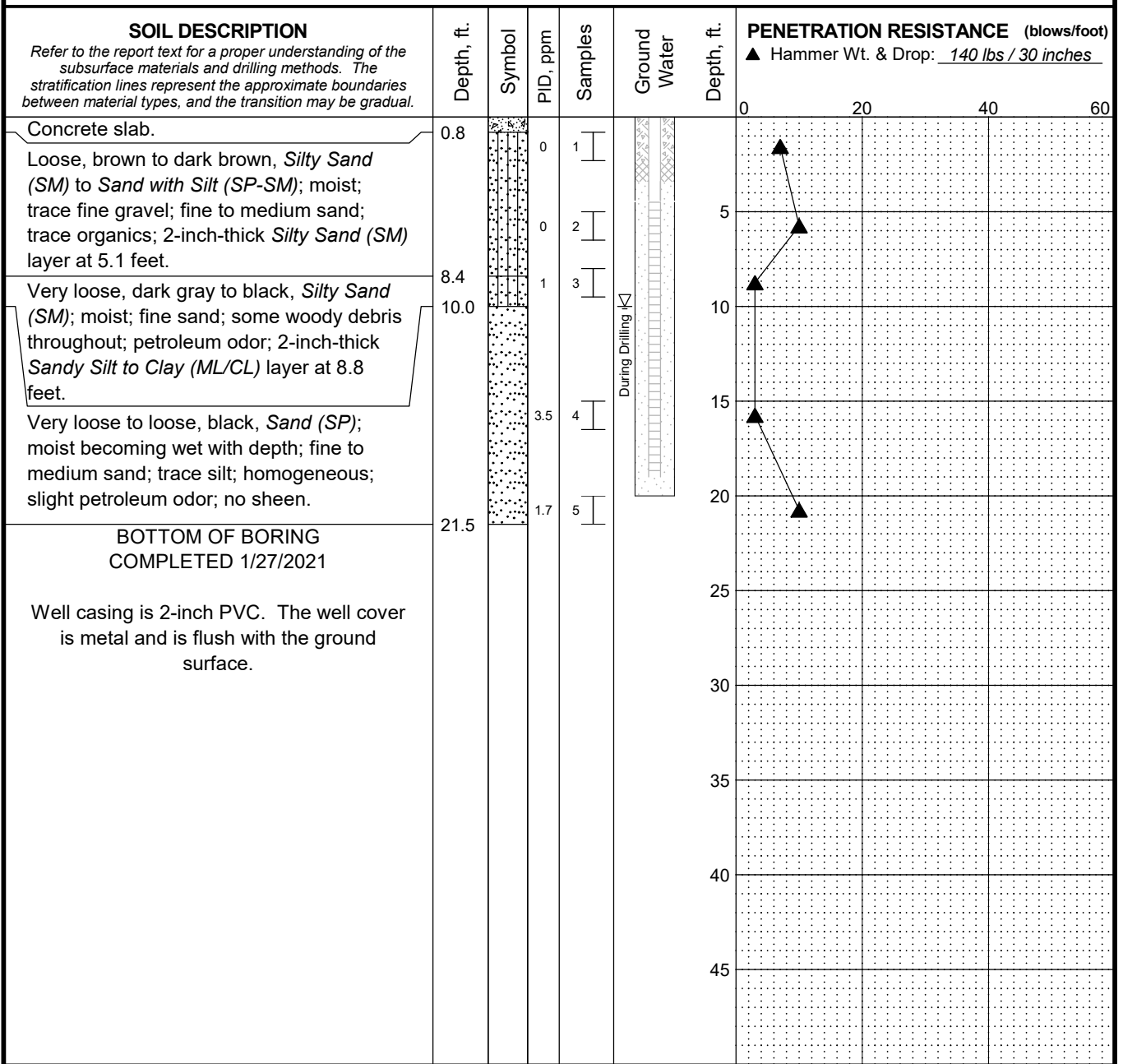
21-1-12596-030

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FIG. C-11

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: MRH Rev: JXS Typ: LKN

Total Depth: 21.5 ft. Northing: 195,665 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 10 in.
 Top Elevation: 17.7 ft. Easting: 1,277,031 ft. Drilling Company: Holt Services Rod Diam.: NWJ
 Vert. Datum: NAVD 88 Station: N/A Drill Rig Equipment: Truck Mobile Drill B57 Hammer Type: Automatic
 Horiz. Datum: WA-N NAD83/11 Offset: N/A Other Comments: Ecology well tag ID BMP463.



- LEGEND**
- * Sample Not Recovered
 - E Environmental Sample Obtained
 - ┌ 2.0" O.D. Split Spoon Sample
 - Well Screen and Sand Filter
 - Bentonite-Cement Grout
 - Bentonite Chips/Pellets
 - Bentonite Grout
 - Ground Water Level ATD
 - ◇ % Fines (<0.075mm)
 - % Water Content

- NOTES**
- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
 - Groundwater level, if indicated above, is for the date specified and may vary.
 - USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-58

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FIG. C-12

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: MRH Rev: JXS Typ: LKN

Total Depth: 21.5 ft. Northing: 195,767 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 10 in.
 Top Elevation: 17.6 ft. Easting: 1,276,929 ft. Drilling Company: Holt Services Rod Diam.: NWJ
 Vert. Datum: NAVD 88 Station: N/A Drill Rig Equipment: Truck Mobile Drill B57 Hammer Type: Automatic
 Horiz. Datum: WA-N NAD83/11 Offset: N/A Other Comments: Ecology well tag ID BMP090.

SOIL DESCRIPTION
 Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

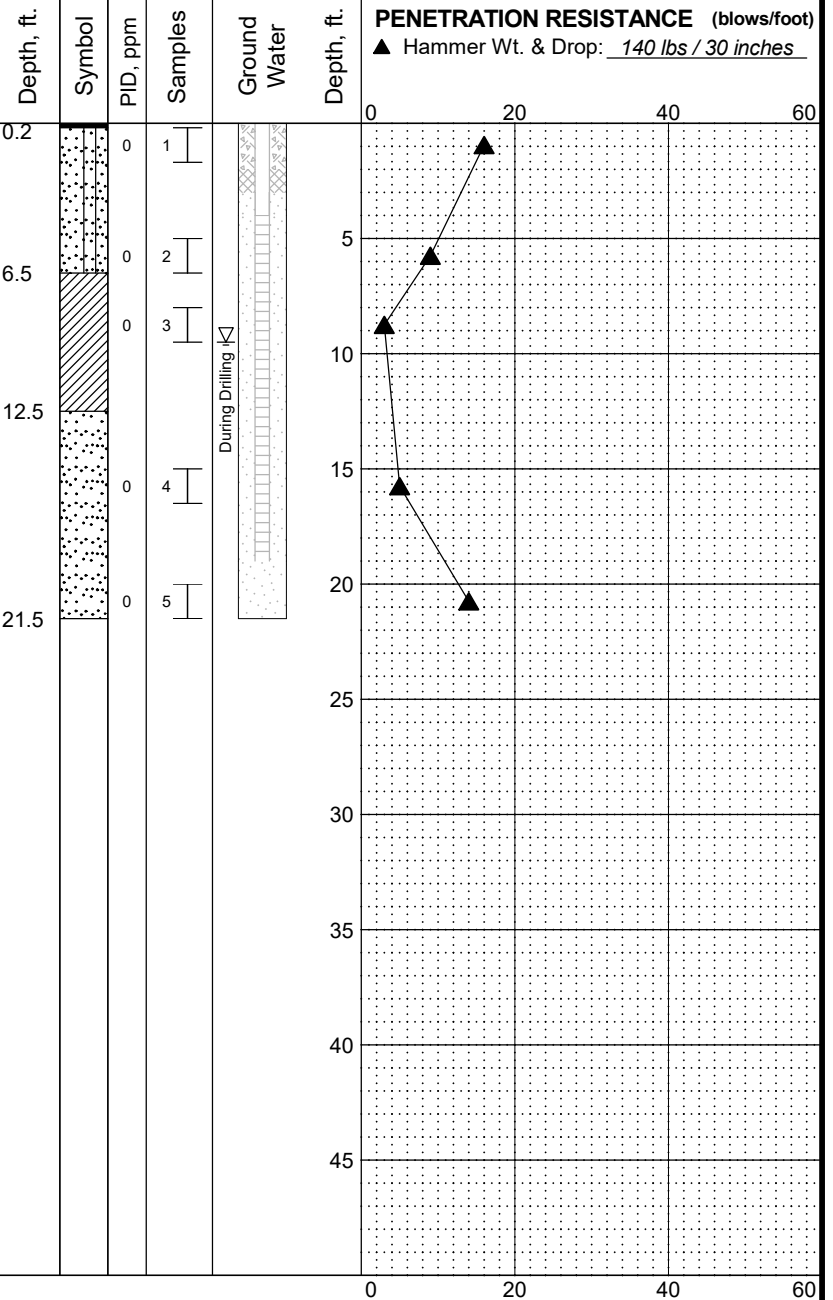
Asphalt slab.
 Medium dense, dark brown, *Poorly Graded Sand with Silt (SP-SM)*; moist; black staining at 1 foot; fine to medium sand.

Soft, olive-brown, *Lean Clay with Sand (CL)*; moist to wet; fine sand; some iron oxide staining.

Loose to medium dense, dark gray, *Poorly Graded Sand (SP)*; wet; fine to medium sand; homogeneous.

BOTTOM OF BORING COMPLETED 2/3/2021

Well casing is 2-inch PVC. The well cover is metal and is flush with the ground surface.



LEGEND

* Sample Not Recovered	Well Screen and Sand Filter
E Environmental Sample Obtained	Bentonite-Cement Grout
┳ 2.0" O.D. Split Spoon Sample	Bentonite Chips/Pellets
	Bentonite Grout
	Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-59

June 2022 21-1-12596-030

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FIG. C-13

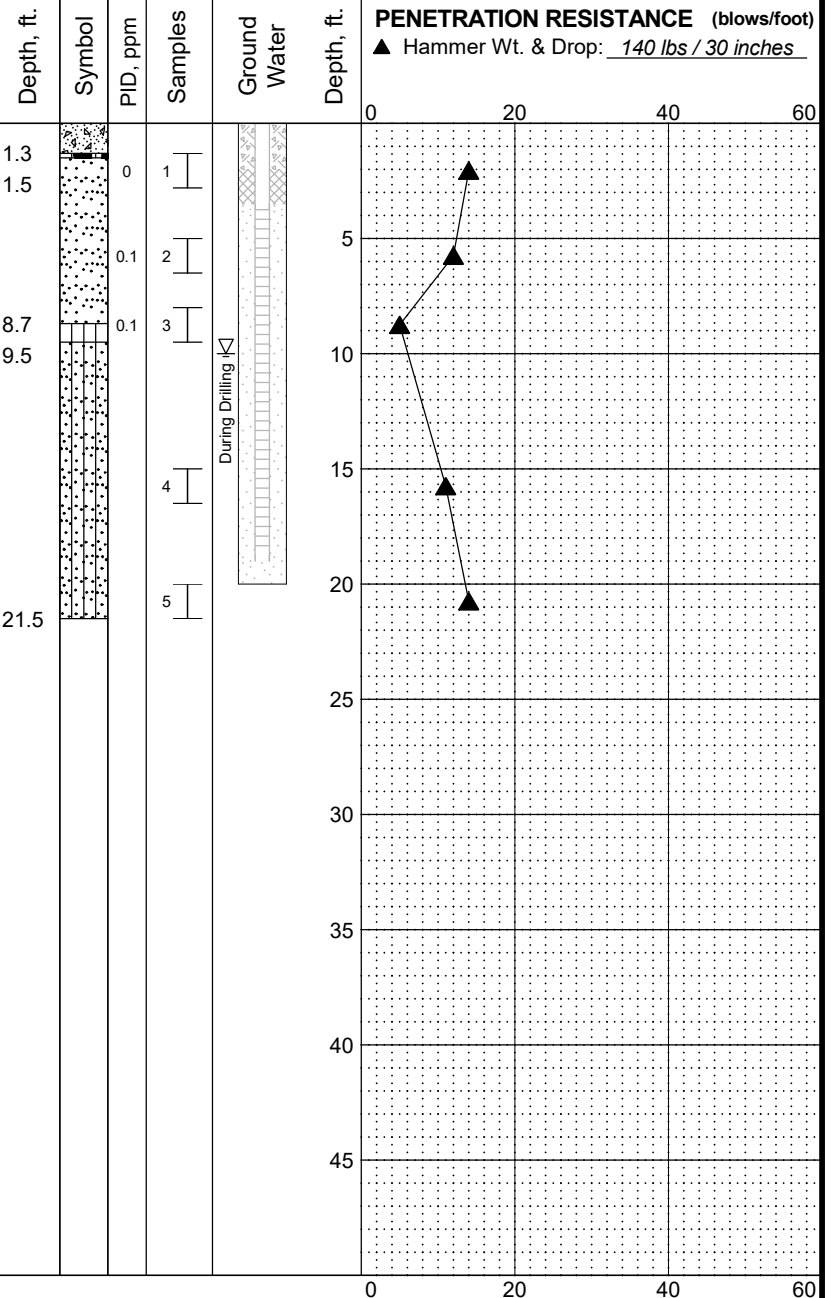
MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: CTC Rev: JXS Typ: LKN

Total Depth: 21.5 ft. Northing: 195,280 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 10 in.
 Top Elevation: 17.3 ft. Easting: 1,276,878 ft. Drilling Company: Holt Services Rod Diam.: NWJ
 Vert. Datum: NAVD 88 Station: N/A Drill Rig Equipment: Truck Mobile Drill B57 Hammer Type: Automatic
 Horiz. Datum: WA-N NAD83/11 Offset: N/A Other Comments: Ecology well tag ID BMP457.

SOIL DESCRIPTION
 Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

Concrete slab.
 Dark brown, *Silty Gravel with Sand (GM)*; moist; rounded to subangular gravel less than 0.5 inch; predominantly fine to coarse sand.
 Brown, *Poorly Graded Sand (SP)*; moist; predominantly fine to medium sand.
 - 2-inch-thick silk lens at 5.1 feet.
 Gray to dark gray *Sandy Silt (ML)*; moist; iron oxide staining at 8.7 feet.
 Gray to dark gray to black, *Silty Sand (SM)*; wet; predominantly fine to medium sand; trace silt.

BOTTOM OF BORING COMPLETED 2/1/2021
 Well casing is 2-inch PVC. The well cover is metal and is flush with the ground surface.



LEGEND

* Sample Not Recovered	Well Screen and Sand Filter	◇ % Fines (<0.075mm)
E Environmental Sample Obtained	Bentonite-Cement Grout	● % Water Content
┳ 2.0" O.D. Split Spoon Sample	Bentonite Chips/Pellets	
	Bentonite Grout	
	Ground Water Level ATD	

NOTES

- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-60

June 2022

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FIG. C-14

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: RBP Rev: JXS Typ: LKN

Total Depth: 21.5 ft. Northing: 195,310 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 10 in.
 Top Elevation: 17.6 ft. Easting: 1,276,946 ft. Drilling Company: Holt Services Rod Diam.: NWJ
 Vert. Datum: NAVD 88 Station: N/A Drill Rig Equipment: Truck Mobile Drill B57 Hammer Type: Automatic
 Horiz. Datum: WA-N NAD83/11 Offset: N/A Other Comments: Ecology well tag ID BMP456.

SOIL DESCRIPTION
 Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

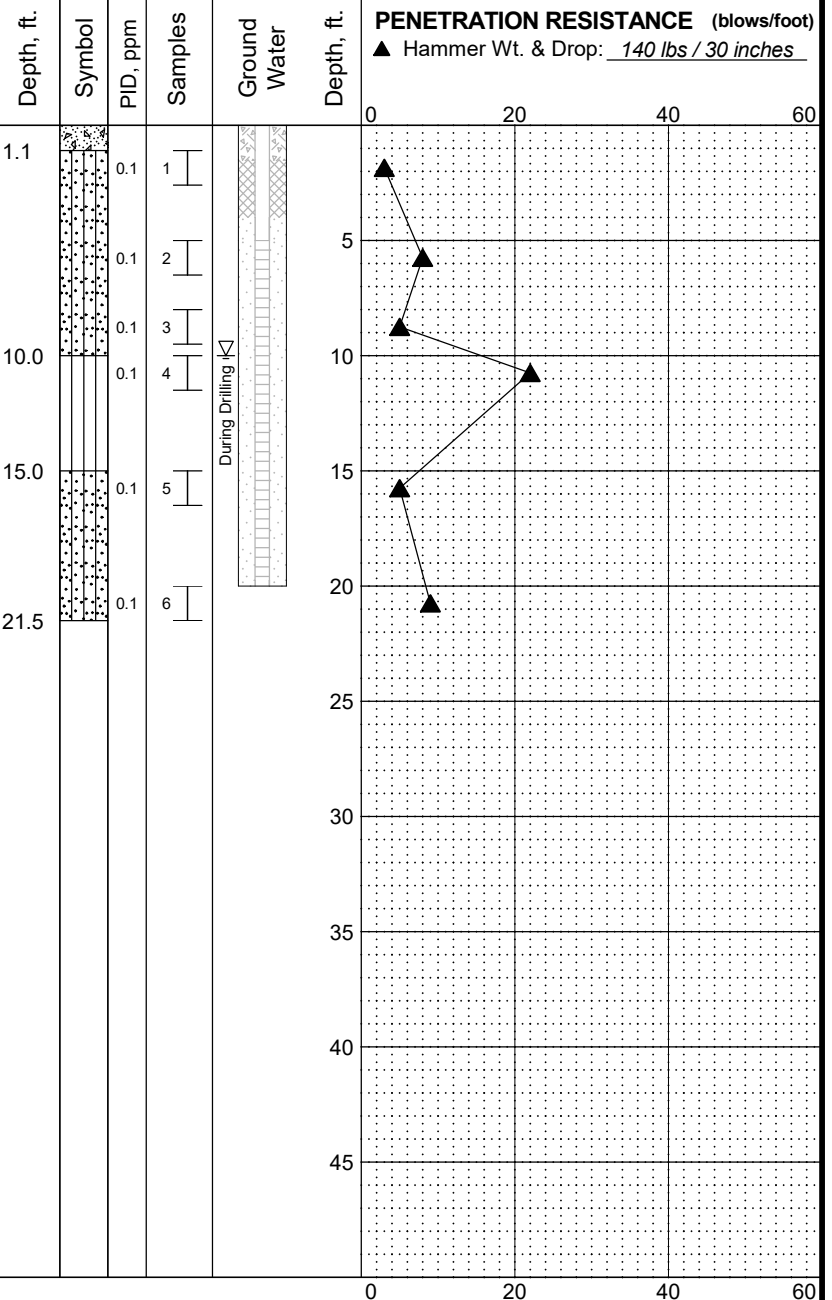
Concrete slab.
 - Pieces of red brick at 1.1 feet.
 Brown to dark brown, *Silty Sand (SM)* to *Poorly Graded Sand (SP)*; moist;
 predominantly fine to medium sand.
 - Wood piece at 5.2 feet.

Gray to dark gray *Sandy Silt (ML)*; moist;
 some black discolorations; sampling spoon wet at 10 feet and deeper.

Gray to dark gray, *Silty Sand (SM)*; wet;
 predominantly fine to medium sand,
 decreasing silt content with depth.

**BOTTOM OF BORING
 COMPLETED 2/1/2021**

Well casing is 2-inch PVC. The well cover
 is metal and is flush with the ground
 surface.



- LEGEND**
- * Sample Not Recovered
 - E Environmental Sample Obtained
 - 2.0" O.D. Split Spoon Sample
 - Well Screen and Sand Filter
 - Bentonite-Cement Grout
 - Bentonite Chips/Pellets
 - Bentonite Grout
 - Ground Water Level ATD
 - % Fines (<0.075mm)
 - % Water Content

- NOTES**
- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
 - Groundwater level, if indicated above, is for the date specified and may vary.
 - USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-61

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FIG. C-15

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: RBP Rev: JXS Typ: LKN

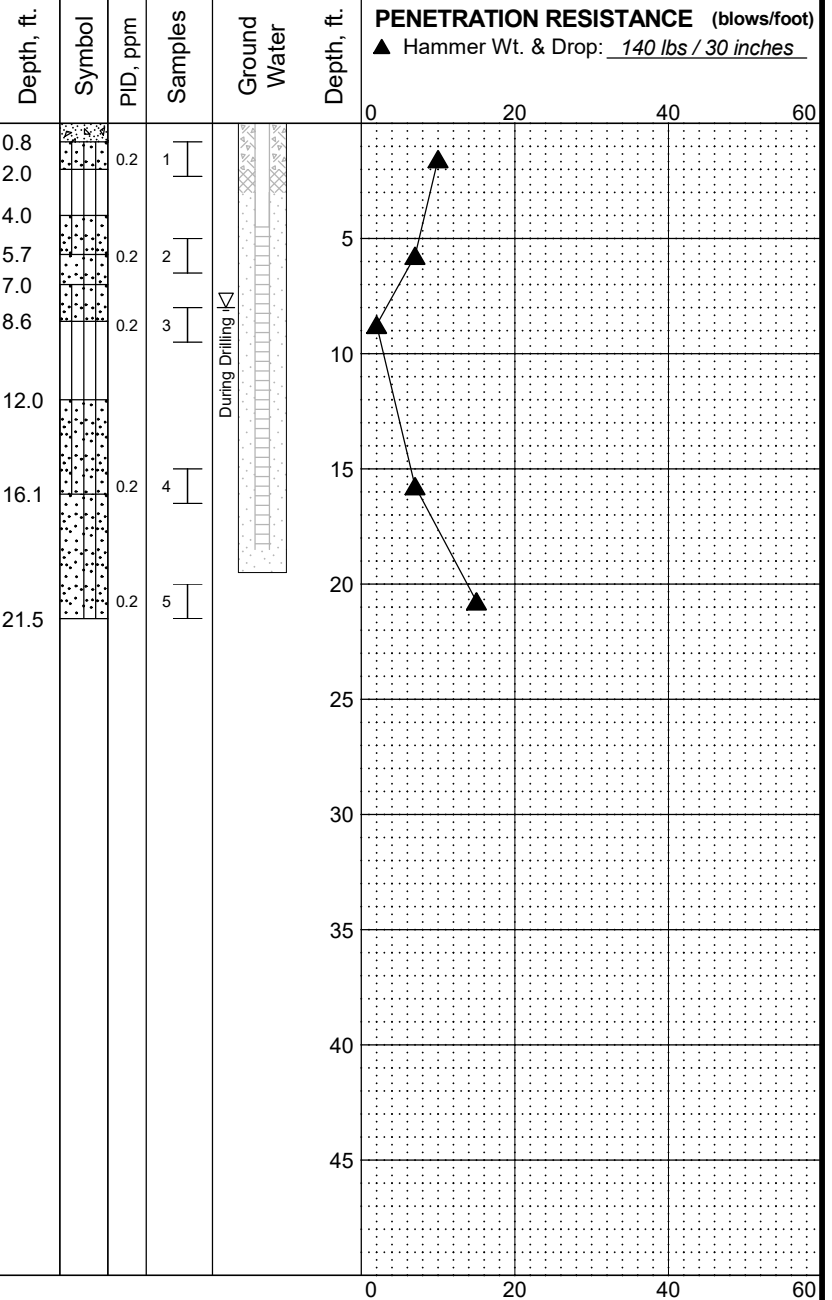
Total Depth: 21.5 ft. Northing: ~ 195,445 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 10 in.
 Top Elevation: ~ 17.47 ft. Easting: ~ 1,276,950 ft. Drilling Company: Holt Services Rod Diam.: NWJ
 Vert. Datum: NAVD 88 Station: ~ N/A Drill Rig Equipment: Truck Mobile Drill B57 Hammer Type: Automatic
 Horiz. Datum: WA-N NAD83/11 Offset: ~ N/A Other Comments: Ecology well tag ID BMP461.

SOIL DESCRIPTION
 Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

Concrete slab.
 Loose, brown, *Silty Sand (SM)*; moist; fine to medium sand; trace fine gravel; trace iron oxide staining.
 Gray to dark gray, *Silt (ML)*; moist; trace black organics throughout.
 Brown, *Silty Sand (SM)*; moist; fine to medium sand; trace coarse sand; 1-inch-thick *Silt (ML)* layer at 5.5 feet.
 Loose, brown, *Sand with Silt (SP-SM)*; moist to wet.
 Brown, *Silty Sand (SM)*; wet; fine sand.
 Soft, gray, *Sandy Silt (ML)*; moist to wet; fine sand.
 Loose, gray to dark gray, *Silty Sand (SM)*; wet; fine sand.
 Medium dense, gray, *Sand with Silt (SP-SM)*; wet; fine to medium sand; homogeneous.

BOTTOM OF BORING
 COMPLETED 1/28/2021

Well casing is 2-inch PVC. The well cover is metal and is flush with the ground surface.



- * Sample Not Recovered
- E Environmental Sample Obtained
- ┤ 2.0" O.D. Split Spoon Sample

LEGEND

- Well Screen and Sand Filter
- Bentonite-Cement Grout
- Bentonite Chips/Pellets
- Bentonite Grout
- Ground Water Level ATD

- ◇ % Fines (<0.075mm)
- % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

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LOG OF BORING MW-62

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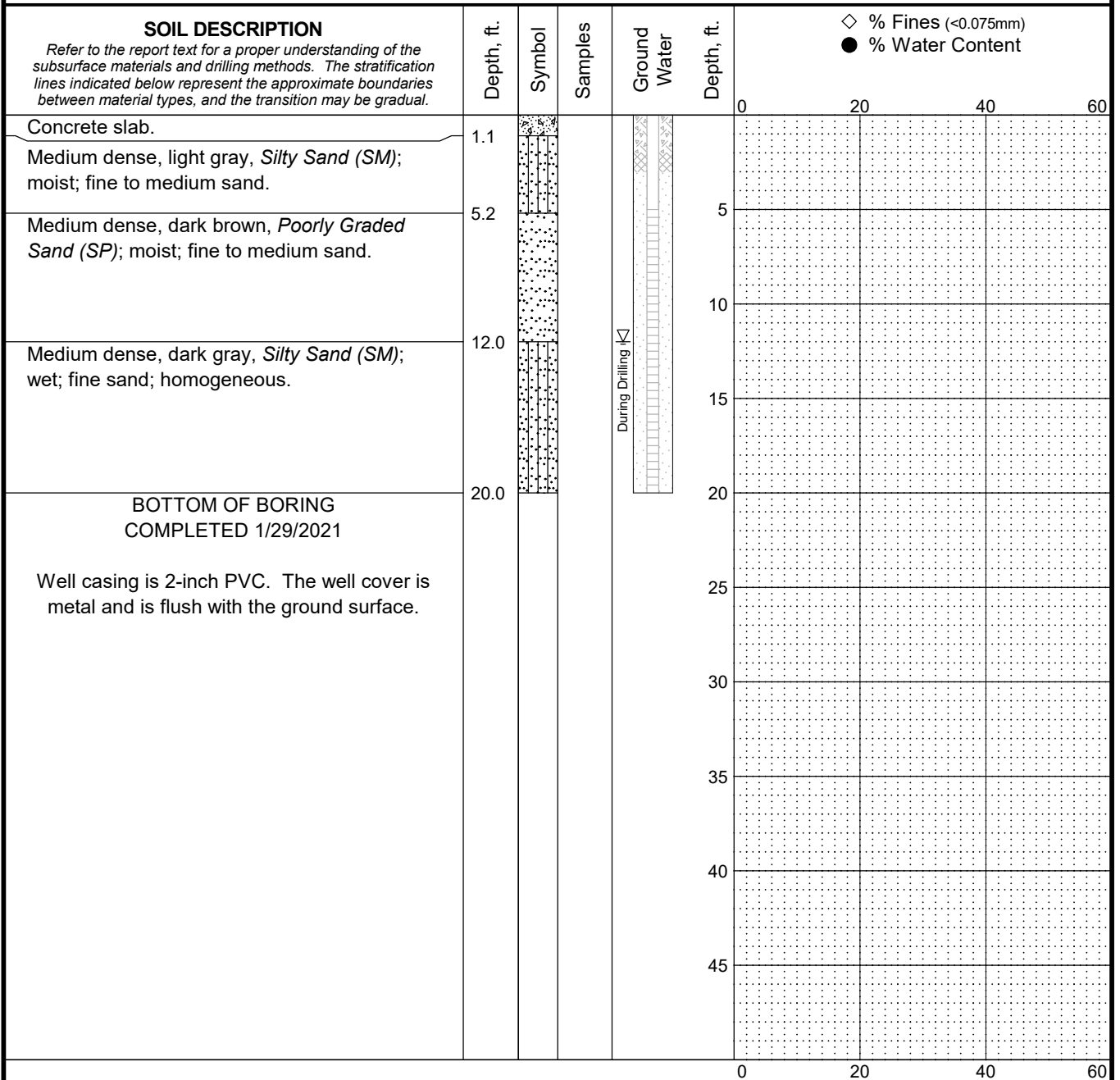
21-1-12596-030

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FIG. C-16

Log: MRH Rev: JXS Typ: LKN
 MASTER LOG E 21-12596.GPJ SHAN WIL.GDT 5/17/22

Total Depth: <u>20 ft.</u>	Northing: <u>195,290 ft.</u>	Drilling Method: <u>Hollow Stem Auger</u>	Hole Diam.: <u>10 in.</u>
Top Elevation: <u>17.5 ft.</u>	Easting: <u>1,276,704 ft.</u>	Drilling Company: <u>Holt Services</u>	Rod Diam.: <u>NWJ</u>
Vert. Datum: <u>NAVD 88</u>	Station: <u>N/A</u>	Drill Rig Equipment: <u>Truck Mobile Drill B57</u>	Hammer Type: <u>Automatic</u>
Horiz. Datum: <u>WA-N NAD83/11</u>	Offset: <u>N/A</u>	Other Comments: <u>Ecology well tag ID BMP458.</u>	



- LEGEND**
- * Sample Not Recovered
 - Well Screen and Sand Filter
 - Bentonite-Cement Grout
 - Bentonite Chips/Pellets
 - Bentonite Grout
 - Ground Water Level ATD

- NOTES**
- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
 - Groundwater level, if indicated above, is for the date specified and may vary.
 - USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-63

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FIG. C-17

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: CTC Rev: JXS Typ: LKN

Total Depth:	<u>61.5 ft.</u>	Northing:	<u>195,286 ft.</u>	Drilling Method:	<u>Hollow Stem Auger</u>	Hole Diam.:	<u>10 in.</u>
Top Elevation:	<u>17.4 ft.</u>	Easting:	<u>1,276,710 ft.</u>	Drilling Company:	<u>Holt Services</u>	Rod Diam.:	<u>NWJ</u>
Vert. Datum:	<u>NAVD 88</u>	Station:	<u>N/A</u>	Drill Rig Equipment:	<u>Truck Mobile Drill B57</u>	Hammer Type:	<u>Automatic</u>
Horiz. Datum:	<u>WA-N NAD83/11</u>	Offset:	<u>N/A</u>	Other Comments:	<u>Ecology well tag ID BMP459.</u>		

SOIL DESCRIPTION				Depth, ft.	Symbol	PID, ppm	Samples	Ground Water	Depth, ft.	PENETRATION RESISTANCE (blows/foot)	
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.										▲ Hammer Wt. & Drop: <u>140 lbs / 30 inches</u>	
Concrete slab.				1.1		0	1			0	20
Medium dense, light gray <i>Silty Sand (SM)</i> ; moist; fine to medium sand, trace fine gravel.				5.2		0	2			5	20
Medium dense, dark brown to red brown, <i>Poorly Graded Sand (SP)</i> ; moist; fine to medium sand, little to trace silt decreasing with depth.				12.0		0	3			10	20
Medium dense, dark gray, <i>Silty Sand (SM)</i> ; wet; fine sand; homogeneous.				25.0		0	4			15	20
						0	5			20	20
Medium dense, dark gray, <i>Poorly Graded Sand with Silt (SP-SM)</i> ; wet; fine sand.						0	6			25	20
						0	7			30	20
						0	8			35	20
						0	9			40	20
						0				45	20

CONTINUED NEXT SHEET

LEGEND

- | | | | |
|---|-------------------------------|---|-----------------------------|
| * | Sample Not Recovered |  | Well Screen and Sand Filter |
| E | Environmental Sample Obtained |  | Bentonite-Cement Grout |
| I | 2.0" O.D. Split Spoon Sample |  | Bentonite Chips/Pellets |
| | |  | Bentonite Grout |
| | |  | Ground Water Level ATD |

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF BORING MW-64

June 2022

21-1-12596-030

SHANNON & WILSON, INC.
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FIG. C-18
Sheet 1 of 2

Total Depth: <u>61.5 ft.</u>	Northing: <u>195,286 ft.</u>	Drilling Method: <u>Hollow Stem Auger</u>	Hole Diam.: <u>10 in.</u>
Top Elevation: <u>17.4 ft.</u>	Easting: <u>1,276,710 ft.</u>	Drilling Company: <u>Holt Services</u>	Rod Diam.: <u>NWJ</u>
Vert. Datum: <u>NAVD 88</u>	Station: <u>N/A</u>	Drill Rig Equipment: <u>Truck Mobile Drill B57</u>	Hammer Type: <u>Automatic</u>
Horiz. Datum: <u>WA-N NAD83/11</u>	Offset: <u>N/A</u>	Other Comments: <u>Ecology well tag ID BMP459.</u>	

SOIL DESCRIPTION
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

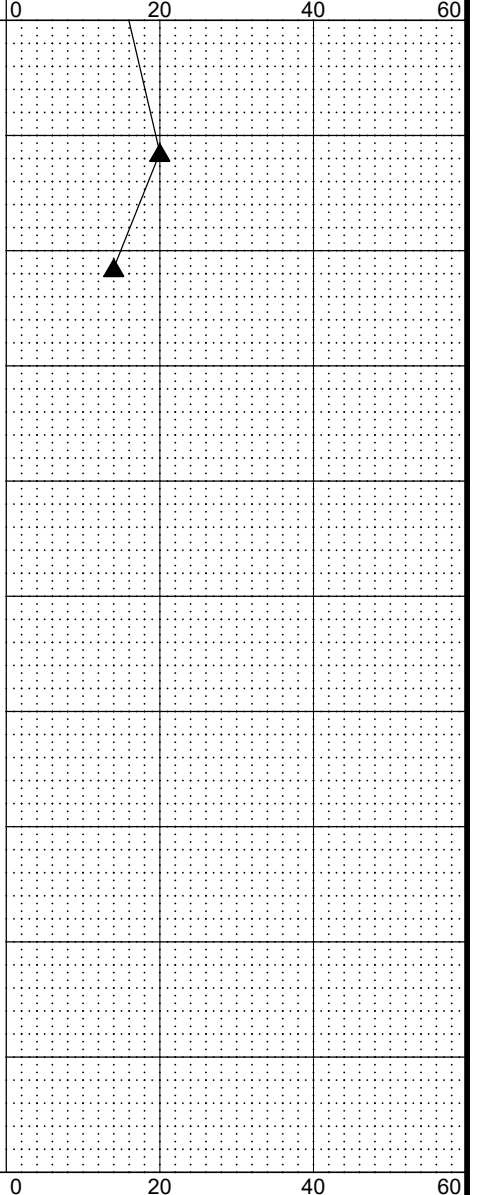
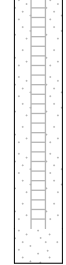
Depth, ft.
Symbol
PID, ppm
Samples

Ground Water
Depth, ft.

PENETRATION RESISTANCE (blows/foot)
▲ Hammer Wt. & Drop: 140 lbs / 30 inches

Medium dense, dark gray, *Silty Sand (SM)*; wet; fine sand.
Medium dense, dark gray to dark brown, *Poorly Graded Sand with Silt (SP-SM)*; wet; fine sand.

55.0
57.0
61.5



BOTTOM OF BORING COMPLETED 1/29/2021
Well casing is 2-inch PVC. The well cover is metal and is flush with the ground surface.

LEGEND

- | | | |
|---------------------------------|--|-----------------------------|
| * Sample Not Recovered | | Well Screen and Sand Filter |
| E Environmental Sample Obtained | | Bentonite-Cement Grout |
| ┳ 2.0" O.D. Split Spoon Sample | | Bentonite Chips/Pellets |
| | | Bentonite Grout |
| | | Ground Water Level ATD |

- ◇ % Fines (<0.075mm)
● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-64

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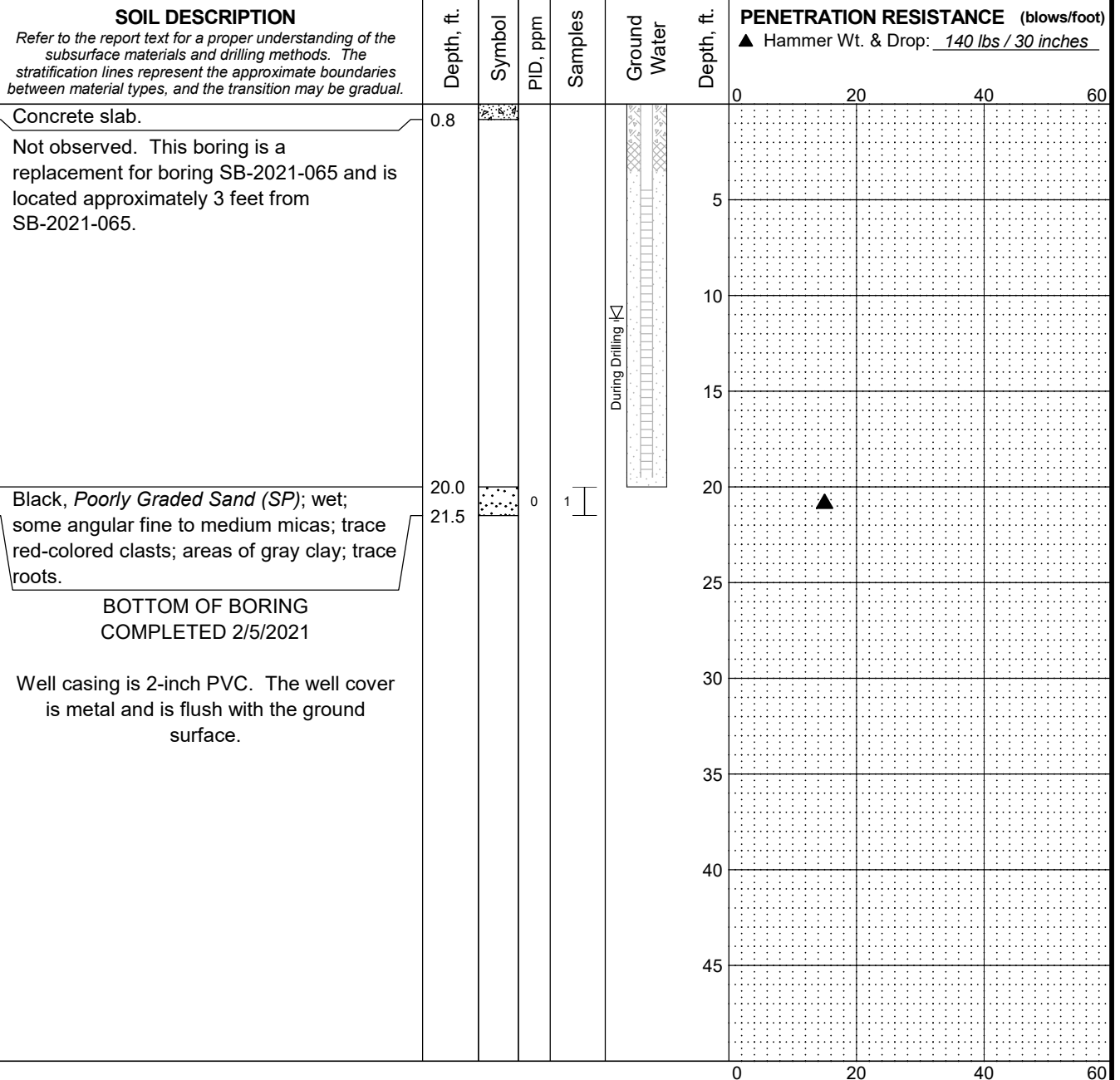
21-1-12596-030

SHANNON & WILSON, INC.
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FIG. C-18
Sheet 2 of 2

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: CTC Rev: JXS Typ: LKN

Total Depth: 21.5 ft. Northing: 195,563 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 10 in.
 Top Elevation: 17.8 ft. Easting: 1,276,218 ft. Drilling Company: Holt Services Rod Diam.: NWJ
 Vert. Datum: NAVD 88 Station: N/A Drill Rig Equipment: Truck Mobile Drill B57 Hammer Type: Automatic
 Horiz. Datum: WA-N NAD83/11 Offset: N/A Other Comments: Ecology well tag ID BMP096.



- LEGEND**
- | | | | | |
|---------------------------------|--|-----------------------------|--|--------------------|
| * Sample Not Recovered | | Well Screen and Sand Filter | | % Fines (<0.075mm) |
| E Environmental Sample Obtained | | Bentonite-Cement Grout | | % Water Content |
| 2.0" O.D. Split Spoon Sample | | Bentonite Chips/Pellets | | |
| | | Bentonite Grout | | |
| | | Ground Water Level ATD | | |

- NOTES**
- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
 - Groundwater level, if indicated above, is for the date specified and may vary.
 - USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-65

June 2022

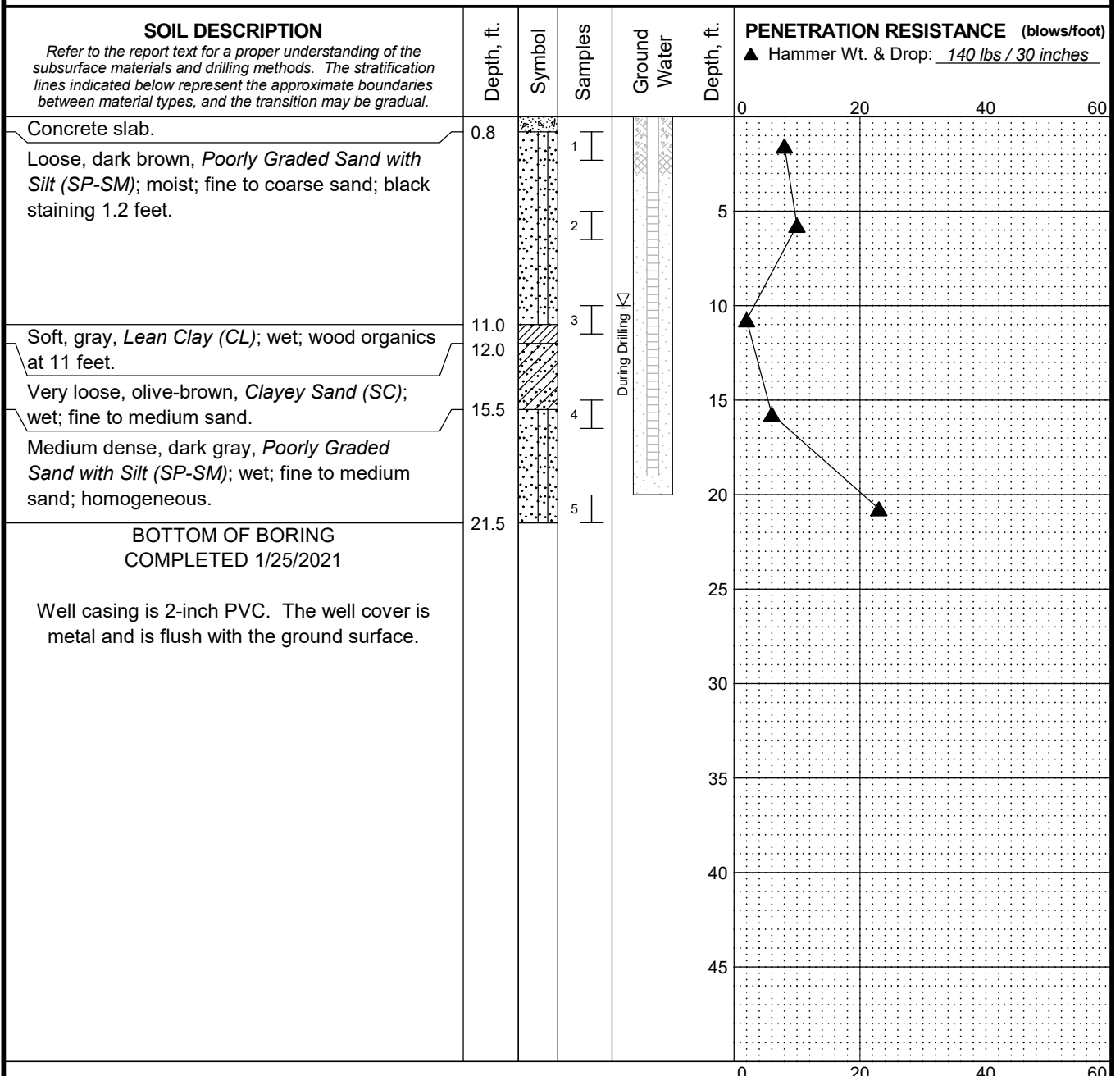
21-1-12596-030

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FIG. C-19

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: RBP Rev: JXS Typ: LKN

Total Depth: <u>21.5 ft.</u>	Northing: <u>195,725 ft.</u>	Drilling Method: <u>Hollow Stem Auger</u>	Hole Diam.: <u>10 in.</u>
Top Elevation: <u>17.9 ft.</u>	Easting: <u>1,276,210 ft.</u>	Drilling Company: <u>Holt Services</u>	Rod Diam.: <u>NWJ</u>
Vert. Datum: <u>NAVD 88</u>	Station: <u>N/A</u>	Drill Rig Equipment: <u>Truck Mobile Drill B57</u>	Hammer Type: <u>Automatic</u>
Horiz. Datum: <u>WA-N NAD83/11</u>	Offset: <u>N/A</u>	Other Comments: <u>Ecology well tag ID BMP466.</u>	



LEGEND * Sample Not Recovered E Environmental Sample Obtained I 2.0" O.D. Split Spoon Sample		Well Screen and Sand Filter Bentonite-Cement Grout Bentonite Chips/Pellets Bentonite Grout Ground Water Level ATD	◇ % Fines (<0.075mm) ● % Water Content
--	--	---	---

- NOTES**
- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
 - Groundwater level, if indicated above, is for the date specified and may vary.
 - USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-66

June 2022

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FIG. C-20

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: CTC Rev: JXS Typ: LKN

Total Depth: 21.5 ft. Northing: 195,152 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 10 in.
 Top Elevation: 17.0 ft. Easting: 1,276,194 ft. Drilling Company: Holt Services Rod Diam.: NWJ
 Vert. Datum: NAVD 88 Station: N/A Drill Rig Equipment: Truck Mobile Drill B57 Hammer Type: Automatic
 Horiz. Datum: WA-N NAD83/11 Offset: N/A Other Comments: Ecology well tag ID BMP464

SOIL DESCRIPTION
 Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

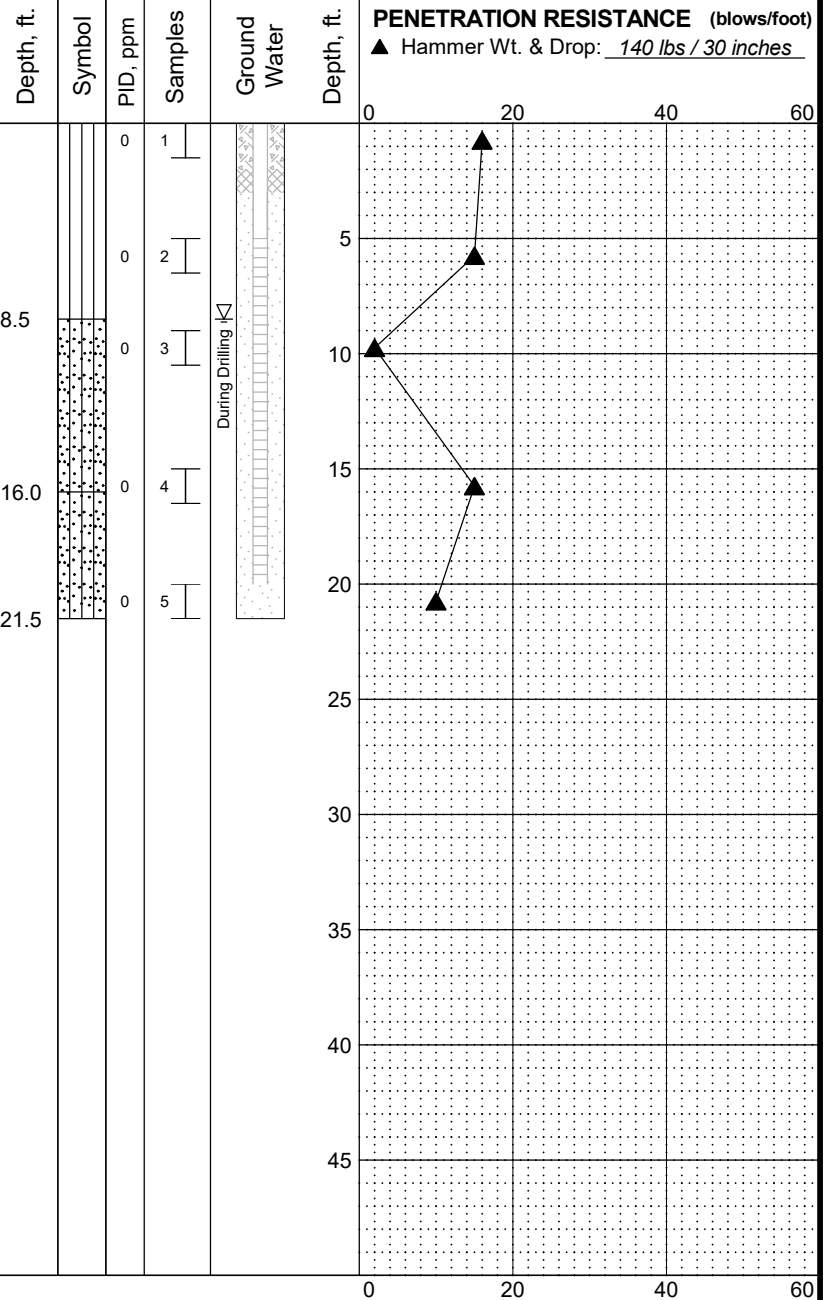
Medium dense, dark brown, *Silt with Sand (ML)*; moist; fine sand; trace fine gravel.

Soft, dark to very dark gray, *Silty Sand (SM)*; wet; predominantly fine sand; homogeneous soil texture.

Medium dense, dark gray, *Silty Sand (SM)*; wet; fine to medium sand; homogeneous soil texture.

BOTTOM OF BORING COMPLETED 1/26/2021

Well casing is 2-inch PVC. The well cover is metal and is flush with the ground surface.



- * Sample Not Recovered
- E Environmental Sample Obtained
- ┤ 2.0" O.D. Split Spoon Sample

- LEGEND**
- Well Screen and Sand Filter
 - Bentonite-Cement Grout
 - Bentonite Chips/Pellets
 - Bentonite Grout
 - Ground Water Level ATD

- ◇ % Fines (<0.075mm)
- % Water Content

NOTES

- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-67

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FIG. C-21

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: CTC Rev: JXS Typ: LKN

Total Depth: <u>21.5 ft.</u>	Northing: <u>195,173 ft.</u>	Drilling Method: <u>Hollow Stem Auger</u>	Hole Diam.: <u>10 in.</u>
Top Elevation: <u>17.9 ft.</u>	Easting: <u>1,276,075 ft.</u>	Drilling Company: <u>Holt Services</u>	Rod Diam.: <u>NWJ</u>
Vert. Datum: <u>NAVD 88</u>	Station: <u>N/A</u>	Drill Rig Equipment: <u>Truck Mobile Drill B57</u>	Hammer Type: <u>Automatic</u>
Horiz. Datum: <u>WA-N NAD83/11</u>	Offset: <u>N/A</u>	Other Comments: <u>Ecology well tag ID BMP455.</u>	

SOIL DESCRIPTION
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

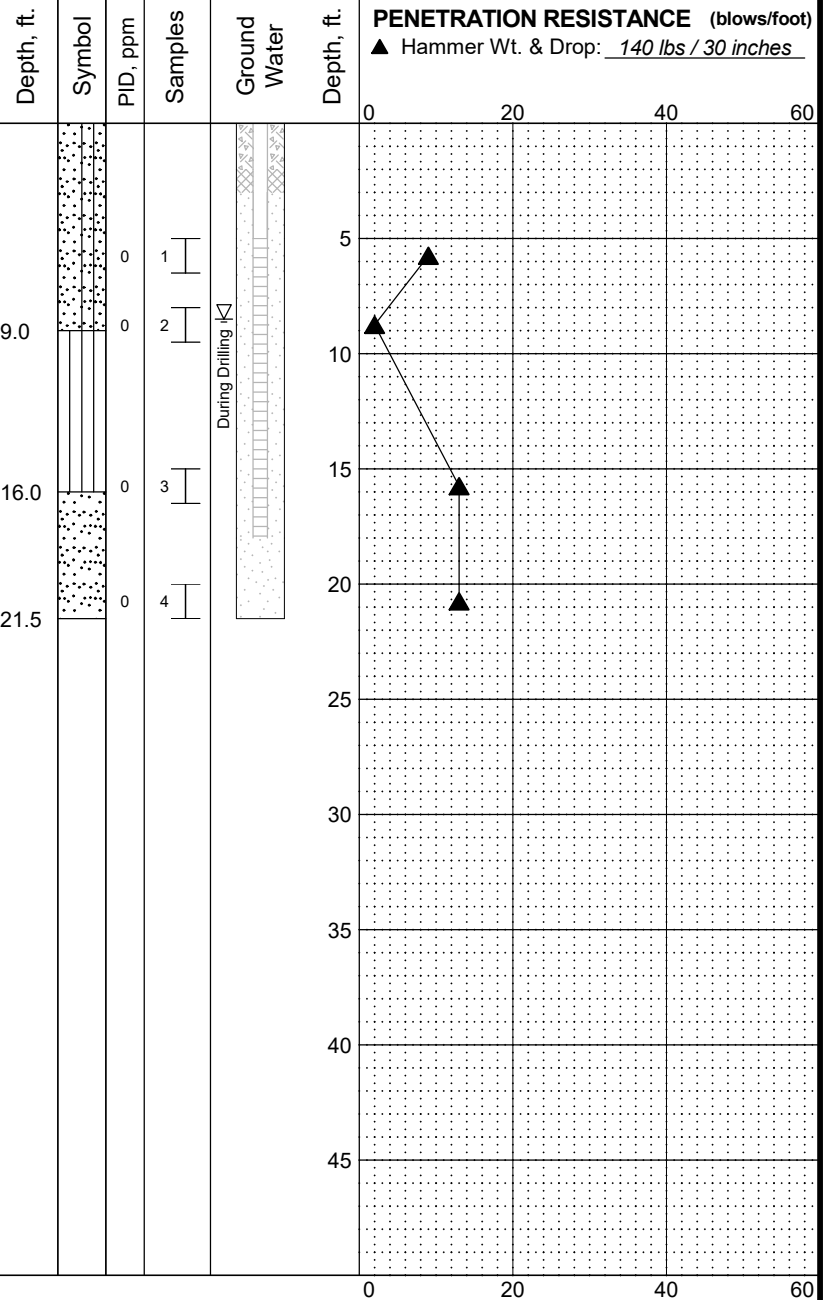
Loose, dark brown, *Poorly Graded Sand with Silt (SP-SM)*; moist; fine to coarse sand; few to little subangular gravel; concrete pad from 6.5 to 7 feet below ground surface.

Stiff, dark brownish gray *Silt to Lean Clay (ML/CL)*; wet; homogeneous soil texture.

Medium dense, dark gray, *Poorly Graded Sand (SP)*; wet; fine to medium sand.

BOTTOM OF BORING COMPLETED 2/2/2021

Well casing is 2-inch PVC. The well cover is metal and is flush with the ground surface.



LEGEND

* Sample Not Recovered		Well Screen and Sand Filter
E Environmental Sample Obtained		Bentonite-Cement Grout
┳ 2.0" O.D. Split Spoon Sample		Bentonite Chips/Pellets
		Bentonite Grout
		Ground Water Level ATD

NOTES

- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-68

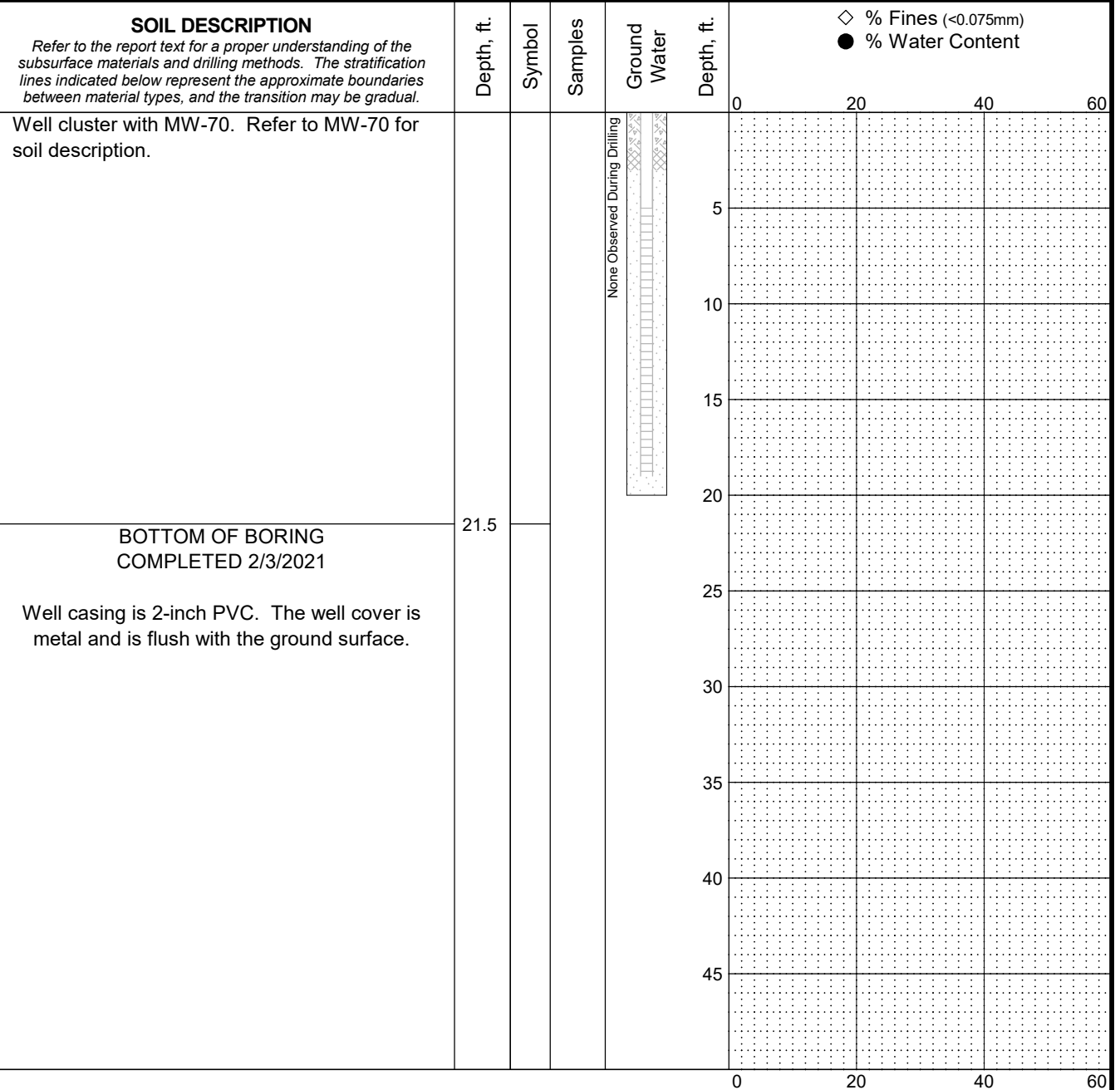
June 2022 21-1-12596-030

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FIG. C-22

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: CTC Rev: JXS Typ: LKN

Total Depth:	<u>21.5 ft.</u>	Northing:	<u>195,787 ft.</u>	Drilling Method:	<u>Hollow Stem Auger</u>	Hole Diam.:	<u>10 in.</u>
Top Elevation:	<u>17.7 ft.</u>	Easting:	<u>1,275,877 ft.</u>	Drilling Company:	<u>Holt Services</u>	Rod Diam.:	<u>NWJ</u>
Vert. Datum:	<u>NAVD 88</u>	Station:	<u>N/A</u>	Drill Rig Equipment:	<u>Truck Mobile Drill B57</u>	Hammer Type:	<u>Automatic</u>
Horiz. Datum:	<u>WA-N NAD83/11</u>	Offset:	<u>N/A</u>	Other Comments:	<u>Ecology well tag ID BMP149.</u>		



- LEGEND**
- * Sample Not Recovered
 - Well Screen and Sand Filter
 - Bentonite-Cement Grout
 - Bentonite Chips/Pellets
 - Bentonite Grout

- NOTES**
- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
 - Groundwater level, if indicated above, is for the date specified and may vary.
 - USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-69

June 2022

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FIG. C-23

MASTER LOG E 21-12596.GPJ SHAN WIL.GDT 5/17/22 Log: MRH Rev: JXS Typ: LKN

Total Depth: 61.5 ft. Northing: 195,794 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 10 in.
 Top Elevation: 17.5 ft. Easting: 1,275,882 ft. Drilling Company: Holt Services Rod Diam.: NWJ
 Vert. Datum: NAVD 88 Station: N/A Drill Rig Equipment: Truck Mobile Drill B57 Hammer Type: Automatic
 Horiz. Datum: WA-N NAD83/11 Offset: N/A Other Comments: Ecology well tag ID BMP148. Well cluster with MW-69.

SOIL DESCRIPTION
 Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

Medium dense, brown, *Silty Sand (SM)*; moist; fine to coarse sand; angular black metallic fragments (slag); homogeneous; yellow brick fragment at 0.4 foot; trace gravel.

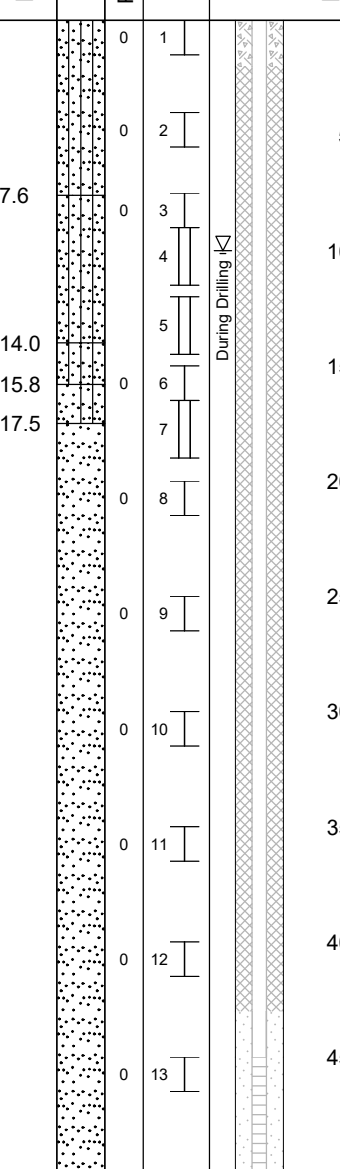
Very loose/soft, brown, *Silty Sand to Sandy Silt (SM/ML)*; moist to wet; trace fine gravel; trace iron oxide staining.

Gray, *Silty Sand (SM)*; wet; fine to medium sand; homogeneous.

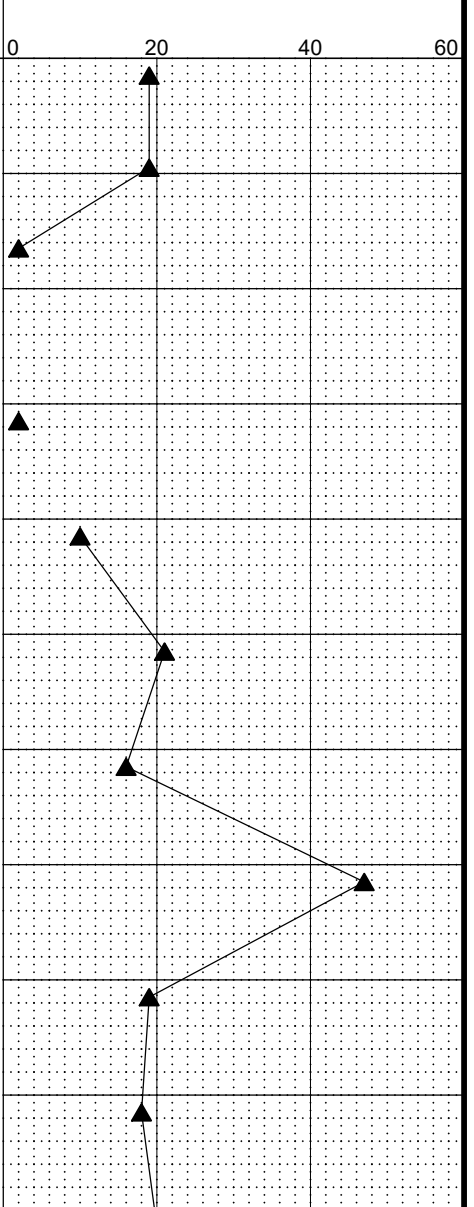
Very loose, gray *Sand with Silt (SP-SM)*; wet; fine to medium sand; homogeneous.

Loose to dense, gray to dark gray *Sand (SP)*; wet; fine to medium sand; homogeneous; some coarse sand from 45.1 to 45.3 feet.

Depth, ft.
 Symbol
 PID, ppm
 Samples
 Ground Water



PENETRATION RESISTANCE (blows/foot)
 ▲ Hammer Wt. & Drop: 140 lbs / 30 inches



CONTINUED NEXT SHEET

LEGEND

- * Sample Not Recovered
- E Environmental Sample Obtained
- 2.0" O.D. Split Spoon Sample
- Thin Wall Sample
- Well Screen and Sand Filter
- Bentonite-Cement Grout
- Bentonite Chips/Pellets
- Bentonite Grout
- Ground Water Level ATD

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-70

June 2022

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FIG. C-24
 Sheet 1 of 2

MASTER LOG E 21-12596.GPJ SHAN WIL GDT 5/17/22 Log: MRH Rev: JXS Typ: LKN

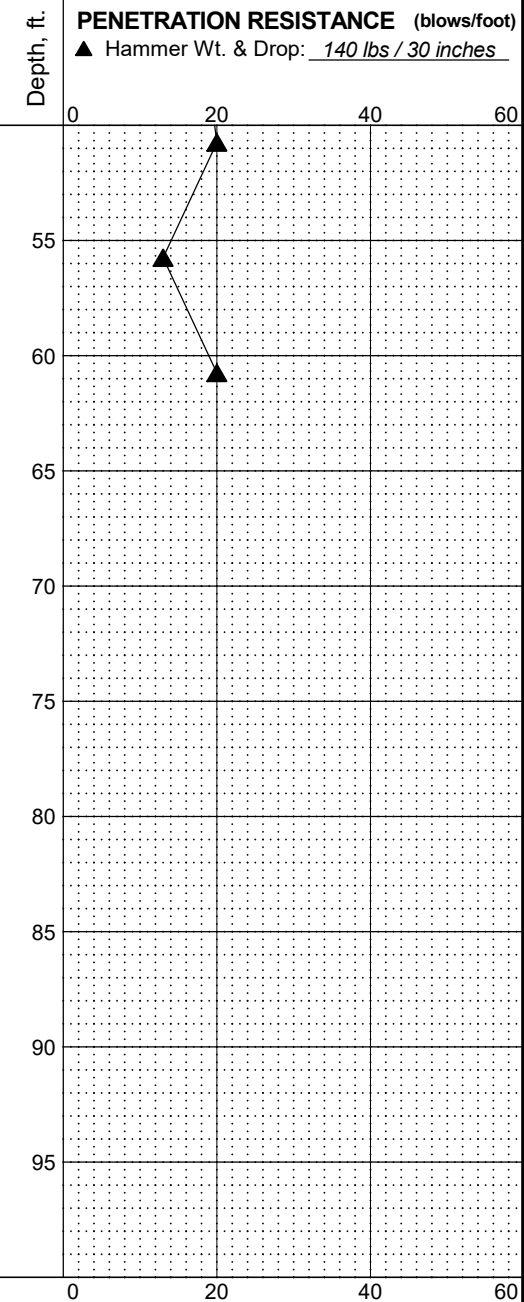
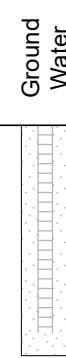
Total Depth: 61.5 ft. Northing: 195,794 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 10 in.
 Top Elevation: 17.5 ft. Easting: 1,275,882 ft. Drilling Company: Holt Services Rod Diam.: NWJ
 Vert. Datum: NAVD 88 Station: N/A Drill Rig Equipment: Truck Mobile Drill B57 Hammer Type: Automatic
 Horiz. Datum: WA-N NAD83/11 Offset: N/A Other Comments: Ecology well tag ID BMP148. Well cluster with MW-69.

SOIL DESCRIPTION
 Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

Medium dense, gray to dark gray, *Silty Sand (SM)*; wet; fine to medium sand; homogeneous.
 Medium dense, gray to dark gray *Sand (SP)*; wet; fine to medium sand; some 1/2- to 1-inch-thick *Sand with Silt (SP-SM)* lenses at 60.4 and 61.5 feet.

BOTTOM OF BORING COMPLETED 2/3/2021
 Well casing is 2-inch PVC. The well cover is metal and is flush with the ground surface.

Depth, ft.	Symbol	PID, ppm	Samples
50.4		0	14
53.0		0	15
61.5		0	16



- LEGEND**
- * Sample Not Recovered
 - E Environmental Sample Obtained
 - 2.0" O.D. Split Spoon Sample
 - Thin Wall Sample
 - Well Screen and Sand Filter
 - Bentonite-Cement Grout
 - Bentonite Chips/Pellets
 - Bentonite Grout
 - Ground Water Level ATD

- NOTES**
- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
 - Groundwater level, if indicated above, is for the date specified and may vary.
 - USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-70

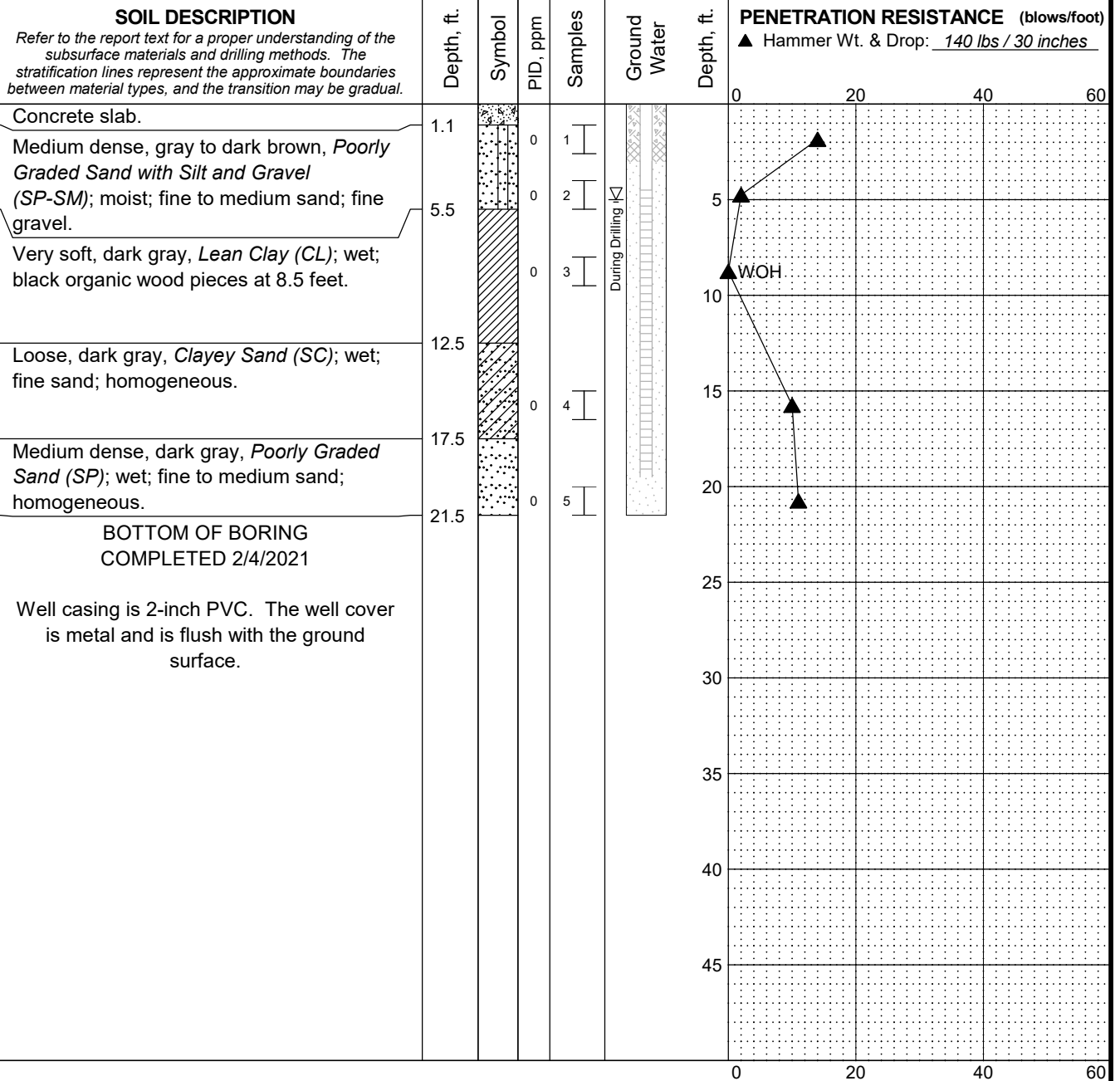
June 2022 21-1-12596-030

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FIG. C-24
 Sheet 2 of 2

MASTER LOG E 21-12596.GPJ SHAN WIL.GDT 5/17/22 Log: MRH Rev: JXS Typ: LKN

Total Depth: 21.5 ft. Northing: 195,762 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 10 in.
 Top Elevation: 17.8 ft. Easting: 1,276,460 ft. Drilling Company: Holt Services Rod Diam.: NWJ
 Vert. Datum: NAVD 88 Station: N/A Drill Rig Equipment: Truck Mobile Drill B57 Hammer Type: Automatic
 Horiz. Datum: WA-N NAD83/11 Offset: N/A Other Comments: Ecology well tag ID BMP092.



- * Sample Not Recovered
- E Environmental Sample Obtained
- ┌ 2.0" O.D. Split Spoon Sample

LEGEND

- Well Screen and Sand Filter
- Bentonite-Cement Grout
- Bentonite Chips/Pellets
- Bentonite Grout
- Ground Water Level ATD

- % Fines (<0.075mm)
- % Water Content

NOTES

- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-71

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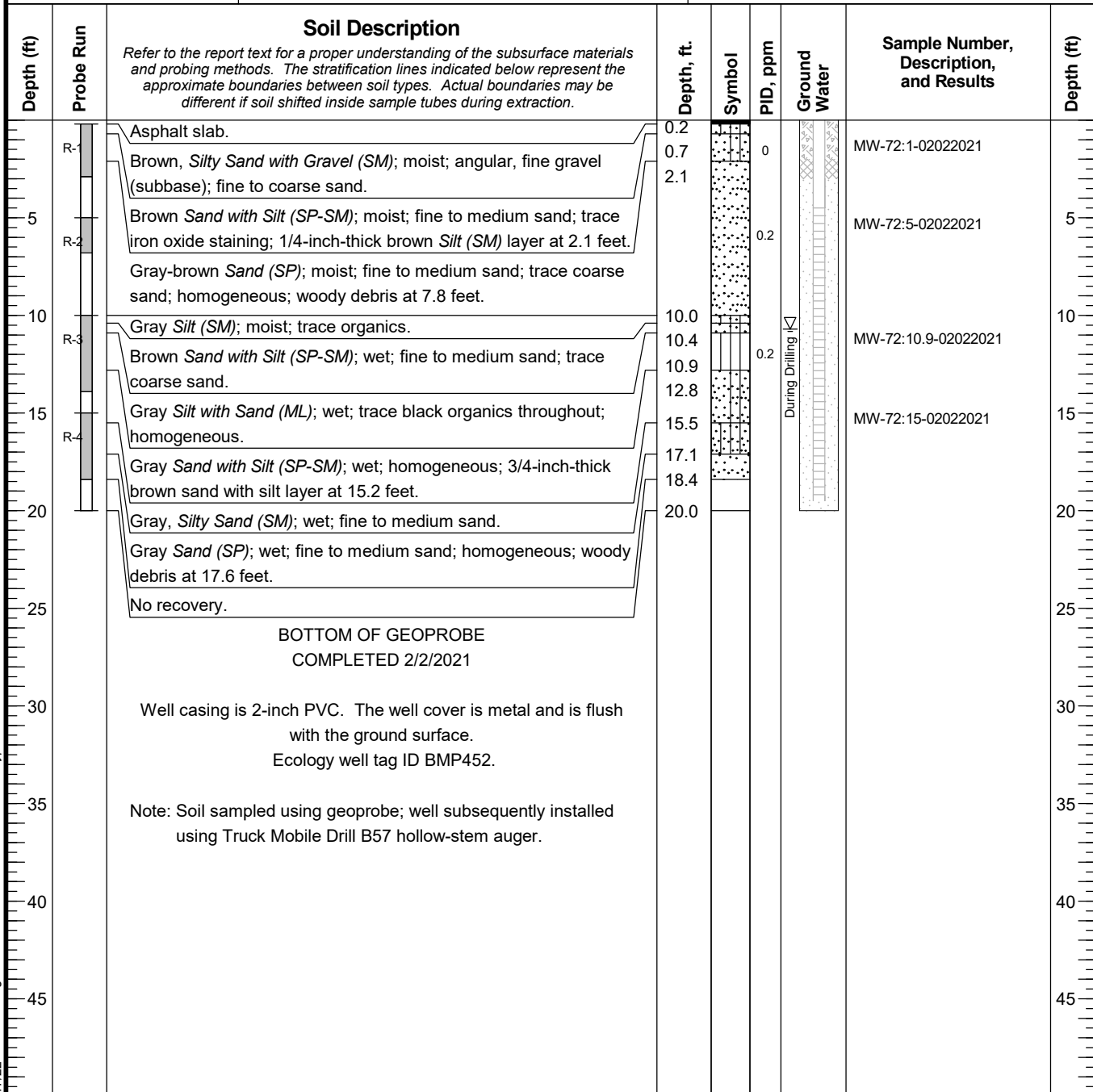
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FIG. C-25

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: CTC Rev: JXS Typ: LKN

LOG OF GEOPROBE

Date Started	2/2/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 17.9 feet
Date Completed	2/2/21			Typical Run Length	5 feet
Total Depth (ft)	20.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches



NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

	2" Plastic Tube - No Soil Recovery		Piezometer Screen and Sand Filter
	2" Plastic Tube with Soil Recovery		Bentonite-Cement Grout
	Run No.		Bentonite Chips/Pellets
	Ground Water Level ATD		Bentonite Grout

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LOG OF GEOPROBE MW-72

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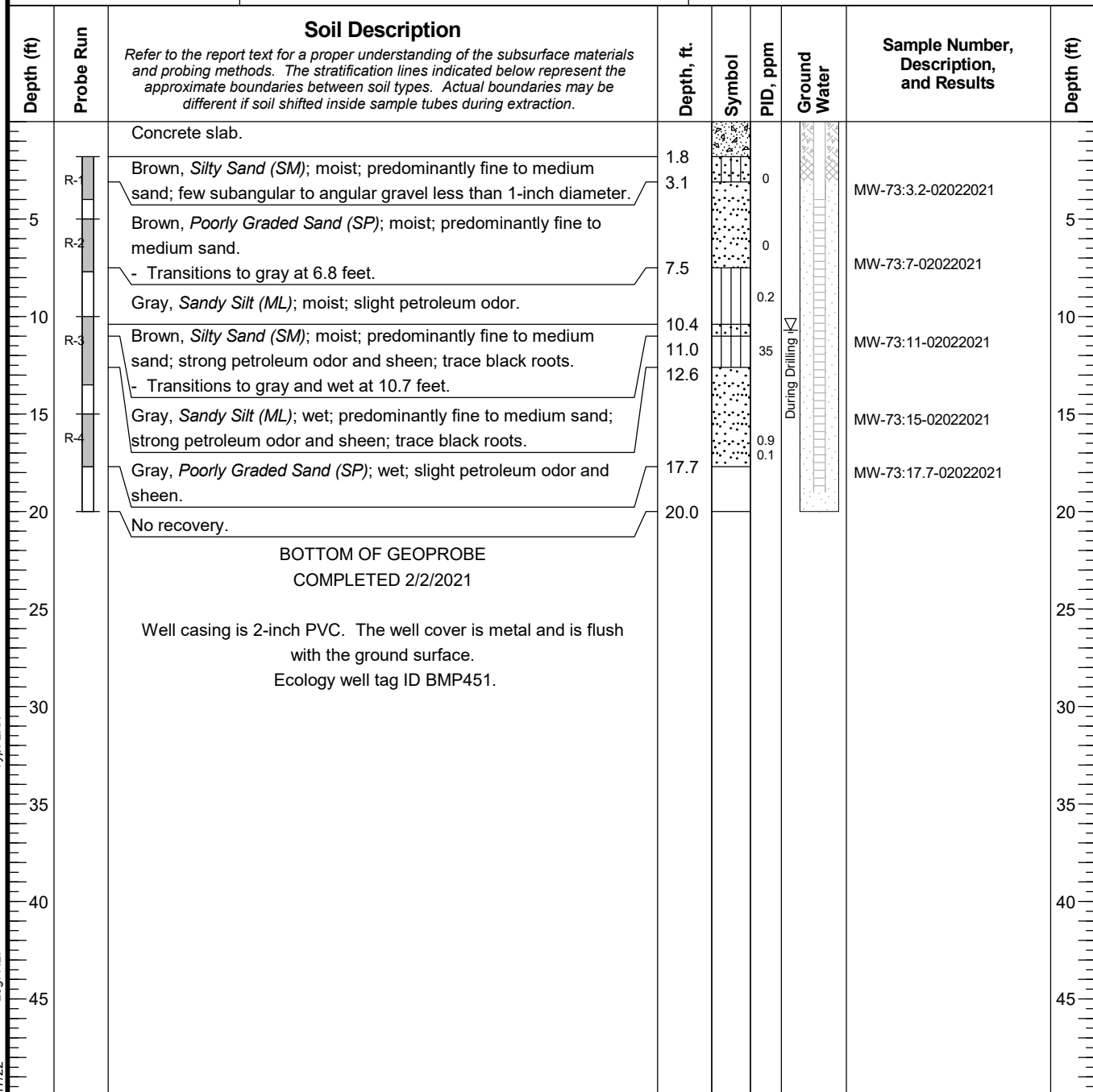
FIG. C-26

Typ: LKV
Rev: JXS
Log: MRH

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

LOG OF GEOPROBE

Date Started	2/2/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 17.4 feet
Date Completed	2/2/21			Typical Run Length	5 feet
Total Depth (ft)	20.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches



NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

	2" Plastic Tube - No Soil Recovery		Piezometer Screen and Sand Filter
	2" Plastic Tube with Soil Recovery		Bentonite-Cement Grout
	Run No.		Bentonite Chips/Pellets
	Ground Water Level ATD		Bentonite Grout

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LOG OF GEOPROBE MW-73

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FIG. C-27

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

LOG OF GEOPROBE

Date Started	2/2/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 17.6 feet
Date Completed	2/2/21			Typical Run Length	5 feet
Total Depth (ft)	20.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Concrete slab.	0.9					
5	R-2	Brown, Silty Sand with Gravel (SM); moist; angular, fine gravel; fine to coarse sand; some metallic fragments; trace iron oxide staining.	2.5		2.6		MW-74:3-02022021	5
		Brown Sand with Silt (SP-SM); moist; fine to medium sand; homogeneous; trace iron oxide staining.	3.2					
10	R-3	Gray, Silty Sand (SM); moist; homogeneous; 4-inch clay layer at base.	5.0		0.1		MW-74:6-02022021	10
		Brown to dark brown Sand with Silt (SP-SM); moist; fine to coarse sand; trace iron oxide staining; 4-inch-thick sandy silt layer at 5.5 feet; 1-inch-thick light brown Silt or Clay (ML/CL) layer at 7.4 feet; 2-inch-thick Silt (ML) layer at 7.9 feet.	10.0		0.1		MW-74:10.3-02022021 MW-101:10.3-02022021	10
15	R-4	Gray Silt with Sand (ML); wet; homogeneous.	12.8		0.1		MW-74:15-02022021	15
		Gray, Sandy Silt (ML); wet; fine to medium sand; woody debris; trace fine gravel at 16.3 feet.	17.7		0.1			
20		Dark gray Sand with Silt (SP-SM); wet; fine to medium sand; homogeneous.	19.8					20
		No recovery.	20.0					
25		BOTTOM OF GEOPROBE COMPLETED 2/2/2021						25
30		Well casing is 2-inch PVC. The well cover is metal and is flush with the ground surface. Ecology well tag ID BMP453.						30
35		Note: Soil sampled using geoprobe; well subsequently installed using Truck Mobile Drill B57 hollow-stem auger.						35
40								40
45								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

	2" Plastic Tube - No Soil Recovery		Piezometer Screen and Sand Filter
	2" Plastic Tube with Soil Recovery		Bentonite-Cement Grout
	Run No.		Bentonite Chips/Pellets
	Ground Water Level ATD		Bentonite Grout

Jorgensen Forge Corporation Property
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Tukwila, Washington

LOG OF GEOPROBE MW-74

June 2022

21-1-12596-030

SHANNON & WILSON, INC.
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FIG. C-28

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

Total Depth: <u>21.5 ft.</u>	Northing: <u>195,502 ft.</u>	Drilling Method: <u>Hollow Stem Auger</u>	Hole Diam.: <u>10 in.</u>
Top Elevation: <u>17.6 ft.</u>	Easting: <u>1,276,759 ft.</u>	Drilling Company: <u>Holt Services</u>	Rod Diam.: <u>NWJ</u>
Vert. Datum: <u>NAVD 88</u>	Station: <u>N/A</u>	Drill Rig Equipment: <u>Truck Mobile Drill B57</u>	Hammer Type: <u>Automatic</u>
Horiz. Datum: <u>WA-N NAD83/11</u>	Offset: <u>N/A</u>	Other Comments: <u>Ecology well tag ID BMP460.</u>	

SOIL DESCRIPTION
Refer to the report text for a proper understanding of the subsurface materials and drilling methods. The stratification lines represent the approximate boundaries between material types, and the transition may be gradual.

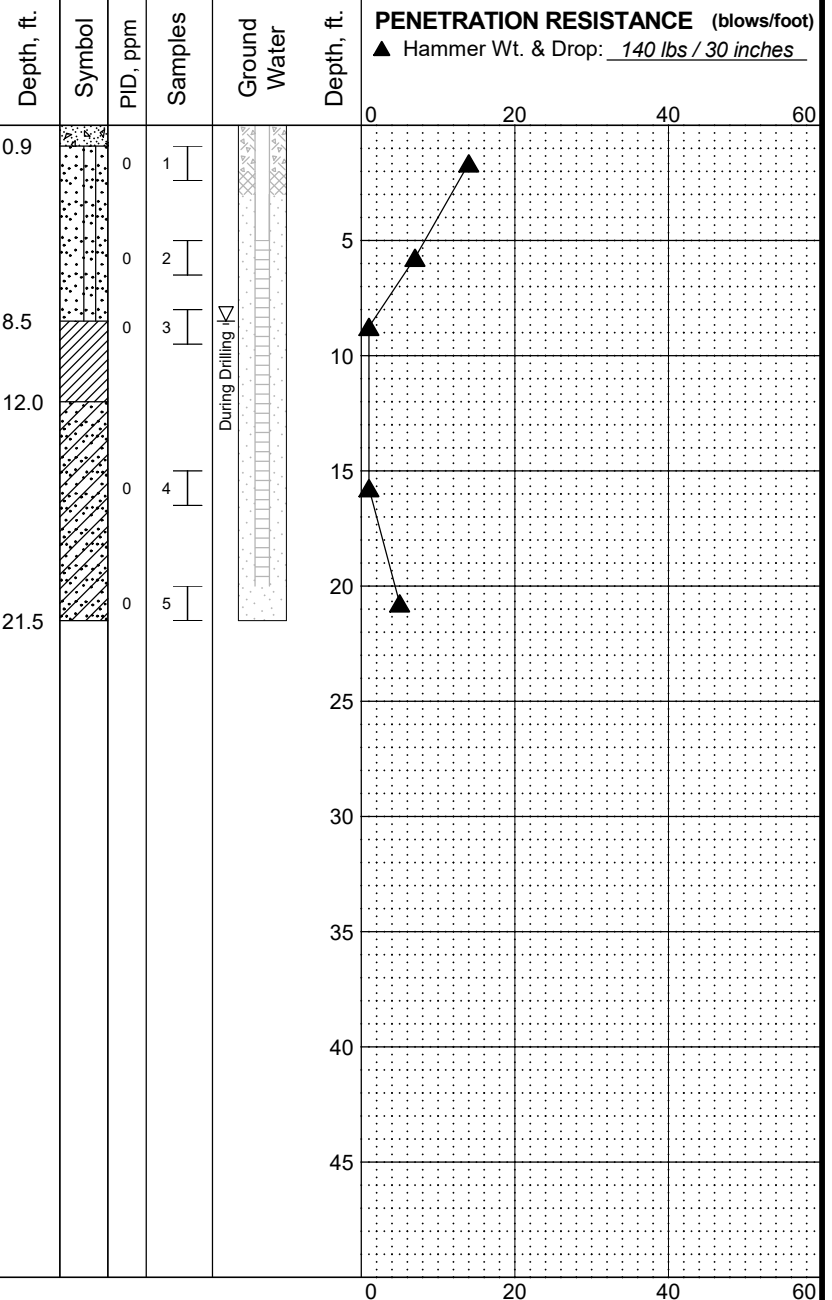
Concrete slab.
Medium dense to loose, dark brown to red brown, *Poorly Graded Sand with Silt (SP-SM)*; moist; fine to medium sand; homogeneous.

Very soft, gray, *Lean Clay (CL)*; wet; blocky black smearing.

Loose to medium dense, gray to dark gray, *Clayey Sand (SC)* to *Silty Sand (SM)*; wet; fine sand; homogeneous.

BOTTOM OF BORING COMPLETED 1/28/2021

Well casing is 2-inch PVC. The well cover is metal and is flush with the ground surface.



- LEGEND**
- | | | |
|---------------------------------|--|-----------------------------|
| * Sample Not Recovered | | Well Screen and Sand Filter |
| E Environmental Sample Obtained | | Bentonite-Cement Grout |
| 2.0" O.D. Split Spoon Sample | | Bentonite Chips/Pellets |
| | | Bentonite Grout |
| | | Ground Water Level ATD |

- ◇ % Fines (<0.075mm)
● % Water Content

NOTES

- Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
- Groundwater level, if indicated above, is for the date specified and may vary.
- USCS designation is based on visual-manual classification and selected lab testing.

Jorgensen Forge Corporation Property
Remedial Investigation Report
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LOG OF BORING MW-75

June 2022

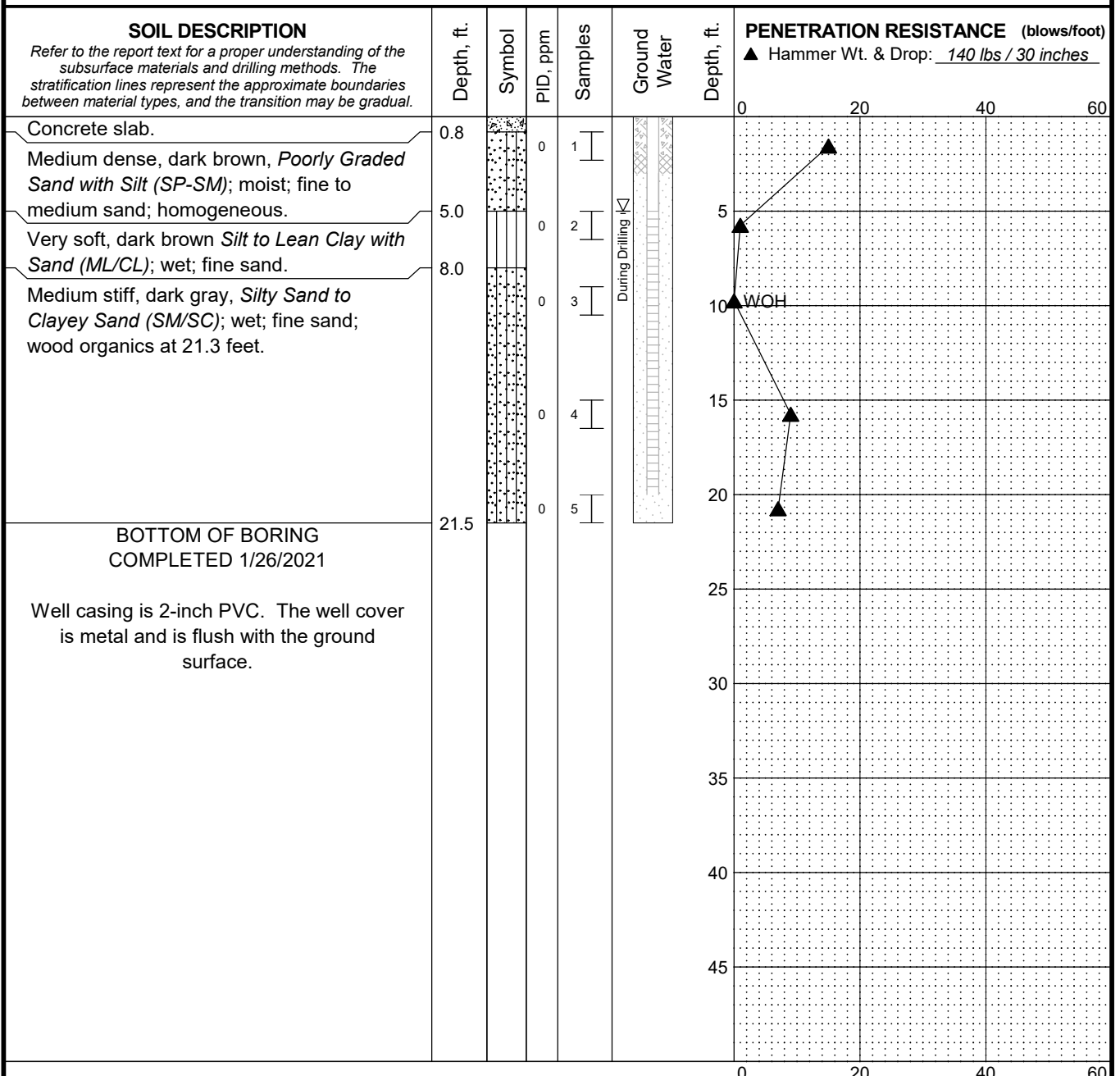
21-1-12596-030

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FIG. C-29

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: CTC Rev: JXS Typ: LKN

Total Depth: 21.5 ft. Northing: 195,620 ft. Drilling Method: Hollow Stem Auger Hole Diam.: 10 in.
 Top Elevation: 17.8 ft. Easting: 1,276,442 ft. Drilling Company: Holt Services Rod Diam.: NWJ
 Vert. Datum: NAVD 88 Station: N/A Drill Rig Equipment: Truck Mobile Drill B57 Hammer Type: Automatic
 Horiz. Datum: WA-N NAD83/11 Offset: N/A Other Comments: Ecology well tag ID BMP465.



LEGEND

* Sample Not Recovered		Well Screen and Sand Filter	
E Environmental Sample Obtained		Bentonite-Cement Grout	
┳ 2.0" O.D. Split Spoon Sample		Bentonite Chips/Pellets	
		Bentonite Grout	
		Ground Water Level ATD	

◇ % Fines (<0.075mm)
● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.

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LOG OF BORING MW-76

June 2022

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FIG. C-30

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: CTC Rev: JXS Typ: LKN

LOG OF GEOPROBE

Date Started	11/3/20	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	11/3/20			Typical Run Length	5 feet
Total Depth (ft)	10.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Concrete slab.	0.8					
		Dark brown, <i>Silty Sand (SM)</i> ; moist; fine to medium sand.	1.1				SB-2020-001:2.2-11032020	
5		Brown, orange, and gray, <i>Sandy Silt (ML)</i> ; moist; fine to medium sand.	5.3					5
	R-2	Dark brown to dark gray, <i>Poorly Graded Sand (SP)</i> ; moist; fine to medium sand; trace fines.	6.8				SB-2020-001:6.8-11032020	
10		No recovery.	10.0					10
		BOTTOM OF GEOPROBE COMPLETED 11/3/2020						
15		No unusual odor or sheen observed in the boring.						15
20								20
25								25
30								30
35								35
40								40
45								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2020-001

June 2022

21-1-12596-030

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FIG. C-31

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Typ: LKV Rev: JXS Log: RBP

LOG OF GEOPROBE

Date Started	11/6/20	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	11/6/20			Typical Run Length	5 feet
Total Depth (ft)	30.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Brown to dark brown, <i>Silty Sand (SM)</i> ; moist; fine to medium sand; trace coarse sand.	2.5		0		SB-2020-004:2.5-11062020	
5	R-2	Gray <i>Silt (ML)</i> ; moist; trace fine sand.	3.0					5
		Dark brown to very dark brownish gray, <i>Poorly Graded Sand (SP)</i> ; moist; fine to medium sand; trace coarse sand.			0.1			
10	R-3	Gray <i>Lean Clay with Sand (CL)</i> ; wet; predominantly fine sand; sand content decreases with depth; homogeneous soil texture.	8.3			During Drilling	SB-2020-004:8-11062020	10
		Gray, <i>Silty Sand (SM)</i> ; wet; fine sand.	13.0		0.1		SB-2020-004:13-11062020	
15	R-4	Dark to very dark gray, <i>Poorly Graded Sand (SP)</i> ; wet; fine to medium sand; trace coarse sand.	15.0		0.1		SB-2020-004:17-11062020 SB-2020-101:17-11062020	15
20	R-5				0.1		SB-2020-004:21-11062020	20
25	R-6				0.1		SB-2020-004:27-11062020	25
30		No recovery.	28.2					30
		BOTTOM OF GEOPROBE COMPLETED 11/6/2020	30.0					

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2020-004

June 2022

21-1-12596-030

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FIG. C-32

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Typ: LKN Rev: JXS Log: CTC

LOG OF GEOPROBE

Date Started	11/4/20	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	11/4/20			Typical Run Length	5 feet
Total Depth (ft)	25.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Grass and metal pieces (slag).	0.3		0		SB-2020-005:1-11042020	
5	R-2	Brown to dark brownish gray, <i>Silty Sand (SM)</i> ; moist; fine to medium sand; increasing silt content with depth.	5.8		0.1		SB-2020-005:6-11042020	5
10	R-3	Gray to dark gray, <i>Silt (ML)</i> ; moist; trace fine sand; some wood pieces.	6.5					10
		Gray to very dark brownish gray, <i>Silty Sand (SM)</i> ; moist; fine to medium sand.	10.6					
		- 1-inch wood piece at 10.6 feet.	12.1		0		SB-2020-005:12-11042020	
15	R-4	Gray to green gray, <i>Lean Silty Clay (CL)</i> ; moist; trace fine sand.						15
		Gray to very dark brownish gray, <i>Silty Sand (SM)</i> ; wet; fine to medium sand becoming coarser with depth; areas of brown color.			0			
20	R-5				0.1		SB-2020-005:20-11042020	20
25		No recovery.	24.0					
		BOTTOM OF GEOPROBE COMPLETED 11/4/2020	25.0					

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

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LOG OF GEOPROBE SB-2020-005

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FIG. C-33

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22
Typ: LKN
Rev: JXS
Log: RBP

LOG OF GEOPROBE

Date Started	11/4/20	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	11/4/20			Typical Run Length	5 feet
Total Depth (ft)	25.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Concrete slab.	0.5					
		Brown, Silty Sand (SM); moist; fine to medium sand.	1.2		0		SB-2020-007:1.2-2.8-11042020	
		Yellow-brown, Silty Sand (SM); moist; fine sand.	2.8					
5	R-2	Gray to dark gray Silt (ML); moist; trace fine sand.						5
		- Wet at 7 feet and deeper.			0	During Drilling	SB-2020-007:6-7-11042020	
10	R-3	Gray, Sandy Silt (ML); wet; fine sand.	10.0					10
		Very dark gray to black Silt (ML); few wood pieces and metal pieces (slag).	10.4		0		SB-2020-007:10-10.9-11042020	
			10.9					
15	R-4	Gray to very dark gray, Sandy Sand (SM); wet; fine to medium sand.			0			15
		- Lens of black silt from 18.3 to 18.4 feet.						
20	R-5	- Wood pieces at 20.9 feet.	21.4		0		SB-2020-007:20-21.4-11042020	20
		Gray to very dark gray, Sandy Silt (ML); moist; several approximately 0.5-inch lenses of wood pieces.	24.6				SB-2020-007:23-24.6-11042020	
25		No recovery.	25.0					25
		BOTTOM OF GEOPROBE COMPLETED 11/4/2020						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

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LOG OF GEOPROBE SB-2020-007

June 2022

21-1-12596-030

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FIG. C-34

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22
Typ: LKN
Rev: JXS
Log: RBP

LOG OF GEOPROBE

Date Started	11/5/20	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	11/5/20			Typical Run Length	5 feet
Total Depth (ft)	25.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Asphalt slab.	0.2		0		SB-2020-008:2-11052020	
5	R-2	Dark brown, Poorly Graded Sand with Silt (SP-SM); moist; fine to medium sand; trace iron oxide staining.	5.5		0		SB-2020-008:5.5-11052020	5
10	R-3	Olive-brown laminated with red-brown, Sandy Silt (ML); moist; fine sand; iron oxide staining in places.	11.8		0	During Drilling	SB-2020-008:11.5-11052020	10
15	R-4	Gray to very dark brownish gray, Silty Sand (SM); wet; homogeneous soil texture.			0			15
20	R-5	- Timber at 20 feet below ground surface.			0		SB-2020-008:20-11052020	20
25		Dark gray Silt (ML); wet; trace fine sand; some clay fines.	23.0					
		No recovery.	23.2					
			25.0					
		BOTTOM OF GEOPROBE COMPLETED 11/5/2020						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
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LOG OF GEOPROBE SB-2020-008

June 2022

21-1-12596-030

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FIG. C-35

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22
Typ: LKV
Rev: JXS
Log: CTC

LOG OF GEOPROBE

Date Started	11/5/20	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	11/5/20			Typical Run Length	5 feet
Total Depth (ft)	25.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
5	R-1	Gray-brown, <i>Poorly Graded Gravel with Silt and Sand (GP-GM)</i> ; moist; fine to coarse, subrounded to subangular gravel up to 1-inch diameter.			0		SB-2020-013:1.5-11052020	5
10	R-2	Dark brown, <i>Poorly Graded Sand with Silt (SP-SM)</i> ; moist; fine to medium sand; trace coarse sand and fine gravel; homogeneous soil texture.	6.0		0		SB-2020-013:6-11052020	10
15	R-3		12.5		0	During Drilling	SB-2020-013:11.5-11052020	15
20	R-4	Gray to very dark gray, <i>Silty Sand (SM)</i> ; wet; fine to medium sand; homogeneous soil texture.			0			
25	R-5	Dark to very dark gray <i>Silt (ML)</i> ; wet; trace fine sand; some clay fines.	20.5		0		SB-2020-013:20.5-11052020	20
		Dark to very dark gray, <i>Silty Sand (SM)</i> ; wet; fine to medium sand; homogeneous soil texture.	23.0				SB-2020-013:23-11052020	25
		No recovery.	23.1					
			25.0					
		BOTTOM OF GEOPROBE COMPLETED 11/5/2020						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

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LOG OF GEOPROBE SB-2020-013

June 2022

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FIG. C-36

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

LOG OF GEOPROBE

Date Started	11/5/20	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	11/5/20			Typical Run Length	5 feet
Total Depth (ft)	25.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Gravel, silt, and organics (grass).	1.0		0.1		SB-2020-014:1.5-11052020	
5	R-2	Brown, Silty Sand (SM); moist; areas of gray silt 1- to 2-inch-thick; areas of orange laminate silt 1/4-inch-thick.	6.4		0		SB-2020-014:7-11052020	5
		Dark brown, Poorly Graded Sand (SP); moist; fine to medium sand.	7.1					
10	R-3	Orange, gray, and brown Silt (ML); moist; trace fine sand.	10.2				SB-2020-014:11-11052020	10
		Brown, Silty Sand (SM); moist.	11.4		193		SB-2020-100:11-11052020	
		- Petroleum odor and heavy sheen at 10.6 feet and lower.						
		- Transition to gray and wet at 10.7 feet.						
15	R-4	Gray Silt (ML); wet; strong petroleum odor and heavy sheen.	15.3				SB-2020-014:18-11052020	15
		Brown, Poorly Graded Sand (SP); wet; fine to medium sand; petroleum odor and sheen; becomes sandier with depth; decreasing petroleum odor and sheen with depth.			138			
20	R-5	- Transitions to gray at 15.4 feet.			1.4		SB-2020-014:23-11052020	20
		No recovery.	23.3					
25		BOTTOM OF GEOPROBE COMPLETED 11/5/2020	25.0					25

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

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LOG OF GEOPROBE SB-2020-014

June 2022

21-1-12596-030

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-37

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

LOG OF GEOPROBE

Date Started	11/4/20	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	11/4/20			Typical Run Length	5 feet
Total Depth (ft)	25.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Gravel and metal pieces (slag).	0.7		0		SB-2020-015:1-11042020	
		Brown, Poorly Graded Sand (SP); moist; fine to medium sand.	1.5					
5	R-2	Brown, Silty Sand (SM); moist; fine to medium sand; trace coarse sand; brown-orange oxidation from 1.5 to 2 feet.			0		SB-2020-015:7-11042020	5
		- One clast of fine gravel at 6 feet.						
10	R-3	Gray, Lean Clay with Silt (CL); moist; trace black wood pieces in places.	10.7		0		SB-2020-015:13-11042020	10
15	R-4	Gray to very dark gray, Silty Sand (SM); wet; fine to medium sand; trace coarse sand.	15.0		0			15
20	R-5	- Pieces of metal (slag) at 20.5 feet.			0		SB-2020-015:20.5-11042020	20
		- Wood piece at 21.5 feet.					SB-2020-015:23-11042020	
25		No recovery.	23.0					25
			25.0					
		BOTTOM OF GEOPROBE COMPLETED 11/4/2020						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2020-015

June 2022

21-1-12596-030

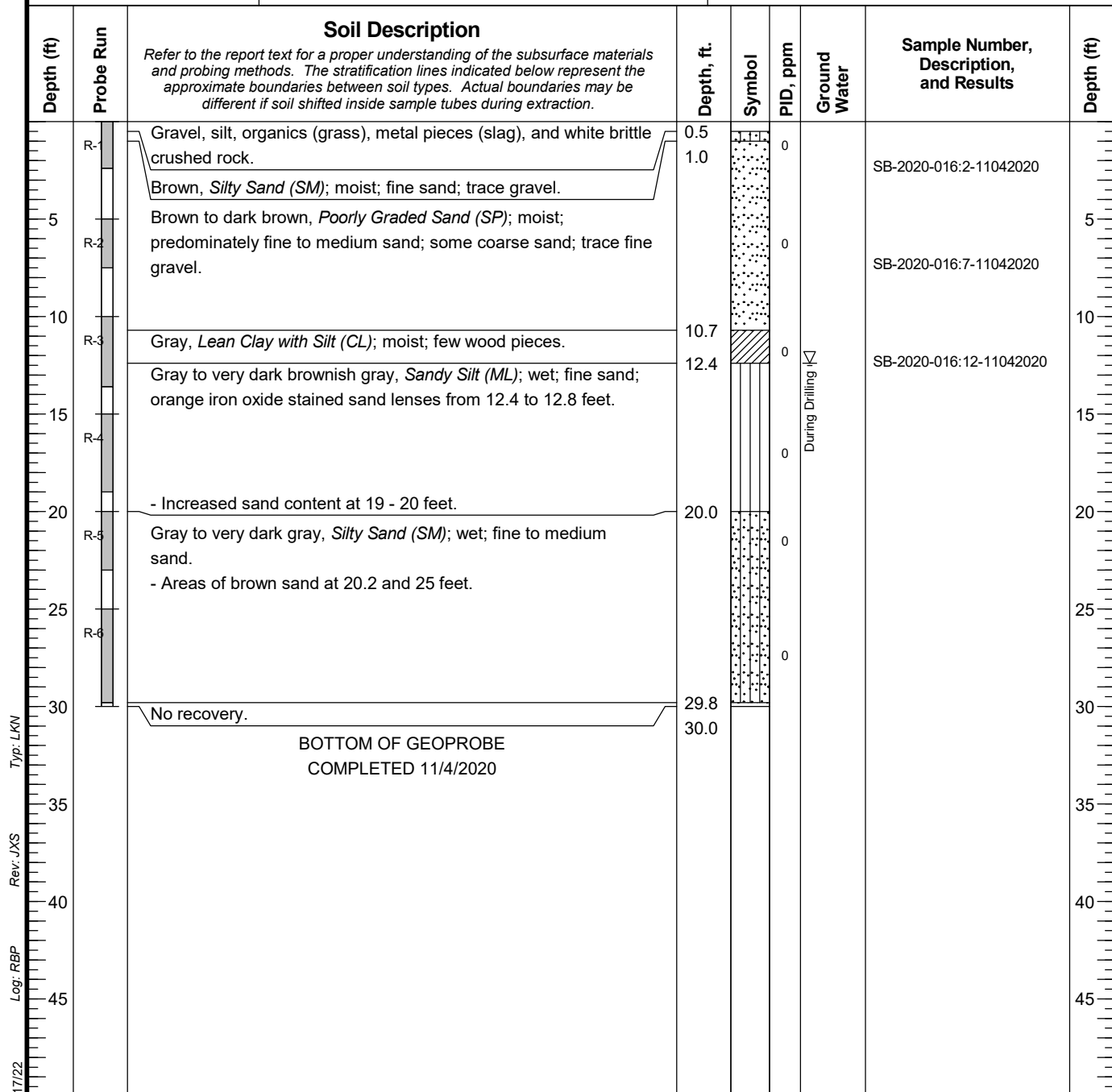
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FIG. C-38

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

LOG OF GEOPROBE

Date Started	11/4/20	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	11/4/20			Typical Run Length	5 feet
Total Depth (ft)	30.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches



NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2020-016

June 2022

21-1-12596-030

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FIG. C-39

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

LOG OF GEOPROBE

Date Started	11/3/20	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	11/3/20			Typical Run Length	5 feet
Total Depth (ft)	10.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)	
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.							
	R-1	Concrete slab.	0.8		0	None Observed During Drilling	SB-2020-028:2.3-11032020		
		Yellow-brown, <i>Silty Sand (SM)</i> ; moist; fine to medium sand; silt lenses in places.	2.1						
5	R-2	Brown, orange, and gray to very dark gray, <i>Sandy Silt (ML)</i> ; moist; fine to medium sand.	5.2				0	SB-2020-028:6.8-11032020	5
		Dark brown to dark brownish gray, <i>Poorly Graded Sand (SP)</i> ; moist; fine to medium sand; trace fines.	6.8						
10		No recovery.	10.0						10
		BOTTOM OF GEOPROBE COMPLETED 11/3/2020							
15							15		
20							20		
25							25		
30							30		
35							35		
40							40		
45							45		

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.

Jorgensen Forge Corporation Property
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Tukwila, Washington

LOG OF GEOPROBE SB-2020-028

June 2022

21-1-12596-030

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FIG. C-40

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22
Typ: LKV
Rev: JXS
Log: RBP

LOG OF GEOPROBE

Date Started	11/3/20	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	11/3/20			Typical Run Length	5 feet
Total Depth (ft)	10.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Concrete slab.	0.8					
		Yellow-brown, <i>Silty Sand (SM)</i> ; moist; fine to medium sand; siltier lenses in places.	1.4		0		SB-2020-029:3.2-11032020	
5		Brown, <i>Sandy Silt (ML)</i> ; moist; fine to medium sand.	2.1					5
	R-2	Gray to dark brownish gray, <i>Poorly Graded Sand (SP)</i> ; moist; fine to medium sand; trace coarse sand; trace fines.	7.5		0		SB-2020-029:7.5-11032020	
10		No recovery.	10.0					10
		BOTTOM OF GEOPROBE COMPLETED 11/3/2020						
15								15
20								20
25								25
30								30
35								35
40								40
45								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2020-029

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21-1-12596-030

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FIG. C-41

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Typ: LKN Rev: JXS Log: RBP

LOG OF GEOPROBE

Date Started	11/3/20	Location 8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	11/3/20		Typical Run Length	5 feet
Total Depth (ft)	10.0	Drilling Company: Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description <i>Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.</i>	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
	R-1	Concrete slab.	0.7					
		Yellow-brown, <i>Silty Sand (SM)</i> ; moist; fine to medium sand.	1.7		0		SB-2020-045:2.8-11032020	
5		Brown, orange, and gray, <i>Sandy Silt (ML)</i> ; moist; fine to medium sand.	2.1					5
	R-2	Dark yellow-brown to dark brownish gray, <i>Poorly Graded Sand (SP)</i> ; moist; fine to medium sand; trace coarse sand; trace fines.	7.2		0		SB-2020-045:7.2-11032020	
10		No recovery.						10
		BOTTOM OF GEOPROBE COMPLETED 11/3/2020	10.0					

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2020-045

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21-1-12596-030

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FIG. C-42

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22
Typ: LKN
Rev: JXS
Log: RBP

LOG OF GEOPROBE

Date Started	1/28/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/28/21			Typical Run Length	5 feet
Total Depth (ft)	10.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Concrete slab.						
		Brown, Poorly Graded Sand (SP); moist; predominantly fine to medium sand.	1.6		0.2		SB-2021-002:3-01282021	
5		Gray to dark gray Silt (ML); moist.	2.0					
	R-2	- Black discoloration and odor of decaying organic matter from 2 to 3.3 feet; no sheen or elevated PID readings.	4.6		0		SB-2021-002:6-01282021	5
		Brown, Poorly Graded Sand (SP); moist; predominantly fine to medium sand.	6.5				SB-2021-105:6-01282021	
10		No recovery.	10.0					10
		BOTTOM OF GEOPROBE COMPLETED 1/28/2021						
15								15
20								20
25								25
30								30
35								35
40								40
45								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-002

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21-1-12596-030

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FIG. C-43

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Typ: LKN Rev: JXS Log: RBP

LOG OF GEOPROBE

Date Started	1/26/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/26/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Concrete slab.	0.8					
5	R-2	Brown to dark brown, <i>Silty Sand (SM)</i> ; moist; fine to medium sand; trace iron oxide staining; Gray-brown, <i>Clay (CL)</i> layers at 1.9 and 2.1 feet; woody debris at 2.3 feet.	2.6		0.3		SB-2021-003:2-01262021	5
10		Brown to dark brown, <i>Sand with Silt (SP-SM)</i> ; moist; fine to medium sand; trace iron oxide staining; black organics at 7.2 feet.	7.6		0.2			10
15	R-3	Gray, <i>Sandy Silt (ML)</i> ; moist to wet; fine sand; low to nonplastic fines.	10.3				SB-2021-003:10.3-01262021	15
		Gray, <i>Clay (CL)</i> ; moist to wet; medim plasticity; black organics at 11.2 feet.	11.5		0.3		SB-2021-003:11.5-01262021	
		Gray, <i>Silty Sand (SM)</i> ; wet; fine sand.	13.1					
		No recovery.	15.0					
		BOTTOM OF GEOPROBE COMPLETED 1/26/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-003

June 2022

21-1-12596-030

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FIG. C-44

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

LOG OF GEOPROBE

Date Started	1/29/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/29/21			Typical Run Length	5 feet
Total Depth (ft)	20.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Concrete slab.	0.6					
		Brown, Silty Sand (SM); moist; trace gravel; fine to medium sand; trace iron oxide staining throughout; metallic fragment at 1.0 foot.	2.2		0		SB-2021-006:1.5-01292021	
5	R-2	Gray to dark gray, Sandy Silt (ML); moist; fine sand; homogeneous.	2.8					5
		Brown, Sand with Silt (SP-SM); moist; fine to medium sand; trace coarse sand.	7.4		0.1		SB-2021-006:6-01292021	
10	R-3	Brown, Silt (ML); moist; trace black organics; homogeneous.	10.0				SB-2021-006:10-01292021	10
		Gray to very dark gray/black, Silty Sand (SM); wet; fine sand; homogeneous; petroleum odor; slight sheen.	15.6		19			15
15	R-4	Gray, Sand with Silt (SP-SM); wet; fine to medium sand; homogeneous; no petroleum odor observed.	18.9		0.2			20
20		No recovery.	20.0				SB-2021-006:20-01292021	20
		BOTTOM OF GEOPROBE COMPLETED 1/29/2021						
25								25
30								30
35								35
40								40
45								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-006

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21-1-12596-030

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FIG. C-45

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

LOG OF GEOPROBE

Date Started	1/25/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/25/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Concrete slab.	0.7					
5	R-2	Brown to dark brown, <i>Silty Sand (SM)</i> ; moist; fine to coarse sand.			0.1		SB-2021-009:2-01252021	5
		- Iron oxide staining at 7 feet.			0.1		SB-2021-009:6-01252021	
10	R-3	Brown to light brown <i>Silt with Sand (ML)</i> ; wet; trace fine sand.	10.3				SB-2021-009:10.8-01252021	10
		Gray to dark gray, <i>Silty Sand (SM)</i> ; wet; predominantly fine to medium sand; more brown and increasing silt content with depth.	10.8		0.1			
15		Brown to gray <i>Silt with Sand (ML)</i> ; wet; trace fine to medium sand; increasing sand content with depth.	12.4				SB-2021-009:13.3-01252021	15
		No recovery.	13.3					
20			15.0					
		BOTTOM OF GEOPROBE COMPLETED 1/25/2021						
25								25
30								30
35								35
40								40
45								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

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LOG OF GEOPROBE SB-2021-009

June 2022

21-1-12596-030

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FIG. C-46

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

LOG OF GEOPROBE

Date Started	1/28/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/28/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Concrete slab.	1.2		0		SB-2021-010:1.5-01282021	
5	R-2	Brown to dark brown, <i>Poorly Graded Sand (SP)</i> ; moist; trace subrounded to rounded gravel <0.5 inch; predominantly fine to medium sand; increasing silt content with depth. - Piece of red brick at 1.5 feet.			0		SB-2021-010:6-01282021 SB-2021-104:6-01282021	5
10	R-3	Brown to dark brown, <i>Silty Sand (SM)</i> ; moist. - 0.5-inch-thick silt lenses from 10.4 to 11 feet. - Wet at 11 feet.	10.4		0	During Drilling	SB-2021-010:11-01282021	10
15		No recovery.	12.7					15
			15.0					
		BOTTOM OF GEOPROBE COMPLETED 1/28/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

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LOG OF GEOPROBE SB-2021-010

June 2022

21-1-12596-030

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FIG. C-47

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

LOG OF GEOPROBE

Date Started	1/25/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/25/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
5	R-1	Brown, <i>Silty Sand (SM)</i> ; moist; fine to coarse sand; trace iron oxide staining; scattered trace fine gravel throughout; metallic fragments at 1, 1.7, and 3.8 feet; white fine grained material at 1.8 feet; yellow brick fragment at 3 and 3.9 feet; black metallic fragment (slag) at 2.9 feet.	5.2		0.1		SB-2021-011:1-01252021 SB-2021-101:1-01252021 SB-2021-011:3-01252021	5
10	R-2	Dark gray, <i>Sand with Silt (SP-SM)</i> ; moist; fine sand; 1-inch-thick red-brown, <i>Sand with Silt (SP-SM)</i> layer at 6.1 and 6.9 feet; 1.4-inch-thick gray, <i>Clay (CL)</i> layer at 7.1 feet; becomes wet at 10 feet.	10.6		0.3			10
15	R-3	- Wet at 10 feet.	12.9		0.3		SB-2021-011:10-01252021	15
		Gray, <i>Clay (CL)</i> ; moist; mottled gray and brown in places; medium plasticity.	13.4					
		Gray-brown, <i>Silty Sand (SM)</i> ; moist to wet; fine to medium sand; trace iron oxide staining.	13.9					
20		Dark gray, <i>Sand with Silt (SP-SM)</i> ; moist to wet; fine to medium sand.	15.0					20
		No recovery.						
25		BOTTOM OF GEOPROBE COMPLETED 1/25/2021						25
30								30
35								35
40								40
45								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-011

June 2022

21-1-12596-030

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FIG. C-48

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

LOG OF GEOPROBE

Date Started	1/25/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/25/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Asphalt slab.	0.6					
		Brown, Silty Gravel with Sand (GM); dry; subangular to angular gravel up to 1 inch; fine to coarse sand.	1.4		0.3		SB-2021-012:2-01252021	
5	R-2	Brown to dark brown, Silty Sand (SM); moist; fine to coarse sand.			0.3		SB-2021-012:3.4-01252021	5
		- Wood pieces and brown silt at 3.4 feet.						
10	R-3	- Wet and increased silt content at 10.4 feet and deeper.			0.3		SB-2021-012:10.4-01252021	10
		No recovery.	12.6					
15			15.0					15
		BOTTOM OF GEOPROBE COMPLETED 1/25/2021						
20								20
25								25
30								30
35								35
40								40
45								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-012

June 2022

21-1-12596-030

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FIG. C-49

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

LOG OF GEOPROBE

Date Started 1/25/21	Location 8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation: Approx. 18.0 feet
Date Completed 1/25/21		Typical Run Length 5 feet
Total Depth (ft) 15.0	Drilling Company: Holt Services	Hole Diameter: 2.25 inches

Depth (ft)	Probe Run	Soil Description <i>Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.</i>	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
	R-1	Concrete slab.	0.4		0		SB-2021-017:2-01252021	
5	R-2	Brown to dark brown, <i>Silty Sand (SM)</i> ; moist; predominantly fine to medium sand; occasional lenses of gray silt; iron oxide staining in places.			0.1		SB-2021-017:5-01252021	5
10	R-3	- Transitions to gray color at 10 feet. - Wet at 10.5 feet and deeper.	11.5		0.3		SB-2021-017:10.5-01252021	10
15		Dark gray <i>Silt (ML)</i> ; moist.	12.6					15
		No recovery.	15.0					15
		BOTTOM OF GEOPROBE COMPLETED 1/25/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-017

June 2022

21-1-12596-030

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FIG. C-50

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22
Typ: LKN
Rev: JXS
Log: RBP

LOG OF GEOPROBE

Date Started	1/27/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/27/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Dark gray, <i>Well-graded Gravel with Sand (GW)</i> ; moist; angular to subangular gravel; slag in places.	0.9		0.4		SB-2021-018:1.5-01272021 SB-2021-018:2.5-01272021	
5	R-2	Brown to dark red-brown, <i>Poorly Graded Sand (SP)</i> ; moist; fine to medium sand; trace silt.	5.0		6.4		SB-2021-018:5.5-01272021	5
		Tan to brown, <i>Sandy Silt (ML)</i> ; increasing moisture with depth; predominantly fine sand; trace iron oxide staining.	6.3		116		SB-2021-018:7.2-01272021 SB-2021-018:8.2-01272021	
10	R-3	Dark brown-gray, <i>Poorly Graded Sand with Silt (SP-SM)</i> ; wet; stained black in places; strong sheen; weak petroleum odor.	7.8		3			10
		Dark brownish-gray <i>Silt with Sand (ML)</i> ; moist to wet; black organics (woody debris) in places; no petroleum odor or sheen; increased sand content from 10 to 10.5 feet.	10.5		1.2		SB-2021-018:11-01272021	
15		Dark gray, <i>Poorly Graded Sand with Silt (SP-SM)</i> ; wet; fine sand; no petroleum odor or sheen.	11.0		0.2			15
		Dark gray <i>Silt (ML)</i> ; moist to wet; trace fine sand; no petroleum odor or sheen.	12.2					
20		No recovery.	15.0					20
25								25
30								30
35								35
40								40
45								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-018

June 2022

21-1-12596-030

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FIG. C-51

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: JXS/RBP Rev: JXS Typ: LKN

LOG OF GEOPROBE

Date Started	1/27/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/27/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Gray to brown, <i>Well-graded Gravel with Sand and Slag (GW)</i> ; moist; subangular, fine gravel; fine to coarse sand; slag in places.	1.3		0.1		SB-2021-019:0.8-01272021	
5	R-2	Gray to reddish-brown, <i>Poorly Graded Sand (SP)</i> ; moist; fine to medium sand; trace silt; iron oxide-stained.	5.0		0.1		SB-2021-019:2.5-01272021	5
		Gray to dark gray, <i>Sandy Silt (ML)</i> ; moist; black organics (woody debris) in places.	8.2		0.9		SB-2021-019:5-01272021	
10	R-3	Brown to orange-brown, <i>Poorly Graded Sand (SP)</i> ; wet; fine to medium sand; trace coarse sand; trace silt; from 10.4 to 12 feet increased silt and darker gray color.	12.2		0.2		SB-2021-019:7-01272021	10
15		No recovery.	15.0		0.1			15
		BOTTOM OF GEOPROBE COMPLETED 1/27/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-019

June 2022

21-1-12596-030

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FIG. C-52

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: JXS/RBP Rev: JXS Typ: LKV

LOG OF GEOPROBE

Date Started	1/27/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/27/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Dark gray to black to dark brown, <i>Well-graded Gravel with Sand (GW)</i> ; moist; fine to coarse sand and slag; subangular gravel up to 1/2-inch-diameter.	1.4		0.1 0.1 0.8		SB-2021-020:1.5-01272021 SB-2021-020:2.2-01272021	
5	R-2	Dark brown, <i>Poorly Graded Sand (SP)</i> ; moist; predominantly fine sand; trace silt; iron oxide staining in places. - Black to gray silt lens from 2.1 to 2.4 feet.	5.4		0.2 0.1	During Drilling	SB-2021-020:6-01272021 SB-2021-020:7-01272021	5
10	R-3	Gray to gray-brown, <i>Sandy Silt (ML)</i> ; moist except wet from 5.9 to 6.2 feet in sand lens; fine sand; trace black organics (woody debris), from 7.7 to 10 feet grades to underlying SP.	10.0		0.1			10
15		Brown to dark brown-gray, <i>Poorly Graded Sand (SP)</i> ; wet; fine to medium sand; trace coarse sand; trace silt.	12.8					15
		No recovery.	15.0					
		BOTTOM OF GEOPROBE COMPLETED 1/27/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-020

June 2022

21-1-12596-030

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FIG. C-53

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: JXS/RBP Rev: JXS Typ: LKN

LOG OF GEOPROBE

Date Started	1/27/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/27/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Brownish-gray, <i>Well-graded Gravel with Sand (GW)</i> ; moist; subangular gravel up to 1-inch-diameter; fine to medium sand and slag.	1.0		0.1		SB-2021-021:1.5-01272021	
			1.7		0.1		SB-2021-103:1.5-01272021	
5	R-2	Gray to brown, <i>Poorly Graded Sand (SP)</i> ; moist; fine to medium sand; trace silt; trace iron oxide staining.	5.0		0.2		SB-2021-021:2.5-01272021	5
			7.4		0.1		SB-2021-021:7-01272021	
		Brownish-gray, <i>Sandy Silt (ML)</i> ; moist; fine sand in places; trace black organics.			0.1		SB-2021-021:5.2-01272021	
10	R-3	Dark brownish-gray, <i>Poorly Graded Sand (SP)</i> ; moist; predominantly fine sand; trace silt.	12.7					10
		Gray <i>Silt (ML)</i> ; moist; trace fine sand; trace black organics; trace iron oxide staining.	15.0					15
		- Increased sand content and wet from 10.3 to 11.1 feet.						
		No recovery.						
		BOTTOM OF GEOPROBE COMPLETED 1/27/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-021

June 2022

21-1-12596-030

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FIG. C-54

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: JXS/RBP Rev: JXS Typ: LKN

LOG OF GEOPROBE

Date Started	1/27/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/27/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Brown to dark brown, <i>Well-graded Gravel with Sand (GW)</i> ; moist; angular to subangular gravel; fine to coarse sand and slag.	0.7		0.1		SB-2021-022:1.5-01272021	
		Brown to dark brown, <i>Poorly Graded Sand (SP)</i> ; moist; fine to medium sand; trace silt.	1.8		0.1		SB-2021-022:2.5-01272021	
5	R-2	Reddish-brown to gray <i>Silt with Sand (ML)</i> ; moist; fine sand.	5.5		0.1		SB-2021-022:7-01272021 SB-2021-022:5.5-01272021	5
10	R-3	Dark brown to dark gray, <i>Poorly Graded Sand (SP)</i> ; moist becoming wet with depth; fine to medium sand; trace coarse sand; trace silt; trace organics.	10.5		0.1			10
		Gray <i>Silt (ML)</i> ; moist to wet; trace fine sand and black organics (woody debris).	13.0		0.2			
15		No recovery.	15.0					15
		BOTTOM OF GEOPROBE COMPLETED 1/27/2021						
20								20
25								25
30								30
35								35
40								40
45								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-022

June 2022

21-1-12596-030

SHANNON & WILSON, INC.
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FIG. C-55

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: JXS/RBP Rev: JXS Typ: LKN

LOG OF GEOPROBE

Date Started	1/27/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/27/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Brown to dark brownish-gray, <i>Well-graded Gravel with Silt and Sand (GW)</i> ; moist; subangular gravel up to 1/2-inch-diameter; medium to coarse sand and slag.	1.5		0.2		SB-2021-023:1.5-01272021	
5	R-2	Brown to dark brown, <i>Poorly Graded Sand (SP)</i> ; moist; fine to medium sand; trace silt.	5.6		0.1		SB-2021-023:2.7-01272021	5
		- Black silt lens from 2.5 to 2.8 feet.	7.8		0.1		SB-2021-023:5.5-01272021	
10	R-3	Gray, <i>Silt with Sand (ML)</i> ; moist; fine sand; brown-orange color at top and bottom 0.2 foot; trace wood.	10.9		0.2		SB-2021-023:7-01272021	10
		Reddish-brown to brown, <i>Poorly Graded Sand (SP)</i> ; moist becoming wet at 10 feet; fine to medium sand; trace silt as <1-inch-thick lenses.	12.4		0.2			
15		Gray, <i>Sandy Silt (ML)</i> ; moist; fine sand; becomes sandier and wet from 12 to 12.4 feet.	15.0		0.2			15
		No recovery.						
20		BOTTOM OF GEOPROBE COMPLETED 1/27/2021						20
25								25
30								30
35								35
40								40
45								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-023

June 2022

21-1-12596-030

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-56

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: JXS/RBP Rev: JXS Typ: LKN

LOG OF GEOPROBE

Date Started	1/27/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/27/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Brown, <i>Well-graded Gravel with Silt and Sand (GW)</i> ; moist; subrounded gravel up to 1-inch-diameter; fine to coarse sand and slag.	1.5		0.1 0.1 0.2		SB-2021-024:0.5-01272021 SB-2021-024:2.4-01272021	
5	R-2	Brown, <i>Poorly Graded Sand (SP)</i> ; moist; trace silt; fine to medium sand.	5.5					5
		Dark grayish-brown <i>Silt with Sand (ML)</i> ; moist, wet and sandier at 5.7' to 7.7'	7.9		0.2		SB-2021-024:5.6-01272021 SB-2021-024:7-01272021	
10	R-3	Reddish-brown, <i>Poorly Graded Sand (SP)</i> ; moist; becomes at 10 feet; fine to medium sand; trace coarse sand; trace silt with few <1-inch silt lenses.	11.0		0.1			10
		Gray <i>Silt (ML)</i> ; wet; trace fine sand; trace wood organics.	12.0		0			
15		Orangish-brown, <i>Silty Sand (SM)</i> ; wet; fine to medium sand.	12.2		0.1			15
		No recovery.	15.0					
		BOTTOM OF GEOPROBE COMPLETED 1/27/2021						
20								20
25								25
30								30
35								35
40								40
45								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-024

June 2022

21-1-12596-030

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-57

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: JXS/RBP Rev: JXS Typ: LKN

LOG OF GEOPROBE

Date Started 1/27/21	Location 8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation: Approx. 18.0 feet
Date Completed 1/27/21		Typical Run Length 5 feet
Total Depth (ft) 15.0	Drilling Company: Holt Services	Hole Diameter: 2.25 inches

Depth (ft)	Probe Run	Soil Description <i>Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.</i>	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
0.9	R-1	Brown and gray, <i>Well-graded Gravel with Silt and Sand (GW)</i> ; moist; fine to coarse sand and slag; orange staining in places.	0.9		0.1		SB-2021-025:1.5-01272021	0.9
5.8	R-2	Brown, <i>Silty Sand (SM)</i> ; moist; fine to medium sand; few <2-inch silt lenses; iron oxide staining in silt lenses.	5.8		0.1		SB-2021-025:2.5-01272021	5.8
10.5	R-3	Grayish-brown <i>Silt with Sand (ML)</i> ; moist; fine sand; trace black organics and wood chunks; iron oxide-staining in places.	10.5		0.2		SB-2021-025:5.5-01272021 SB-2021-025:6.5-01272021	10.5
11.0		Reddish-brown, becoming gray with depth, <i>Silty Sand (SM)</i> ; wet; fine to medium sand; trace coarse sand.	11.0		0.1		SB-2021-025:11-01272021	11.0
11.9		Gray to dark gray <i>Silt with Sand (ML)</i> ; moist to wet; fine sand.	11.9		0.2		SB-2021-025:10-01272021	11.9
15.0		No recovery.	15.0					15.0
BOTTOM OF GEOPROBE COMPLETED 1/27/2021								

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-025

June 2022

21-1-12596-030

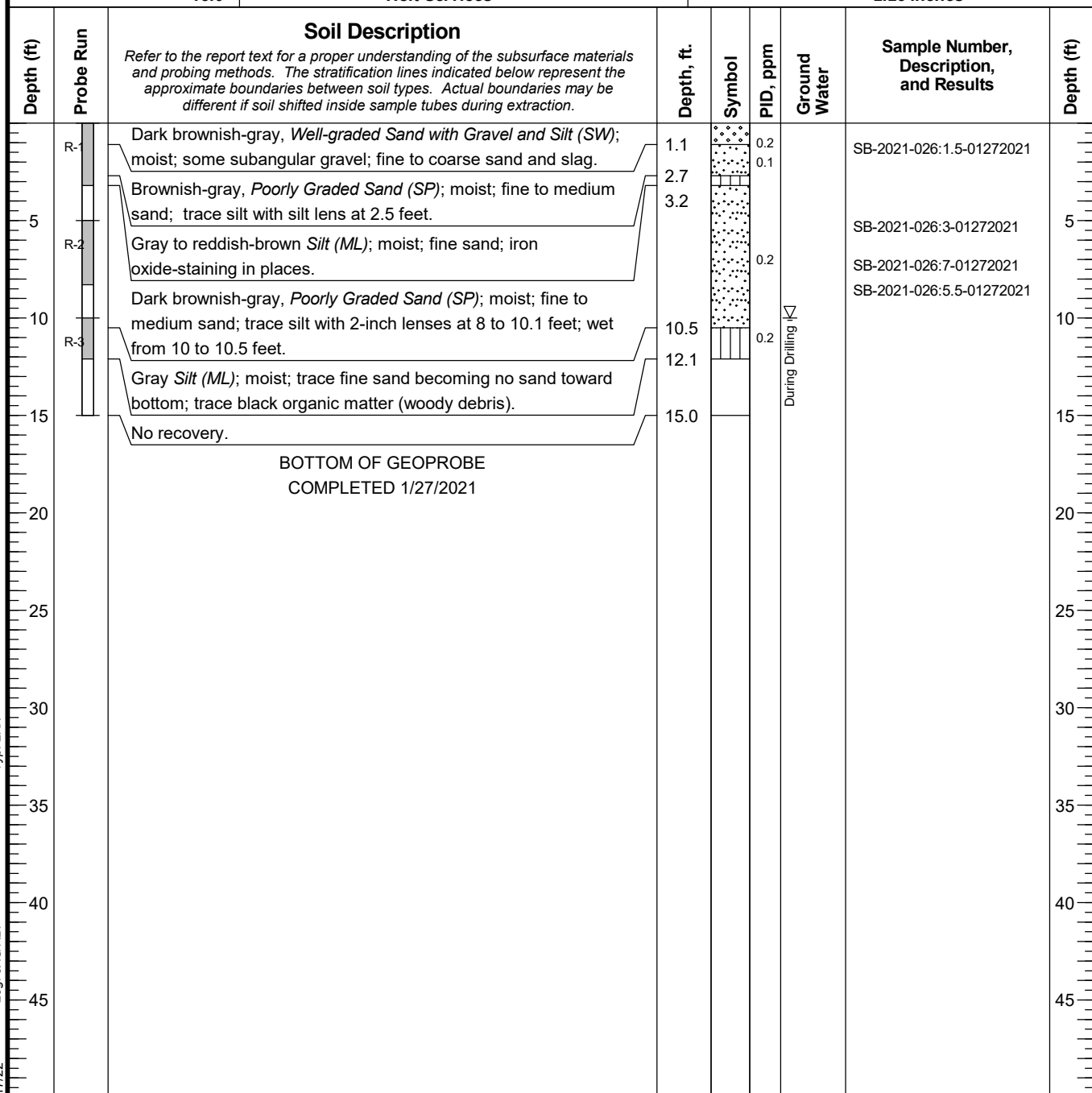
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FIG. C-58

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: JXSRBP Rev: JXS Typ: LKN

LOG OF GEOPROBE

Date Started	1/27/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/27/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches



NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-026

June 2022

21-1-12596-030

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FIG. C-59

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: JXS/RBP Rev: JXS Typ: LKN

LOG OF GEOPROBE

Date Started	1/28/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/28/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Concrete slab.	0.8				SB-2021-027:2.2-01282021	
5	R-2	Brown to gray, <i>Silty Sand (SM)</i> ; moist; trace iron oxide staining; trace fine gravel; Gray, <i>Clay (CL)</i> with iron oxide stained laminations at 2 and 2.3 feet; becomes wet at 5.3 feet.	5.7		0.2		SB-2021-027:5.3-01282021	5
		Gray, <i>Clay (CL)</i> ; moist; trace sand; trace black organics; trace iron oxide staining.	6.1		0.1			
10	R-3	Gray, <i>Sand with Silt (SP-SM)</i> ; wet; fine to medium sand; homogeneous; increased silt content 10 to 11.9 feet.	11.9		0.1		SB-2021-027:10-01282021	10
		Gray, <i>Silt to Clay (ML/CL)</i> ; moist; homogeneous; trace black organics throughout.	13.7					
15		Gray, <i>Silty Sand to Sandy Silt (SM/ML)</i> ; wet; predominantly fine sand; homogeneous.	15.0					15
		BOTTOM OF GEOPROBE COMPLETED 1/28/2021						
20								20
25								25
30								30
35								35
40								40
45								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-027

June 2022

21-1-12596-030

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FIG. C-60

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22
Typ: LKN
Rev: JXS
Log: RBP

LOG OF GEOPROBE

Date Started	1/26/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/26/21			Typical Run Length	5 feet
Total Depth (ft)	20.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Asphalt slab.	0.5					
		Olive, <i>Silty Gravel with Sand (GM)</i> ; moist; rounded to angular up to 0.5-inch diameter gravel; fine to coarse sand.	1.1		0.1			
5	R-2	Brown to dark brown, <i>Silty Sand (SM)</i> ; moist; predominantly fine to medium sand.			0.1			5
		- Few asphalt pieces at 1.6 feet.	6.3					
		- Gravelly layer at 5.2 feet.						
10	R-3	Brown <i>Silt (SM)</i> ; moist; trace fine sand; increasing sand content with depth.	10.7		1311		SB-2021-033:11-01262021	10
		Brown to gray, <i>Silty Sand (SM)</i> ; wet; predominantly fine to medium sand; increasing sand content with depth; strong petroleum odor decreasing with depth.			40		SB-2021-033:15-01262021	15
15	R-4	- Petroleum-like sheen visible on soil from 10.7 to 12.7 feet.			0.3			
		- No discernable petroleum odor at 18.1 feet; PID reading of 0.3ppm at 18.1 feet.	18.1				SB-2021-033:18-01262021	18
20		No recovery.	20.0					20
		BOTTOM OF GEOPROBE COMPLETED 1/26/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-033

June 2022

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FIG. C-61

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Typ: LKN Rev: JXS Log: RBP

LOG OF GEOPROBE

Date Started	1/25/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/25/21			Typical Run Length	5 feet
Total Depth (ft)	25.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Asphalt slab.	0.3					
		Brown, Silty Gravel with Sand (GM); dry; subangular to angular gravel; fine to coarse sand.	0.5		0.3			
5	R-2	Brown to dark brown, Silty Sand (SM); moist; predominantly fine to medium sand.			0.3			5
10	R-3	Gray, Sandy Silt (ML); wet; predominantly fine sand; strong petroleum odor decreasing with depth.	10.7		13.5	During Drilling	SB-2021-034:10.7-01252021 SB-2021-102:10.7-01252021	10
15	R-4				6.1			15
20	R-5	- No discernable petroleum odor at 21 feet and deeper.			0.4			20
25		No recovery.	24.5					25
		BOTTOM OF GEOPROBE COMPLETED 1/25/2021	25.0					

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-034

June 2022

21-1-12596-030

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FIG. C-62

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

LOG OF GEOPROBE

Date Started	1/26/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/26/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Asphalt slab.	0.3					
		Olive, Silty Gravel with Sand (GM); moist; rounded to angular gravel up to 0.5-inch diameter; fine to coarse sand.	0.8		0.2			
5	R-2	Brown to dark brown, Silty Sand (SM); moist; predominantly fine to medium sand; occasional potential silt rip-up (?) clasts; trace angular gravel up to 1-inch diameter.			0.3			5
10		- Black sand and gravel lens at 7.8 feet.						10
	R-3	Yellow-brown to gray Silt (ML); wet; trace fine sand; slight odor of decaying organic matter.	11.0		0.3	During Drilling	SB-2021-035:11-01262021	
15		Gray to dark gray, Sandy Silt (ML); wet; fine to medium sand; slight odor of decaying organic matter.	12.8					15
		No recovery.	13.8					
			15.0				SB-2021-035:13.8-01262021	
20								20
25								25
30								30
35								35
40								40
45								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

Jorgensen Forge Corporation Property
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LOG OF GEOPROBE SB-2021-035

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21-1-12596-030

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FIG. C-63

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22
Typ: LKN
Rev: JXS
Log: RBP

LOG OF GEOPROBE

Date Started	1/26/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/26/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Concrete slab.	0.7		0.2		SB-2021-038:2-01262021	
5	R-2	Brown, Silty Sand (SM); moist; fine to medium sand; trace iron oxide staining; metallic fragment (slag) at 1 foot; red-brown organic woody debris at 5.5 feet.						5
		Gray-brown, Sand with Silt (SP-SM); moist then wet at 7.7 feet; trace iron oxide staining.	6.9		0.3		SB-2021-038:6.9-01262021 SB-2021-038:7.6-01262021	
10	R-3	Gray, Clay (CL); moist; scattered organics throughout.	10.0					10
		Gray, Silty Sand (SM); wet; fine sand; black woody debris at 11.4 feet.	11.2		0.3			
15		No recovery.	12.9				SB-2021-038:12.9-01262021	15
		BOTTOM OF GEOPROBE COMPLETED 1/26/2021	15.0					

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-038

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21-1-12596-030

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FIG. C-64

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Typ: LKN Rev: JXS Log: MRH

LOG OF GEOPROBE

Date Started	1/25/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/25/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Concrete slab.	0.7		0.1		SB-2021-039:2-01252021	
5	R-2	Brown, Sand with Silt (SP-SM); moist; fine to medium sand; some iron oxide staining; 0.5- to 1.5-inch-thick Silt (ML) layers throughout; trace fine gravel at 6.8 feet.			0.1		SB-2021-039:7.4-01252021	5
10	R-3	Gray, Silty Sand (SM); moist to wet; fine to medium sand; woody debris at 7.9 feet; 2-inch-thick gray Clay (CL) layer at 7.9 feet; 12-inch-thick gray Clay (CL) layer at 10.7 feet.	7.4		0.1		SB-2021-039:10.7-01252021	10
15		No recovery.	13.2					
		BOTTOM OF GEOPROBE COMPLETED 1/25/2021	15.0					

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-039

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21-1-12596-030

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FIG. C-65

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: MRH Rev: JXS Typ: LKN

Date Started	1/28/21	Location 8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/28/21		Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company: Holt Services	Hole Diameter:	2.25 inches

SEOPROBE WEI 21-12596 GP.I 21-20447 GP.I 5/17/22

1. In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
2. Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
3. Refer to KEY for definitions and explanation of symbols.
4. CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

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2" Plastic Tube with Soil Recovery
Run No.
▽ Ground Water Level ATD

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LOG OF GEOPROBE

Date Started	1/28/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/28/21			Typical Run Length	5 feet
Total Depth (ft)	25.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Concrete slab.	0.6					
		Dark brown, <i>Silty Sand (SM)</i> ; moist; fine to coarse sand; trace pieces of clay.	1.0		0.2		SB-2021-041:2-01282021 SB-2021-106:2-01282021	
5	R-2	Dark brown to brown, <i>Poorly Graded Sand (SP)</i> ; moist; predominantly fine to medium sand; trace silt.			0.1		SB-2021-041:6-01282021	5
10	R-3	- Wet at 10.5 feet.	10.8		0.1		SB-2021-041:10.5-01282021	10
		Gray, <i>Lean Clay (CL)</i> ; moist.	12.6				SB-2021-041:13.3-01282021	
		- Black wood pieces at 11 and 11.7 feet.						
		- Iron oxide staining at 12 feet.						
15	R-4	Gray to dark gray, <i>Silty Sand (SM)</i> ; wet; predominantly fine to medium sand.			0		SB-2021-041:19-01282021	15
20	R-5				0			20
25		No recovery.	23.4				SB-2021-041:23-01282021	25
		BOTTOM OF GEOPROBE COMPLETED 1/28/2021	25.0					

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level

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LOG OF GEOPROBE SB-2021-041

June 2022

21-1-12596-030

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Geotechnical and Environmental Consultants

FIG. C-67

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

LOG OF GEOPROBE

Date Started 1/29/21	Location 8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation: Approx. 18.0 feet
Date Completed 1/29/21		Typical Run Length 5 feet
Total Depth (ft) 11.0	Drilling Company: Holt Services	Hole Diameter: 10 inches

Depth (ft)	Probe Run	Soil Description <i>Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.</i>	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
0.5		Slag.	0.5					
5		Gray to brown gray, <i>Silty Sand (SM)</i> ; moist; fine to medium sand.						5
10		- Top of yellow-painted concrete pipe at 8.5 feet.						10
11.0		BORING COMPLETED USING AN AIR KNIFE AND VACUUM TRUCK. COMPLETED 1/29/2021	11.0			During Drilling [X]	SB-2021-042: 11-01292021 SB-2021-106: 11-01292021	11.0

NOTES

1. In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
2. Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
3. Refer to KEY for definitions and explanation of symbols.
4. CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

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LOG OF GEOPROBE SB-2021-042

June 2022

21-1-12596-030

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FIG. C-68

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: RBP Rev: JXS Typ: LKN

LOG OF GEOPROBE

Date Started 1/29/21	Location 8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation: Approx. 18.0 feet
Date Completed 1/29/21		Typical Run Length 5 feet
Total Depth (ft) 9.5	Drilling Company: Holt Services	Hole Diameter: 10 inches

Depth (ft)	Probe Run	Soil Description <i>Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.</i>	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
0.5		Slag.	0.5					
5		Gray to brown gray, <i>Silty Sand (SM)</i> ; moist; predominantly fine to medium sand.						5
10		- Top of concrete pipe at 8 feet.	9.5					10
15		BORING COMPLETED USING AN AIR KNIFE AND VACUUM TRUCK. COMPLETED 1/29/2021					SB-2021-043:9.5-01292021	15
20								20
25								25
30								30
35								35
40								40
45								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

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Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-043

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21-1-12596-030

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FIG. C-69

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Typ: LKN Rev: JXS Log: RBP

LOG OF GEOPROBE

Date Started	2/5/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	2/5/21			Typical Run Length	5 feet
Total Depth (ft)	14.0	Drilling Company:	Holt Services	Hole Diameter:	10 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
		Slag.	0.5					
		Brown to gray, Silty Gravel with Sand (GM); moist.	1.5					
		Brown to gray, Poorly Graded Sand (SP); moist.						
5								5
10		- Top of concrete pipe at 8.5 feet. - Wet at 10 feet.						10
15		BORING COMPLETED USING AN AIR KNIFE AND VACUUM TRUCK. COMPLETED 2/5/2021	14.0				SB-2021-044:12-02052021	15
20								20
25								25
30								30
35								35
40								40
45								45

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

Jorgensen Forge Corporation Property
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LOG OF GEOPROBE SB-2021-044

June 2022

21-1-12596-030

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FIG. C-70

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Typ: LKN Rev: JXS Log: RBP

LOG OF GEOPROBE

Date Started	1/26/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/26/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Asphalt slab.	0.4		0			
5	R-2	Brown to dark brown, <i>Silty Sand (SM)</i> ; moist; predominantly fine to medium sand.			0		SB-2021-046:2-01262021 SB-2021-046:5.6-01262021	5
		- Gray silt lens and piece of lumber at 5.6 feet.						
10	R-3	Dark gray, <i>Sandy Silt (ML)</i> ; wet; predominantly fine sand.	10.7				SB-2021-046:10.7-01262021	10
		Gray to dark gray, <i>Lean Clay (CL)</i> ; moist; trace fine sand, increasing sand content with depth.	11.2		0.1			
15		No recovery.	13.9				SB-2021-046:13.9-01262021	15
			15.0					
		BOTTOM OF GEOPROBE COMPLETED 1/26/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-046

June 2022

21-1-12596-030

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FIG. C-71

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22
Typ. LKN
Rev. JXS
Log. RBP

LOG OF GEOPROBE

Date Started	2/2/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	2/2/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		<i>Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.</i>						
	R-1	Dark brown, <i>Gravel with Silt and Sand (GP)</i> ; moist; angular to subangular predominantly fine gravel.	0.5		0		SB-2021-047:1.5-02022021	
5	R-2	Brown, <i>Poorly Graded Sand (SP)</i> ; moist; fine to medium sand; trace silt; homogeneous.	5.6		0		SB-2021-047:7.1-02022021	5
		Brown, <i>Silty Sand (SM)</i> ; moist; fine to medium sand; some iron oxide staining; gray, siltier lense from 6.2 to 6.6 feet.	7.1					
10	R-3	Brown, <i>Sandy Silt (ML)</i> ; moist; fine sand; trace iron oxide staining; wood debris at 7.1 feet.	8.1				SB-2021-047:10.5-02022021	10
		Brown, <i>Clay (CL)</i> ; moist; trace iron oxide staining.	8.5					
15		Brown, <i>Sand with Silt (SP-SM)</i> ; moist to wet; fine to medium sand; trace iron oxide staining; trace fine gravel at 10.3 feet.	10.9					
		Gray, <i>Silty Sand (SM)</i> ; wet; fine sand; homogeneous.	12.0					
20		Gray to dark brown gray, <i>Poorly Graded Sand (SP)</i> ; wet; fine to medium sand; trace silt.	12.7					
		No recovery.	15.0					
		BOTTOM OF GEOPROBE COMPLETED 2/2/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-047

June 2022

21-1-12596-030

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FIG. C-72

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

LOG OF GEOPROBE

Date Started	10/4/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	10/4/21			Typical Run Length	5 feet
Total Depth (ft)	10.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Loose, dark brown, <i>Well-Graded Sand with Gravel and Silt (SW)</i> ; moist; slag in places.	0.8		0		SB-2021-048:1.5-10042021 SB-2021-048:2.2-10042021	
5	R-2	Loose, tan to brown, <i>Poorly Graded Sand (SP)</i> ; moist; trace silt; fine sand; silt lense at 2.2 feet below ground surface (bgs).					SB-2021-048:6-10042021	5
		Soft to medium stiff, dark gray to black, <i>Sandy Silt (ML)</i> ; moist then wet at 8 feet bgs; fine sand; petroleum odor.	7.7		0		SB-2021-048:8.5-10042021	
10		No recovery.	9.2		87.5			10
			10.0					
		BOTTOM OF GEOPROBE COMPLETED 10/4/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-048

June 2022

21-1-12596-030

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FIG. C-73

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Typ: LKV Rev: JXS Log: EMJ

LOG OF GEOPROBE									
Date Started		Location		Ground Elevation:					
Date Completed				Typical Run Length					
Total Depth (ft)		Drilling Company:		Hole Diameter:					
10/4/21		8531 E Marginal Way South Tukwila, WA 98108		Approx. 18.0 feet					
10/4/21				5 feet					
10.0		Holt Services		2.25 inches					
Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)	
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.							
	R-1	Loose, brown to dark brown, <i>Well-Graded Sand with Gravel and Silt (SW)</i> ; moist; slag in places.	1.4		0.1	None Observed During Drilling	SB-2021-049:1-10042021 SB-2021-049:2.2-10042021		
5		Brown, <i>Poorly Graded Sand (SP)</i> ; moist; fine sand; trace silt; iron oxide-stained in places; increasing silt content with depth.							
	R-2	Soft, dark gray to black <i>Silt with Sand (ML)</i> ; moist; fine sand; petroleum odor and sheen.	7.0		0		SB-2021-049:6.5-10042021 SB-2021-049:7.5-10042021		
10		No recovery.	8.0		167				
		BOTTOM OF GEOPROBE COMPLETED 10/4/2021		10.0					

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LOG OF GEOPROBE

Date Started	10/4/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	10/4/21			Typical Run Length	5 feet
Total Depth (ft)	10.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Loose, dark gray to black, <i>Well-Graded Sand with Gravel (SW)</i> ; moist; minor silt; fine to coarse sand.	1.0		0		SB-2021-050:0.5-10042021	
5	R-2	Loose, dark brownish-gray, <i>Poorly Graded Sand (SP)</i> ; moist; minor silt; fine to medium sand; silt lense at 2.5 feet below ground surface (bgs).	5.0				SB-2021-050:2.5-10042021	5
		Soft to medium stiff, gray to dark gray <i>Silt (ML)</i> ; moist then wet at 6.5 bgs; minor fine sand.	7.8		1.4 0 0.1		SB-2021-050:6.5-10042021	
10		Brown to reddish-brown, <i>Silty Sand (SM)</i> ; wet; iron oxide-stained in places.	8.2				SB-2021-050:7.5-10042021	10
		No recovery.	10.0					
		BOTTOM OF GEOPROBE COMPLETED 10/4/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-050

June 2022

21-1-12596-030

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FIG. C-75

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22
 Log: JXS/RMV Rev: JXS Typ: LKV

LOG OF GEOPROBE

Date Started	10/4/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	10/4/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Loose, dark gray to black, <i>Gravelly, Well-Graded Sand (SW)</i> ; moist; minor silt.	0.8				SB-2021-051:1.2-10042021	
		Brown to grayish-brown, <i>Silty Sand (SM)</i> ; moist; minor gravel.	1.4				SB-2021-051:2.4-10042021	
5	R-2	Brown to dark brown, <i>Sandy Silt (ML)</i> ; moist; fine sand.	5.0		1.3			
		Soft, gray to very dark gray <i>Silt (ML)</i> ; moist; fine sand; trace medium sand; petroleum hydrocarbon-like odor and sheen.	8.5		78		SB-2021-051:6.5-10042021	
10	R-3	Gray to black-stained, <i>Silty Sand (SM)</i> ; wet; petroleum odor and sheen.	12.0		65		SB-2021-051:8.0-10042021	
		Dark brownish-gray <i>Poorly Graded Sand (SP)</i> ; minor silt; no petroleum odor or sheen.	12.8		4		SB-2021-051:10.5-10042021	
15		No recovery.	15.0				SB-2021-051:12.5-10042021	
		BOTTOM OF GEOPROBE COMPLETED 10/4/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-051

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FIG. C-76

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: JXS/RMV Rev: JXS Typ: LKN

LOG OF GEOPROBE

Date Started	10/4/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	10/4/21			Typical Run Length	5 feet
Total Depth (ft)	10.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Brown to dark brown, <i>Well-Graded Gravel with Sand (GW)</i> ; moist; coarse gravel up to 1.5 inches in diameter.	0.7		0.1		SB-2021-052:0.1-10042021	
5		Brown to grayish-brown, <i>Poorly Graded Sand with Silt (SP)</i> ; moist; little to some silt.					SB-2021-052:2.4-10042021	5
	R-2	Gray <i>Silt with Sand (ML)</i> ; moist; few fine sand.	6.0		0.2		SB-2021-052:6.0-10042021	
		Brown to reddish-brown, <i>Poorly Graded Sand (SP)</i> ; moist; trace silt; fine to medium sand.	7.6		0.1		SB-2021-052:7.7-10042021	
10		No recovery.	8.3					10
			10.0					
		BOTTOM OF GEOPROBE COMPLETED 10/4/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-052

June 2022

21-1-12596-030

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FIG. C-77

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: JXS/RMV Rev: JXS Typ: LKN

LOG OF GEOPROBE

Date Started 10/4/21	Location 8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation: Approx. 18.0 feet
Date Completed 10/4/21		Typical Run Length 5 feet
Total Depth (ft) 15.0	Drilling Company: Holt Services	Hole Diameter: 2.25 inches

Depth (ft)	Probe Run	Soil Description <i>Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.</i>	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
0.8	R-1	Black and brown, <i>Well-Graded Sand with Gravel (SW)</i> ; fine to medium sand; trace silt; trace slag.	0.8		7.5 0		SB-2021-053:1.0-10042021	0.8
5	R-2	Gray to dark gray, <i>Poorly Graded Sand (SP)</i> ; moist; trace silt; silt lense at 2.8 feet.	6.4		0.8 0.1		SB-2021-053:2.8-10042021	5
10	R-3	Soft, gray, <i>Sandy Silt (ML)</i> ; moist.	9.0		0.1		SB-2021-053:11.0-10042021	10
		Gray to brownish-gray, <i>Poorly Graded Sand (SP)</i> ; wet; trace silt.	11.4		0.1 0.2		SB-2021-053:13.0-10042021	
		Soft, gray <i>Silt (ML)</i> ; wet; fine sand.	12.6		0.1			
		Brownish-gray, <i>Poorly Graded Sand with Silt (SP)</i> ; wet.	13.4					
15		No recovery.	15.0					15
BOTTOM OF GEOPROBE COMPLETED 10/4/2021								

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-053

June 2022

21-1-12596-030

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FIG. C-78

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: JXS/RMV Rev: JXS Typ: LKV

LOG OF GEOPROBE

Date Started	10/4/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	10/4/21			Typical Run Length	5 feet
Total Depth (ft)	10.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Brown to black, <i>Well-Graded Sand with Gravel (SW)</i> ; moist; fine to coarse sand; minor silt; trace slag.	0.9		0		SB-2021-054:0.5-10042021	
		Gray to grayish-brown, <i>Poorly Graded Sand (SP)</i> ; moist; fine to medium sand; minor silt.	1.6				SB-2021-054:2.5-10042021	
5	R-2	Gray <i>Silt (ML)</i> ; moist; fine to minor fine sand.			0.1			5
					0		SB-2021-054:5.9-10042021	
					0		SB-2021-054:7.0-10042021	
10		Brown to reddish-brown, <i>Poorly Graded Sand (SP)</i> ; moist becoming wet at 8.5 feet below ground surface; iron oxide-stained in places.	8.0					10
			8.8					
		No recovery.	10.0					
		BOTTOM OF GEOPROBE COMPLETED 10/4/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-054

June 2022

21-1-12596-030

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FIG. C-79

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: JXS/RMV Rev: JXS Typ: LKN

LOG OF GEOPROBE

Date Started	10/4/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	10/4/21			Typical Run Length	5 feet
Total Depth (ft)	10.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Dark brownish-gray, <i>Well-Graded Sand (SW)</i> ; moist; minor silt; fine to coarse sand; angular gravel.	1.5		0		SB-2021-055:0.5-10042021	
5		Brown to dark brown, <i>Poorly Graded Sand (SP)</i> ; moist then wet at 5.4 feet below ground surface.	5.6		0.1		SB-2021-055:2.2-10042021	5
	R-2	Gray <i>Silt (ML)</i> ; moist with wet seams; trace fine sand.	8.7		0		SB-2021-055:5.5-10042021	
10		Gray to brown to reddish-brown, <i>Poorly Graded Sand (SP)</i> ; wet; minor silt; iron oxide-stained in places.	9.5				SB-2021-055:7.5-10042021	10
		No recovery.	10.0					
		BOTTOM OF GEOPROBE COMPLETED 10/4/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-055

June 2022

21-1-12596-030

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FIG. C-80

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: JXS/RMV Rev: JXS Typ: LKV

LOG OF GEOPROBE

Date Started	10/4/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	10/4/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Dark gray, <i>Well-Graded Sand with Gravel (SW)</i> ; moist, wet in places; some angular gravel; minor silt; fine to coarse sand.	1.3		0.1		SB-2021-056:1.0-10042021	
5	R-2	Brown to gray, <i>Poorly Graded Sand (SP)</i> ; moist; minor silt; iron oxide-stained in places; silt lense from 2.3 to 2.5 feet.	6.2		0.1		SB-2021-056:2.5-10042021	5
10	R-3	Gray <i>Silt with Sand (ML)</i> ; moist; few to little fine sand.	11.5		0.1		SB-2021-056:5.5-10042021	10
15		Brown to reddish-brown, <i>Poorly Graded Sand (SP)</i> ; wet; minor silt.	13.4		0		SB-2021-056:7.7-10042021	15
		No recovery.	15.0					
		BOTTOM OF GEOPROBE COMPLETED 10/4/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-056

June 2022

21-1-12596-030

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-81

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: JXS/RMV Rev: JXS Typ: LKV

LOG OF GEOPROBE

Date Started	10/4/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	10/4/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Brown and black, <i>Well-Graded Sand with Gravel (SW)</i> ; moist; little silt; fine to coarse sand.	0.8		0.1		SB-2021-057:0.8-10042021	
5	R-2	Brown, <i>Poorly Graded Sand with Silt (SP)</i> ; moist; silt lense with weak petroleum odor from 2.3 to 2.6 feet below ground surface (bgs).	6.5		0.3		SB-2021-057:2.4-10042021 SB-2021-Dup	5
		Dark brown <i>Silt (ML)</i> ; moist; minor fine sand.					SB-2021-057:5.5-10042021 SB-2021-057:7.5-10042021	
10	R-3	Brown <i>Sand with Silt (SP)</i> ; fine to medium sand; brick layer at 10.3 feet bgs; silt lense from 10.3 to 11.3 feet bgs.	10.0		0.2			10
15		No recovery.	13.3		0			15
		BOTTOM OF GEOPROBE COMPLETED 10/4/2021	15.0					15

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-057

June 2022

21-1-12596-030

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-82

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Log: JXS/RMV Rev: JXS Typ: LKV

LOG OF GEOPROBE

Date Started	2/2/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	2/2/21			Typical Run Length	5 feet
Total Depth (ft)	15.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Concrete slab.	0.4		0			
5	R-2	Gray, <i>Silty Sand with Gravel (SM)</i> ; moist; fine to coarse sand; metallic fragments (slag) throughout; purple brick fragments at 0.5 and 1.5 feet; yellow brick fragments at 5.3, 6.1, 6.8, and 7.4 feet; woody debris at 6.6 feet; yellowish-white pulverized brick fragments at 7.6 feet; red brick fragment at 10 feet; crushed concrete from 10.5 to 10.8 feet.			0			5
10	R-3							10
		Brown to dark gray, <i>Clay (CL)</i> ; moist; trace angular fine gravel and coarse sand throughout.	11.1		0			
			11.3					
15		Brown to dark reddish brown to gray brown, <i>Silty Sand with Gravel (SM)</i> ; moist to wet; angular to subrounded fine gravel; fine to coarse sand; orange brick fragment at 11.8 feet; 1/4-inch-thick light gray <i>Silty Sand (SM)</i> layer at 12.2 feet.	12.2					15
			13.0					
20		Black, <i>Silty Sand (SM)</i> ; wet; trace angular fine gravel; fine to coarse sand; slight petroleum-like sheen; no petroleum odor; 1/2-inch-thick light gray <i>Silty Sand (SM)</i> layer at 12.9 feet.	15.0					20
25		No recovery.						25
		BOTTOM OF GEOPROBE COMPLETED 2/2/2021					SB-2021-065:11.9-02022021 SB-2021-065:13-02022021	

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Ground Water Level ATD

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE SB-2021-065

June 2022

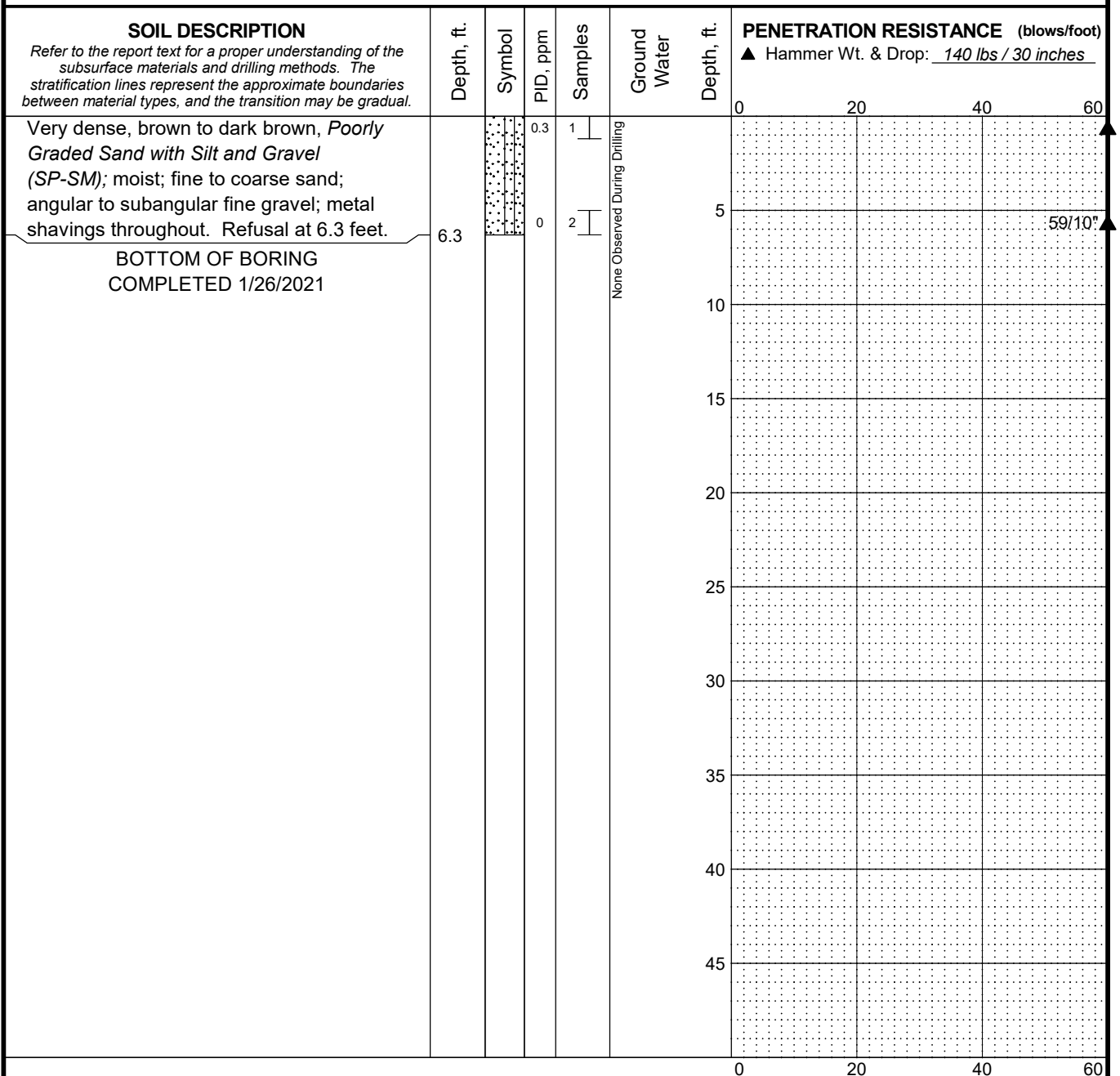
21-1-12596-030

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-83

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22

Total Depth: 6.3 ft. Northing: ~ N/A Drilling Method: Hollow Stem Auger Hole Diam.: 10 in.
 Top Elevation: ~ 18 ft. Easting: ~ N/A Drilling Company: Holt Services Rod Diam.: NWJ
 Vert. Datum: NAVD 88 Station: ~ N/A Drill Rig Equipment: Truck Mobile Drill B57 Hammer Type: Automatic
 Horiz. Datum: WA-N NAD83/11 Offset: ~ N/A Other Comments: _____



LEGEND

* Sample Not Recovered
 E Environmental Sample Obtained
 2.0" O.D. Split Spoon Sample

◇ % Fines (<0.075mm)
 ● % Water Content

NOTES

1. Refer to KEY for explanation of symbols, codes, abbreviations and definitions.
2. Groundwater level, if indicated above, is for the date specified and may vary.
3. USCS designation is based on visual-manual classification and selected lab testing.
4. The hole location was measured from existing site features and should be considered approximate.

Jorgensen Forge Corporation Property
 Remedial Investigation Report
 Tukwila, Washington

LOG OF BORING SB-2021-068

June 2022

21-1-12596-030

SHANNON & WILSON, INC.
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FIG. C-84

MASTER LOG E 21-12596.GPJ SHAN WILGDT 5/17/22 Log: CTC Rev: JXS Typ: LKN

LOG OF GEOPROBE

Date Started 1/25/21	Location 8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation: Approx. 18.0 feet
Date Completed 1/25/21		Typical Run Length 5 feet
Total Depth (ft) 10.0	Drilling Company: Holt Services	Hole Diameter: 2.25 inches

Depth (ft)	Probe Run	Soil Description <i>Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.</i>	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
0.5	R-1	Asphalt slab.	0.5					
0.7		Brown to dark brown, <i>Silty Gravel with Sand (GM)</i> ; dry; subangular to angular gravel up to 1-inch diameter; fine to coarse sand.	0.7		0.1		TSA-2021-004:1.2-01252021 TSA-2021-004:1.7-01252021 TSA-2021-004:3-01252021	
5	R-2	Brown to dark brown, <i>Silty Sand (SM)</i> ; moist; fine to coarse sand; trace angular gravel up to 1 inch; occasional siltier lenses throughout.	7.8		0.1			
10		No recovery.	10.0			None Observed During Drilling		
		BOTTOM OF GEOPROBE COMPLETED 1/25/2021						

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE TSA-2021-004

June 2022

21-1-12596-030

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-85

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Typ: LKN Rev: JXS Log: RBP

LOG OF GEOPROBE

Date Started 1/25/21	Location 8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation: Approx. 18.0 feet
Date Completed 1/25/21		Typical Run Length 5 feet
Total Depth (ft) 10.0	Drilling Company: Holt Services	Hole Diameter: 2.25 inches

Depth (ft)	Probe Run	Soil Description <i>Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.</i>	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
0.5	R-1	Asphalt slab.	0.5					
0.7		Brown, <i>Silty Gravel with Sand (GM)</i> ; dry; subangular to angular gravel up to 1 inch; fine to coarse sand.	0.7		0		TSA-2021-005:1.2-01252021 TSA-2021-100:1.2-01252021 TSA-2021-005:1.7-01252021 TSA-2021-005:3-01252021	
5	R-2	Brown to dark brown, <i>Silty Sand (SM)</i> ; moist; fine to coarse sand.			0.1			5
8.0		No recovery.	8.0			None Observed During Drilling		
10.0		BOTTOM OF GEOPROBE COMPLETED 1/25/2021	10.0					10
15								15
20								20
25								25
30								30
35								35
40								40
45								45

NOTES

1. In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
2. Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
3. Refer to KEY for definitions and explanation of symbols.
4. CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND



2" Plastic Tube - No Soil Recovery

2" Plastic Tube with Soil Recovery

Run No.

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE TSA-2021-005

June 2022

21-1-12596-030

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-86

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Typ: LKN Rev: JXS Log: RBP

LOG OF GEOPROBE

Date Started	1/25/21	Location	8531 E Marginal Way South Tukwila, WA 98108	Ground Elevation:	Approx. 18.0 feet
Date Completed	1/25/21			Typical Run Length	5 feet
Total Depth (ft)	10.0	Drilling Company:	Holt Services	Hole Diameter:	2.25 inches

Depth (ft)	Probe Run	Soil Description	Depth, ft.	Symbol	PID, ppm	Ground Water	Sample Number, Description, and Results	Depth (ft)
		Refer to the report text for a proper understanding of the subsurface materials and probing methods. The stratification lines indicated below represent the approximate boundaries between soil types. Actual boundaries may be different if soil shifted inside sample tubes during extraction.						
	R-1	Asphalt slab.	0.5					
		Brown, Silty Gravel with Sand (GM); dry; subangular to angular gravel up to 0.5-inch diameter; fine to coarse sand.	0.7		0.1		TSA-2021-006:1.2-01252021 TSA-2021-006:1.7-01252021	
5	R-2	Brown to dark brown, Silty Sand (SM); moist; fine to coarse sand.			0.1			5
10		No recovery.	8.3			None Observed During Drilling		10
		BOTTOM OF GEOPROBE COMPLETED 1/25/2021	10.0					

NOTES

- In some cases where recovery was low in the upper part of the run, the soil sample may have slid down in the tube prior to removal from the ground.
- Groundwater level, if indicated above, was estimated during probing and should be considered approximate.
- Refer to KEY for definitions and explanation of symbols.
- CT = corrosion test sample; TR = thermal resistivity sample; EN = environmental sample; GE = geotechnical sample; AR = archeological sample.

LEGEND

-  2" Plastic Tube - No Soil Recovery
 2" Plastic Tube with Soil Recovery
 Run No.

Jorgensen Forge Corporation Property
Remedial Investigation Report
Tukwila, Washington

LOG OF GEOPROBE TSA-2021-006

June 2022

21-1-12596-030

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIG. C-87

GEOPROBE WELL 21-12596.GPJ 21-20447.GPJ 5/17/22 Typ: LKN Rev: JXS Log: RBP



PROFILE NO. Shan 020518
Jorgenson

GENERATOR'S WASTE PROFILE QUESTIONNAIRE

GENERATOR INFORMATION		CUSTOMER INFORMATION	
Generator Name : Earle M. Jorgensen Company (EMJ)	Company Name : Shannon & Wilson, Inc.		
Site Address : 8531 East Marginal Way South	Company Address : 400 North 34th Street, Suite 100		
City, State, Zip : Tukwila, Washington, 98108	City, State, Zip : Seattle, Washington, 98103		
Generator Contact : Gil Leon	Company Contact : Shoshana Howard		
Title : Vice President	Company Phone# : 206-632-8020		
Generator Ph# : 323-923-6120	Treatment Code :		
Facility EPA # :	CWT Code :		

WASTE DESCRIPTION

General Waste Description : Groundwater
Process Generating Waste : Water purged during well redevelopment and sampling activities

Is this Waste a "Hazardous Waste"? ☒ No Based on: Lab Analysis: ☒ MSDS: ☐ Generator Knowledge: ☐

Waste Generations Rate: Per: Waste will be transported in: One Time Disposal?

Cubic Yards: 14-20 Day: Roll-Off Boxes: x Yes

Drums: Week: Vacuum Truck:

Tons: Month: Drum (Type Size):

Gallons: Year:

CHEMICAL COMPOSITION AND OTHER INGREDIENTS

(State for each chemical. Total maximum column must be greater than or equal to 100%). NO TRADE NAMES.

MIN MAX

See attached data tables.

Physical State	Odor	Phases	Water	Ph
Liquid, ☒	None ☒	Homogenous ☒	<1% ☐	>2-6 ☐
Sludge ☐	Mild ☐	Bi-Layered ☐	1-5% ☐	>6-10 ☒
Solid ☐	Strong ☐	Multi ☐	80-90% ☒	>10-<12.5 ☐

Free Liquids ☐ 0 % of Volume: ☐ BTU's Per LB: ☐ Color: ☐ Clear

Notes, Additional Information or Special Handling Instructions: GENERATOR CERTIFIES THAT NO OTHER MATERIALS ARE PRESENT

CERTIFICATION

I hereby certify that the above attached description is complete and accurate to the best of my knowledge and ability to determine that no deliberate or willful omission of composition or properties exist, and that all known or suspected hazards have been disclosed I certify that the materials tested are representative of all material described by this Waste Product Questionnaire.

Generator's Signature

Gil Leon

Name (Type or Print)

Vice President

Title

Date

Reviewed by:

OK Per TM 2/5/2018

TABLE 4
TPH, BTEX, AND PCBs
AUGUST 2017 SAMPLING EVENT

Sample Location	Sample Name	Sample Date	TPH (µg/L)			BTEX (µg/L)			PCBs (µg/L)												Total PCB congeners
			Gasoline Range	Diesel Range	Oil Range	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Arclor ¹ 1016	Arclor ¹ 1221	Arclor ¹ 1232	Arclor ¹ 1242	Arclor ¹ 1248	Arclor ¹ 1260	Arclor ¹ 1262	Arclor ¹ 1268			
MW-3	MW-3-08172017	08/17/17	1,300	<100	<200	0.0300	0.660	2.14	0.820	0.240	—	—	—	—	—	—	—	—	—	—	
MW-4	MW-4-08172017	08/17/17	2,640	110	<200	0.0700 J	0.840	0.290	0.330 J	0.110 J	<0.130	<0.147	<0.147	<0.147	<0.130	<0.147	<0.147	<0.147	<0.147	0.000177 J*	
MW-6	MW-6-08212017	08/21/17	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
MW-8	MW-8-08172017	08/17/17	<100	135	<200	<0.0300	0.470	<0.0400	<0.0500	<0.0300	—	—	—	—	—	—	—	—	—	—	
MW-9	MW-9-08172017	08/17/17	<100	<100	<200	<0.0300	0.480	<0.0400	<0.0500	<0.0300	—	—	—	—	—	—	—	—	—	—	
MW-11	MW-11-08242017	08/24/17	—	971	573	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
MW-14	MW-14-08252017	08/25/17	—	118	<200	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
MW-15	MW-15-08232017	08/23/17	—	<100	<200	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
MW-23	MW-23-08162017	08/16/17	—	<100 J*	<200 J*	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
MW-24	MW-24-08252017	08/25/17	—	<100	<200	—	—	—	—	—	<0.130	<0.147	<0.147	<0.147	<0.130	<0.147	<0.147	<0.147	<0.147	—	
MW-25	MW-25-08232017	08/23/17	—	<100	<200	—	—	—	—	—	<0.130	<0.147	<0.147	<0.147	<0.130	<0.147	<0.147	<0.147	<0.147	—	
MW-30	MW-30-08182017	08/18/17	—	665	<200	—	—	—	—	—	<0.130	<0.147	<0.147	<0.147	<0.130	<0.147	<0.147	<0.147	<0.147	—	
MW-31	MW-31-08162017	08/16/17	—	1,770	1,080	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
MW-32	MW-32-08242017	08/24/17	<100	1,350	623	<0.0300	<0.200 B*	<0.0400	<0.0500	<0.0300	<0.130	<0.147	<0.147	<0.147	<0.130	<0.147	<0.147	<0.147	<0.147	—	
MW-34	MW-34-08212017	08/21/17	—	8,160 E	1,030	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	
MW-39	MW-39-08282017	08/28/17	—	—	—	—	—	—	—	—	<0.130	<0.147	<0.147	<0.147	<0.130	<0.147	<0.147	<0.147	<0.147	—	
MW-41	MW-41-08212017	08/21/17	<100	227	<200	<0.0300	<0.0400	<0.0400	<0.0500	<0.0300	<0.130	<0.147	<0.147	<0.147	<0.130	<0.147	<0.147	<0.147	<0.147	0.000107 J*	
MW-42	MW-42-08232017	08/23/17	—	—	—	—	—	—	—	—	<0.130	<0.147	<0.147	<0.147	<0.130	<0.147	<0.147	<0.147	<0.147	—	
MW-43	MW-43-08242017	08/24/17	<100	584	329	0.190 JL*	0.320 JH*	<0.0400 J*	0.0700 JL*	0.110 JL*	<0.130	<0.147	<0.147	<0.147	<0.130	<0.147	<0.147	<0.147	<0.147	—	
MW-44	MW-44-08232017	08/23/17	<100 J*	378	<200	<0.0300 J*	<0.210 B*	<0.0400 J*	<0.0500 J*	<0.0300 J*	<0.130	<0.147	<0.147	<0.147	<0.130	<0.147	<0.147	<0.147	<0.147	0.000127 J*	
MW-46	MW-46-08242017	08/24/17	<100	1,510	646 J*	0.0400 JL*	0.470 JL*	<0.0400 J*	0.100 JL*	0.0800 JL*	—	—	—	—	—	—	—	—	—	—	
MW-46	MW-101-08242017	08/24/17	<100	1,200	304 J*	0.0400 JL*	0.310 JH*	<0.0400 J*	0.0800 JL*	0.0700 JL*	—	—	—	—	—	—	—	—	—	—	
MW-47	MW-47-08242017	08/24/17	—	—	—	—	—	—	—	—	<0.130	<0.147	<0.147	<0.147	<0.130	<0.147	<0.147	<0.147	<0.147	—	
MW-49	MW-49-08172017	08/17/17	<100	<100	<200	<0.0300	0.380	<0.0400	<0.0500	<0.0300	<0.130	<0.147	<0.147	<0.147	<0.130	<0.147	<0.147	<0.147	<0.147	0.000124 J*	
MW-50	MW-50-08232017	08/23/17	<100	<100	<200	<0.0300	<0.200 B*	<0.0400	<0.0500	<0.0300	<0.130	<0.147	<0.147	<0.147	<0.130	<0.147	<0.147	<0.147	<0.147	—	
MW-51	MW-51-08252017	08/25/17	<100	<100 J*	<200 J*	<0.0300	<0.0400	<0.0400	<0.0500	<0.0300	<0.130	<0.147	<0.147	<0.147	<0.130	<0.147	<0.147	<0.147	<0.147	—	
MW-52	MW-52-08182017	08/18/17	<100	<100	<200	0.0600 J	1.08 J*	<0.0400	<0.0500	<0.0300	<0.130	<0.147	<0.147	<0.147	<0.130	<0.147	<0.147	<0.147	<0.147	—	
MW-52	MW-2100-08182017	08/18/17	<100	<100	<200	0.0500 J	0.160 J*	<0.0400	<0.0500	<0.0300	<0.130	<0.147	<0.147	<0.147	<0.130	<0.147	<0.147	<0.147	<0.147	—	

Notes:

Sample MW-100-08182017 is a field-duplicate of MW-52-08182017.

Sample MW-101-08242017 is a field-duplicate of MW-46-08242017.

Results are in micrograms per liter (µg/L).

Bold text indicates a detected result.

< = analyte not detected; listed as less than the detection limit, unless otherwise flagged due to quality-control failures.

— = not analyzed or not available.

B* = result is considered not detected due to quality control failures; see checklist for details. Flag applied by Shannon & Wilson, Inc.

BTEX = benzene, toluene, ethylbenzene, and xylenes.

E = the analyte concentration exceeds the upper limit of the calibration range of the instrument; result is considered estimated.

J = estimated concentration, detected greater than the method detection limit and less than the reporting limit. Flag applied by the laboratory.

J* = estimated concentration due to quality control failures. Flag applied by Shannon & Wilson, Inc.

JH* = estimated concentration, biased high due to quality control failures. Flag applied by Shannon & Wilson, Inc.

JL* = estimated concentration, biased low due to quality control failures. Flag applied by Shannon & Wilson, Inc.

PCBs = polychlorinated biphenyls.

TPH = total petroleum hydrocarbons.

TABLE 5
POLYCYCLIC AROMATIC HYDROCARBONS
AUGUST 2017 SAMPLING EVENT

Sample Location	Sample Name	Sample Date	1-Methyl-naphthalene	2-Methyl-naphthalene	Acenaphthene	Acenaphthylene	Anthracene	Benzo(a) anthracene	Benzo(a) pyrene	Benzo(b) fluoranthene	Benzo(g,h,i) perylene	Benzo(f) fluoranthene	Benzo(k) fluoranthene	Chrysene	Dibenz(a,h) anthracene	Dibenzofuran	Fluoranthene	Fluorene	Indeno(1,2,3-cd) pyrene	Naphthalene	Phenanthrene	Pyrene
MW-9	MW-9-08172017	08/17/17	<0.0200	<0.0300	<0.0200	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	<0.0200	<0.0800	<0.0200	<0.0200	<0.0300
MW-14	MW-14-08252017	08/25/17	<0.0200	<0.0300	<0.0200	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	<0.0200	<0.0800	<0.0200	<0.0200	<0.0300
MW-15	MW-15-08232017	08/15/17	<0.0200	<0.0300	<0.0200	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	<0.0200	<0.0800	<0.0200	<0.0200	<0.0300
MW-23	MW-23-08162017	08/16/17	<0.0200	<0.0300	<0.0200	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	<0.0200	<0.0800	<0.0200	<0.0200	<0.0300
MW-24	MW-24-08252017	08/25/17	<0.0200	<0.0300	<0.0200	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	<0.0200	<0.0800	<0.0200	<0.0200	<0.0300
MW-25	MW-25-08232017	08/23/17	<0.0200	<0.0300	<0.0200	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	<0.0200	<0.0800	<0.0200	<0.0200	<0.0300
MW-30	MW-30-08182017	08/18/17	<0.0200	<0.0300	<0.0200	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	<0.0200	<0.0800	<0.0200	<0.0200	<0.0300
MW-31	MW-31-08162017	08/16/17	<0.0200	<0.0300	<0.0200	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	0.290	<0.0800	<0.0200	1.30	<0.0300
MW-32	MW-32-08242017	08/24/17	<0.0200	<0.0300	<0.0200	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	<0.0200	<0.0800	<0.0200	<0.0200	<0.0300
MW-37	MW-37-08232017	08/23/17	<0.0200	<0.0300	<0.0200	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	<0.0200	<0.0800	<0.0200	<0.0200	<0.0300
MW-41	MW-41-08212017	08/21/17	<0.0200	<0.0300	<0.0200	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	0.0600J	<0.0800	<0.0200	<0.0200	<0.0300
MW-46	MW-46-08242017	08/24/17	0.330 J*	0.430J*	1.83	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	0.0600J	<0.0800	0.430J*	0.300	<0.0300
MW-46	MW-101-08242017	08/24/17	0.460 J*	0.650J*	1.86	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	0.0800J	<0.0800	0.770J*	0.360	<0.0300
MW-50	MW-50-08232017	08/23/17	<0.0200	<0.0300	<0.0200	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	<0.0200	<0.0800	<0.0200	<0.0200	<0.0300
MW-51	MW-51-08252017	08/25/17	<0.0200	<0.0300	<0.0200	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	<0.0200	<0.0800	<0.0200	<0.0200	<0.0300
MW-52	MW-52-08182017	08/18/17	<0.0200	<0.0300	<0.0200	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	<0.0200	<0.0800	<0.0200	<0.0200	<0.0300
MW-52	MW-100-08182017	08/18/17	<0.0200	<0.0300	<0.0200	<0.0200	<0.0200	<0.0500	<0.0600	<0.0900	<0.0700	<0.0300	<0.0900	<0.0600	<0.0900	<0.0200	<0.0200	<0.0200	<0.0800	<0.0200	<0.0200	<0.0300

Notes:

Sample MW-100-08182017 is a field duplicate of MW-52-08182017.

Sample MW-101-08242017 is a field duplicate of MW-46-08242017.

Results are in micrograms per liter (µg/L).

Bold text indicates a detected result.

< = analyte not detected; listed as less than the detection limit, unless otherwise flagged due to quality-control failures.

— = not analyzed or not available.

J = estimated concentration, detected greater than the method detection limit and less than the reporting limit. Flag applied by the laboratory.

J* = estimated concentration due to quality control failures. Flag applied by Shannon & Wilson, Inc.

JH* = estimated concentration, biased high due to quality control failures. Flag applied by Shannon & Wilson, Inc.

PAHs = polycyclic aromatic hydrocarbons.

TABLE 6
SEMI-VOLATILE ORGANIC COMPOUNDS
AUGUST 2017 SAMPLING EVENT

Sample Location	Sample Name	Sample Date	Semi-Volatile Organic Compounds (µg/L)															
			1,2,4-Trichloro-benzene	1,2-Dichloro-benzene	1,3-Dichlorobenzene	1,4-Dichlorobenzene	2,4,5-Trichlorophenol	2,4,6-Trichlorophenol	2,4-Dichloro-phenol	2,4-Dimethyl-phenol	2,4-Dinitro-phenol	2,4-Dinitro-toluene	2,6-Dinitro-toluene	2-Chloro-naphthalene	2-Chloro-phenol	2-Methylphenol (o-Cresol)	2-Nitroaniline	2-Nitrophenol
MW-14	MW-14-08252017	08/25/17	<0.0300	<0.0300	<0.0300	<0.0300	<0.100	<0.200	<0.100	<0.300	<0.200	<0.0300	<0.0300	<0.0300	<0.0300	<0.200	<0.0400	
MW-24	MW-24-08252017	08/25/17	<0.0300	<0.0300	<0.0300	<0.0300	<0.100	<0.200	<0.100	<0.300	<0.200	<0.0300	<0.0300	<0.0300	<0.0300	<0.200	<0.0400	
MW-30	MW-18-08182017	08/18/17	<0.0300	<0.0300	<0.0300	<0.0300	<0.100	<0.200	<0.100	<0.300	<0.200	<0.0300	<0.0300	<0.0300	<0.0300	<0.200	<0.0400	
MW-31	MW-16-08162017	08/16/17	<0.0300	<0.0300	<0.0300	<0.0300	<0.100	<0.200	<0.100	<0.300	<0.200	<0.0300	<0.0300	<0.0300	<0.0300	<0.200	<0.0400	
MW-32	MW-32-08242017	08/24/17	<0.0300	<0.0300	<0.0300	<0.0300	<0.100	<0.200	<0.100	<0.300	<0.200	<0.0300	<0.0300	<0.0300	<0.0300	<0.200	<0.0400	
MW-37	MW-37-08232017	08/23/17	<0.0300	<0.0300	<0.0300	<0.0300	<0.100	<0.200	<0.100	<0.300	<0.200	<0.0300	<0.0300	<0.0300	<0.0300	<0.200	<0.0400	
MW-41	MW-41-08212017	08/21/17	<0.0300	<0.0300	<0.0300	<0.0300	<0.100	<0.200	<0.100	<0.300	<0.200	<0.0300	<0.0300	<0.0300	<0.0300	<0.200	<0.0400	
MW-46	MW-46-08242017	08/24/17	<0.0300	<0.0300	<0.0300	<0.0300	<0.100	<0.200	<0.100	<0.300	<0.200	<0.0300	<0.0300	<0.0300	<0.0300	<0.200	<0.0400	
MW-46	MW-101-08242017	08/24/17	<0.0300	<0.0300	<0.0300	<0.0300	<0.100	<0.200	<0.100	<0.300	<0.200	<0.0300	<0.0300	<0.0300	<0.0300	<0.200	<0.0400	
MW-50	MW-50-08232017	08/23/17	<0.0300	<0.0300	<0.0300	<0.0300	<0.100	<0.200	<0.100	<0.300	<0.200	<0.0300	<0.0300	<0.0300	<0.0300	<0.200	<0.0400	
MW-51	MW-51-08252017	08/25/17	<0.0300	<0.0300	<0.0300	<0.0300	<0.100	<0.200	<0.100	<0.300	<0.200	<0.0300	<0.0300	<0.0300	<0.0300	<0.200	<0.0400	
MW-52	MW-52-08182017	08/18/17	<0.0300	<0.0300	<0.0300	<0.0300	<0.100	<0.200	<0.100	<0.300	<0.200	<0.0300	<0.0300	<0.0300	<0.0300	<0.200	<0.0400	
MW-52	MW-100-08182017	08/18/17	<0.0300	<0.0300	<0.0300	<0.0300	<0.100	<0.200	<0.100	<0.300	<0.200	<0.0300	<0.0300	<0.0300	<0.0300	<0.200	<0.0400	

TABLE 6
SEMI-VOLATILE ORGANIC COMPOUNDS
AUGUST 2017 SAMPLING EVENT

Sample Location	Sample Name	Sample Date	Semi-Volatile Organic Compounds (µg/L)														
			3,3'-Dichlorobenzidine	β-Nitroaniline	4,6-Dinitro-2-methylphenol	4-Bromophenyl phenyl ether	4-Chloro-3-methylphenol	4-Chloroaniline	4-Chlorophenyl phenyl ether	4-Methylphenol (p-Cresol)	4-Nitroaniline	4-Nitrophenol	Benzoic acid	Benzyl alcohol	Bis(2-chloro-1-methylethyl) ether	Bis(2-chloroethoxy)methane	Bis(2-chloroethyl) ether
MW-14	MW-14-08232017	08/25/17	<0.300	<0.200	<0.400	<0.0200	<0.100	<0.0400 *	<0.0200	<0.0300	<0.200	<0.0600	<0.100 *	<0.0200	<0.0300	<0.0300	<0.0300
MW-24	MW-24-08252017	08/25/17	<0.300	<0.200	<0.400	<0.0200	<0.100	<0.0400 *	<0.0200	<0.0300	<0.200	<0.0600	<0.100 *	<0.0200	<0.0300	<0.0300	<0.0300
MW-30	MW-18-08182017	08/18/17	<0.300	<0.200	<0.400	<0.0200	<0.100	<0.0400 *	<0.0200	<0.0300	<0.200	<0.0600	<0.100 *	<0.0200	<0.0300	<0.0300	<0.200
MW-31	MW-16-08162017	08/16/17	R*	<0.200 *	<0.400	<0.0200	<0.100	<0.0400 *	<0.0200	<0.0300	<0.200	<0.0600 *	<0.100 *	<0.0200	<0.0300	<0.0300	<0.200
MW-32	MW-32-08242017	08/24/17	<0.300	<0.200	<0.400	<0.0200	<0.100	<0.0400 *	<0.0200	<0.0300	<0.200	<0.0600	<0.100 *	<0.0200	<0.0300	<0.0300	<0.200
MW-37	MW-37-08232017	08/23/17	<0.300	<0.200	<0.400	<0.0200	<0.100	<0.0400 *	<0.0200	<0.0300	<0.200	<0.0600	<0.100 *	<0.0200	<0.0300	<0.0300	<0.200
MW-41	MW-41-08212017	08/21/17	<0.300	<0.200	<0.400	<0.0200	<0.100	<0.0400 *	<0.0200	<0.0300	<0.200	<0.0600	<0.100 *	<0.0200	<0.0300	<0.0300	<0.200
MW-46	MW-46-08242017	08/24/17	<0.300	<0.200	<0.400	<0.0200	<0.100	<0.0400 *	<0.0200	<0.0300	<0.200	<0.0600	<0.100 *	<0.0200	<0.0300	<0.0300	<0.200
MW-46	MW-101-08242017	08/24/17	<0.300	<0.200	<0.400	<0.0200	<0.100	<0.0400 *	<0.0200	<0.0300	<0.200	<0.0600	<0.100 *	<0.0200	<0.0300	<0.0300	<0.200
MW-50	MW-50-08232017	08/23/17	<0.300	<0.200	<0.400	<0.0200	<0.100	<0.0400 *	<0.0200	<0.0300	<0.200	<0.0600	<0.100 *	<0.0200	<0.0300	<0.0300	<0.200
MW-51	MW-51-08252017	08/25/17	<0.300	<0.200	<0.400	<0.0200	<0.100	<0.0400 *	<0.0200	<0.0300	<0.200	<0.0600	<0.100 *	<0.0200	<0.0300	<0.0300	<0.200
MW-52	MW-52-08182017	08/18/17	<0.300	<0.200	<0.400	<0.0200	<0.100	<0.0400 *	<0.0200	<0.0300	<0.200	<0.0600	<0.100 *	<0.0200	<0.0300	<0.0300	<0.200
MW-52	MW-100-08182017	08/18/17	<0.300	<0.200	<0.400	<0.0200	<0.100	<0.0400 *	<0.0200	<0.0300	<0.200	<0.0600	<0.100 *	<0.0200	<0.0300	<0.0300	<0.200

TABLE 6
SEMI-VOLATILE ORGANIC COMPOUNDS
AUGUST 2017 SAMPLING EVENT

Sample Location	Sample Name	Sample Date	Semi-Volatile Organic Compounds (µg/L)																
			Butyl benzyl phthalate	Carbazole	Dibutyl phthalate	Diethyl phthalate	Dimethyl phthalate	D-n-octyl phthalate	Hexachlorobenzene	Hexachlorobutadiene	Hexachlorocyclopentadiene	Hexachloroethane	Isophorone	Nitrobenzene	n-Nitrosodimethylamine	n-Nitrosodi-n-propylamine	n-Nitrosodiphenylamine	Pentachlorophenol	
MW-14	MW-14-08252017	08/25/17	<0.0700	<0.0400	<0.0500	<0.0600	<0.0400	<0.0500	<0.0500	<0.0400	<0.100	<0.0400	<0.0300	<0.0300	<0.0400	<0.0400	<0.0300	<0.100	<0.0100 J*
MW-24	MW-24-08252017	08/25/17	<0.0700	<0.0400	<0.0500	<0.0600	<0.0400	<0.0500	<0.0500	<0.0400	<0.100	<0.0400	<0.0300	<0.0300	<0.0400	<0.0400	<0.0300	<0.100	<0.0100 J*
MW-30	MW-18-08182017	08/18/17	<0.0700	<0.0400	<0.0500	<0.0600	<0.0400	<0.0500	<0.0500	<0.0400	<0.100	<0.0400	<0.0300	<0.0300	<0.0400	<0.0400	<0.0300	<0.100	<0.0100 J*
MW-31	MW-16-08162017	08/16/17	<0.0700	<0.0400	<0.0500	<0.0600	<0.0400	<0.0500	<0.0500	<0.0400	<0.100 J*	<0.0400 J*	<0.0300	<0.0300	<0.0400 J*	<0.0400	<0.0300	<0.100	<0.0100 J*
MW-32	MW-32-08242017	08/24/17	<0.0700	<0.0400	<0.0500	<0.0600	<0.0400	<0.0500	<0.0500	<0.0400	<0.100	<0.0400	<0.0300	<0.0300	<0.0400	<0.0400	<0.0300	<0.100	<0.0100 J*
MW-37	MW-37-08232017	08/23/17	<0.0700	<0.0400	<0.0500	<0.0600	<0.0400	<0.0500	<0.0400	<0.0400	<0.100	<0.0400	<0.0300	<0.0300	<0.0400	<0.0400	<0.0300	<0.100	<0.0100 J*
MW-41	MW-41-08212017	08/21/17	<0.0700	<0.0400	<0.0500	0.100 J	<0.0400	<0.0500	<0.0400	<0.0400	<0.100	<0.0400	<0.0300	<0.0300	<0.0400	<0.0400	<0.0300	<0.100	0.100 JL*
MW-46	MW-46-08242017	08/24/17	<0.0700	0.100 J	<0.0500	<0.0600	<0.0400	<0.0500	<0.0400	<0.0400	<0.100	<0.0400	<0.0300	<0.0300	<0.0400	<0.0400	<0.0300	<0.100	<0.0100 J*
MW-50	MW-50-08232017	08/23/17	<0.0700	0.100 J	<0.0500	<0.0600	<0.0400	<0.0500	<0.0400	<0.0400	<0.100	<0.0400	<0.0300	<0.0300	<0.0400	<0.0400	<0.0300	<0.100	<0.0100 J*
MW-51	MW-51-08252017	08/25/17	<0.0700	<0.0400	<0.0500	<0.0600	<0.0400	<0.0500	<0.0400	<0.0400	<0.100	<0.0400	<0.0300	<0.0300	<0.0400	<0.0400	<0.0300	<0.100	<0.0100 J*
MW-52	MW-52-08182017	08/18/17	<0.0700	<0.0400	<0.0500	1.40 J*	<0.0400	<0.0500	<0.0400	<0.0400	<0.100	<0.0400	<0.0300	<0.0300	<0.0400	<0.0400	<0.0300	<0.100	<0.0100 J*
MW-52	MW-100-08182017	08/18/17	<0.0700	<0.0400	<0.0500	<0.0600 J*	<0.0400	<0.0500	<0.0400	<0.0400	<0.100	<0.0400	<0.0300	<0.0300	<0.0400	<0.0400	<0.0300	<0.100	<0.0100 J*

Notes:

Sample MW-100-08182017 is a field-duplicate of MW-52-08182017.

Sample MW-101-08242017 is a field-duplicate of MW-46-08242017.

Results are in micrograms per liter (µg/L).

Bold text indicates a detected result.

< = analyte not detected; listed as less than the detection limit, unless otherwise flagged due to quality-control failures.

— = not available.

J = estimated concentration, detected greater than the method detection limit and less than the reporting limit. Flag applied by the laboratory.

J* = estimated concentration due to quality control failures. Flag applied by Shannon & Wilson, Inc.

JL* = estimated concentration, biased low due to quality control failures. Flag applied by Shannon & Wilson, Inc.

R* = rejected result due to severe quality control failures: see checklist for details. Flag applied by Shannon & Wilson, Inc.

SVOCs = semi-volatile organic compounds

TABLE 7
HALOGENATED VOLATILE ORGANIC COMPOUNDS
AUGUST 2017 SAMPLING EVENT

Sample Location	Sample Name	Sample Date	Halogenated Volatile Organic Compounds (µg/L)										Chlorobenzene	Bromobenzene	Bromomethane	Carbon tetrachloride	Chlorobenzene
			1,1,1,2-Tetrachloroethane	1,1,1-Trichloroethane	1,1,2-Trichloroethane	1,1-Dichloroethane	1,1-Dichloroethylene	1,2,3-Trichloropropane	1,2-Dibromo-3-chloropropane	1,2-Dichloroethane (EDC)	1,2-Dichloropropane	1,3-Dichloropropane	2-Chloroethyl vinyl ether	Bromobenzene	Bromomethane	Carbon tetrachloride	Chlorobenzene
MW-6	MW-6-0812017	08/21/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-7	MW-7-08172017	08/17/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-8	MW-8-08172017	08/17/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-9	MW-9-08172017	08/17/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-15	MW-15-08232017	08/23/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-23	MW-23-08162017	08/16/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-24	MW-24-08252017	08/25/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	R*	<0.0600	<0.250	<0.0400	<0.0200
MW-25	MW-25-08232017	08/23/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-30	MW-30-08182017	08/18/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	R*	<0.0600	<0.250	<0.0400	<0.0200
MW-31	MW-31-08162017	08/16/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-32	MW-32-08242017	08/24/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-36	MW-36-08212017	08/21/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-37	MW-37-08232017	08/23/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-38	MW-38-08162017	08/16/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-39	MW-39-08282017	08/28/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-40	MW-40-08212017	08/21/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-41	MW-41-08212017	08/21/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-42	MW-42-08232017	08/23/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-43	MW-43-08242017	08/24/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	0.300 JL*	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-44	MW-44-08232017	08/23/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-45	MW-45-08162017	08/16/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-46	MW-46-08242017	08/24/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-47	MW-47-08242017	08/24/17	<0.0400	<0.130	<0.0600	<0.0500	0.08	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-48	MW-48-08162017	08/16/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	R*	<0.0600	<0.250	<0.0400	<0.0200
MW-49	MW-49-08172017	08/17/17	<0.0400	<0.130	<0.0600	<0.0500	<0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-50	MW-50-08232017	08/23/17	<0.0400	<0.130	<0.0600	<0.0500	0.0800 J	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-51	MW-51-08252017	08/25/17	<0.0400	<0.130	<0.0600	<0.0500	0.0500	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-52	MW-52-08182017	08/18/17	<0.0400	<0.130	<0.0600	<0.0500	0.240	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200
MW-52	MW-100-08182017	08/18/17	<0.0400	<0.130	<0.0600	<0.0500	0.260	<0.130	<0.370	<0.0700	<0.0600	<0.0600	<0.250	<0.0600	<0.250	<0.0400	<0.0200

TABLE 7
HALOGENATED VOLATILE ORGANIC COMPOUNDS
AUGUST 2017 SAMPLING EVENT

Sample Location	Sample Name	Sample Date	Chloroethane	Chloroform	Chloromethane	trans-1,3-Dichloropropene	Dibromochloromethane	Dibromomethane	Dichlorobromomethane	Dichlorodifluoromethane (CFC-12)	Ethylene dibromide (EDB)	Methylene chloride	Tetrachloroethylene (PCE)	trans-1,2-Dichloroethylene	trans-1,3-Dichloropropene	Trichloroethylene (TCE)	Trichlorofluoromethane (CFC-11)	Vinyl chloride
MW-6	MW-6-08212017	08/21/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-7	MW-7-08172017	08/17/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-8	MW-8-08172017	08/17/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-9	MW-9-08172017	08/17/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-15	MW-15-08232017	08/23/17	<0.0900	0.170J	<0.500 B*	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-23	MW-23-08162017	08/16/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	1.06 JL*	<0.0500	<0.0800	0.280 JL*	<0.0400	<0.0600
MW-24	MW-24-08252017	08/25/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-25	MW-25-08232017	08/23/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-30	MW-30-08182017	08/18/17	<0.0900	<0.0300	0.110 J	<0.0600	<0.0500	<0.150	<0.0500	0.500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-31	MW-31-08162017	08/16/17	<0.0900	<0.0300	<0.500 B*	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-32	MW-32-08242017	08/24/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-36	MW-36-08212017	08/21/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-37	MW-37-08232017	08/23/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-38	MW-38-08162017	08/16/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-39	MW-39-08282017	08/28/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-40	MW-40-08212017	08/21/17	<0.0900	<0.0300	0.190 JL*	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	0.930 JL*	<0.0600
MW-41	MW-41-08212017	08/21/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	0.120 J
MW-42	MW-42-08232017	08/23/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-43	MW-43-08242017	08/24/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	0.350 JL*	<0.0600
MW-44	MW-44-08232017	08/23/17	<0.0900	0.110 JL*	<0.500 B*	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-45	MW-45-08162017	08/16/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	0.140 J
MW-46	MW-46-08242017	08/24/17	0.130 JL*	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	0.170 JL*
MW-47	MW-47-08242017	08/24/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	0.150 JL*
MW-48	MW-48-08162017	08/16/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	<0.0600
MW-49	MW-49-08172017	08/17/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	0.830	<0.0400	0.0700 J
MW-50	MW-50-08232017	08/23/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	1.49
MW-51	MW-51-08252017	08/25/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	0.0700 J	<0.0400	0.410
MW-52	MW-52-08182017	08/18/17	<0.0900	<0.0300	<0.0900	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	0.500 J	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	0.550
MW-52	MW-100-08182017	08/18/17	<0.0900	<0.0300	0.120 J	<0.0600	<0.0500	<0.150	<0.0500	<0.0500	<0.0700	<0.490	<0.0500	<0.0500	<0.0800	<0.0500	<0.0400	0.640

Note:

Sample MW-100-08182017 is a field duplicate of MW-52-08182017.

Sample MW-101-08242017 is a field duplicate to MW-46-08242017.

Results are in micrograms per liter (µg/L).

Bold text indicates a detected result.

< = analyte not detected; listed as less than the detection limit, unless otherwise flagged due to quality-control failures.

— = not available.

B* = Result is considered not detected due to quality control failures; see checklist for details. Flag applied by Shannon & Wilson, Inc.

J* = estimated concentration, detected greater than the method detection limit and less than the reporting limit. Flag applied by Shannon & Wilson, Inc.

JL* = estimated concentration, detected greater than the method detection limit and less than the reporting limit. Flag applied by Shannon & Wilson, Inc.

R* = rejected result due to severe quality control failures; see checklist for details. Flag applied by Shannon & Wilson, Inc.

TABLE 8
TOTAL AND DISSOLVED METALS
AUGUST 2017 SAMPLING EVENT

Sample Location	Sample Name	Sample Date	Metals (µg/L)											
			Arsenic		Cadmium		Chromium		Chromium, hexavalent		Cobalt		Copper	
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
MW-6	MW-6-08212017	08/21/17	39.4	10.8	0.0490 J	<0.0300	1.76	0.209	<13.0	0.092	0.355	0.092	9.69	0.434
MW-7	MW-7-08172017	08/17/17	0.235	0.165	0.0410 J	<0.0300	0.270 J	<0.130	<13.0	0.527	0.527	0.054	1.90 JH*	1.35
MW-9	MW-9-08172017	08/17/17	15.2	0.906	1.37	0.604	0.472 J	5.34	<13.0	3.65	3.65	2.32	6.21	2.09
MW-11	MW-11-08242017	08/24/17	4.24	2.15JL*	0.574	0.0700JL*	<0.933B*	0.388JL*	<13.0	0.756	0.756	0.642JL*	<1.36B*	1.12JL*
MW-14	MW-14-08252017	08/25/17	7.44	1.14	<0.0300	<0.0300	<1.30	0.254	<13.0	1.46	1.46	1.34	0.727	0.348
MW-15	MW-15-08232017	08/23/17	2.33	0.304	0.109	<0.0300	0.289J	<0.130	<13.0	19.0	19.0	0.147	2.96	1.09
MW-23	MW-23-08162017	08/16/17	18.1	12.2	0.0610 J	0.033	0.636	<0.650	<13.0	3.26	3.26	3.25	1.22	0.649
MW-24	MW-24-08252017	08/25/17	30.6	29.4	<0.0300	<0.0300	11.4	11.4	R*	0.684	0.684	0.665	2.14	3.09
MW-25	MW-25-08232017	08/23/17	6.73	0.487JL*	0.0390 J	<0.0300	1.43 J*	<0.130	R*	0.582	0.582	0.046	1.51	<0.340
MW-30	MW-30-08182017	08/18/17	0.491	0.188	<0.0300	<0.0300	0.419 J	<0.260	<13.0	0.136 J	0.136 J	0.064	<0.340	<0.340
MW-31	MW-31-08162017	08/16/17	1.95	1.28	<0.0300	<0.0300	2.08 J	1.02	R*	0.249	0.249	0.2	0.531 J*	<0.340
MW-32	MW-32-08242017	08/24/17	35.0	9.01	<0.0300	<0.0300	<2.50 B*	0.264	R*	0.402	0.402	0.329	<0.500 B*	<0.340
MW-36	MW-36-08212017	08/21/17	46.6	14.3	<0.0300	<0.0300	1.28	0.692	<13.0	0.184 J	0.184 J	0.151	<0.340	<0.340
MW-37	MW-37-08232017	08/23/17	7.23	3.39	0.0840 J	0.053	1.31	0.715	<13.0	1.80	1.80	1.53	7.17	4.81
MW-38	MW-38-08162017	08/16/17	0.523	0.449	0.0740 J	0.059	0.177 J	<0.650	<13.0	0.336	0.336	0.22	2.87	2.54
MW-39	MW-39-08282017	08/28/17	1.83 J	1.67	<0.300	<0.300	22.3	27.4	24.0	<0.290	<0.290	<0.290	<3.40	<3.40
MW-42	MW-42-08232017	08/23/17	3.45	2.29	<0.0300	<0.0300	2.30	0.238	<13.0	0.101 J	0.101 J	0.076	0.928	0.79
MW-43	MW-43-08242017	08/24/17	0.141 J	0.075	<0.0300	<0.0300	<1.00 B*	0.346	<13.0	0.197 J	0.197 J	0.132	<2.15 B*	0.376
MW-44	MW-44-08232017	08/23/17	1.21	1.06	0.0320 J	<0.0300	2.11	1.02	<13.0	0.453	0.453	0.371	1.28	0.466
MW-45	MW-45-08162017	08/16/17	0.478	0.415	<0.0300	<0.0300	0.559	<0.650	<13.0	0.195 J	0.195 J	0.175	<0.340	<0.340
MW-48	MW-48-08162017	08/16/17	0.555	0.344	<0.0300	<0.0300	0.309 J	<0.650	<13.0	0.114 J	0.114 J	<0.145	0.496 J	<0.340
MW-50	MW-50-08232017	08/23/17	0.196 J	0.127	<0.0300	<0.0300	0.877	0.525	<13.0	0.140 J	0.140 J	0.114	<0.340	<0.340
MW-51	MW-51-08252017	08/25/17	0.166 J	0.14	<0.0300	<0.0300	1.66	1.45	13.0	0.0640 J	0.0640 J	0.057	0.519	0.462
MW-52	MW-52-08182017	08/18/17	1.16	0.52	<0.0300	<0.0300	0.802 J	<0.260	R*	0.0870 J	0.0870 J	0.06	0.677 J*	<0.340
MW-52	MW-100-08182017	08/18/17	1.19	0.592	<0.0300	<0.0300	0.854 J	<0.260	R*	0.0780 J	0.0780 J	0.061	<0.340 J*	<0.340

TABLE 8
TOTAL AND DISSOLVED METALS
AUGUST 2017 SAMPLING EVENT

Sample Location	Sample Name	Sample Date	Metals (µg/L)											
			Manganese		Mercury, inorganic		Nickel		Selenium		Silver		Zinc	
			Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved	Total	Dissolved
MW-6	MW-08212017	08/21/17	516	510	<0.100	<0.100	1.22	0.272	<0.440	<0.440	<0.0170	<0.0170	<4.75 B*	1.11
MW-7	MW-08172017	08/17/17	98.6	6.45	<0.100	<0.100	2.40	1.41	<0.440	<0.440	<0.0170	<0.0170	<4.00 B*	2.23
MW-9	MW-08172017	08/17/17	1140	810	<0.100	<0.100	2.95	2.38	<0.440	<0.440	<0.0170	<0.0170	<4.82 B*	2.86
MW-11	MW-11-08242017	08/24/17	1740	1570 JL*	<0.100	<0.100*	2.95	1.49 JL*	<0.440	<0.440*	<0.0170	<0.0170*	<6.31 B*	<4.00 B*
MW-14	MW-14-08252017	08/25/17	2130	2050	<0.100	<0.100	2.00	1.7	<0.440	<0.440	<0.0170	<0.0170	4.04	1.98
MW-15	MW-15-08232017	08/23/17	457	596	<0.100	<0.100	5.90	1.47	<0.440	<0.440	<0.0340	<0.0170	1.76 J	1.52
MW-23	MW-23-08162017	08/16/17	2280	2270	<0.100	<0.100	1.17	1.13	<0.440	<0.380	<0.0170	<0.0170	1.09 J	1.84
MW-24	MW-24-08252017	08/25/17	1110	1100	<0.100	<0.100	0.675	0.532	0.971	0.972	0.0480 J	0.044	5.20	2.53
MW-25	MW-25-08232017	08/23/17	401	318	<0.100	<0.100	1.18	0.0910 J*	<0.440	<0.440	<0.0170	<0.0170	2.86 J	1.07
MW-30	MW-30-08182017	08/18/17	850	763	<0.100	<0.100	0.412 J	0.308	<0.440	<0.440	<0.0170	<0.0170	<4.00 B*	0.879
MW-31	MW-31-08162017	08/16/17	841	767	<0.100	<0.100	1.29	1.12	<0.440	<0.440	<0.0170	<0.0170	2.14 J	2.85
MW-32	MW-32-08242017	08/24/17	1110	971	<0.100	<0.100	<0.725 B*	0.588 J*	<0.440	<0.440	<0.0170	<0.0170	<4.00 B*	<4.00 B*
MW-36	MW-36-08212017	08/21/17	3210	3110	<0.100	<0.100	0.656	0.557	<0.440	<0.440	<0.0170	<0.0170	<4.00 B*	1.75
MW-37	MW-37-08232017	08/23/17	1100	1010	<0.100	<0.100	8.60	6.54	<0.440	<0.440	<0.0850	<0.0170	2.69 J	2.35
MW-38	MW-38-08162017	08/16/17	103	82.6	<0.100	<0.100	1.54	1.32	0.646	<2.20	<0.0170	<0.0170	1.41 J	2.54
MW-39	MW-39-08282017	08/28/17	4.41	1.27	<0.100	<0.100	0.720 J	0.6	<0.440	<0.440	<0.0170	<0.0170	16.6 J	<8.20
MW-42	MW-42-08232017	08/23/17	95.7	89	0.100	<0.100	0.330 J	0.322	<0.440	<0.440	<0.0170	<0.0170	1.49 J	1.17
MW-43	MW-43-08242017	08/24/17	130	116	<0.100	<0.100	<0.500 B*	<0.500 B*	<0.440	<0.440	<0.0170	<0.0170	<4.00 B*	<4.00 B*
MW-44	MW-44-08232017	08/23/17	117	80.9	<0.100	<0.100	2.04	2.01	0.545	0.529	<0.0850	<0.0170	49.0	24
MW-45	MW-45-08162017	08/16/17	867	814	<0.100	<0.100	0.554	0.439 J*	<0.440	<2.20	<0.0170	<0.0170	<0.820	1.37
MW-48	MW-48-08162017	08/16/17	561	512	<0.100	<0.100	0.183 J	<0.500 B*	<0.440	<2.20	<0.0170	<0.0170	<0.820	1.34
MW-50	MW-50-08232017	08/23/17	740	693	<0.100	<0.100	0.238 J	0.233	<0.440	<0.440	<0.0850	<0.0170	0.952 J	1.04
MW-51	MW-51-08252017	08/25/17	335	338	<0.100	<0.100	0.131 J	0.178	<0.440	<0.440	<0.0170	<0.0170	<0.820	4.12
MW-52	MW-52-08182017	08/18/17	1160	1080	<0.100	<0.100	0.430 J	0.374	<0.440	<0.440	<0.0170	<0.0170	<0.820	<0.820
MW-52	MW-100-08182017	08/18/17	1220	1000	<0.100	<0.100	0.369 J	0.314	<0.440	<0.440	<0.0170	<0.0170	<4.00 B*	1.12

Notes:

Sample MW-100-08182017 is a field-duplicate of MW-52-08182017.

Sample MW-101-08242017 is a field-duplicate to MW-46-08242017.

Results are in micrograms per liter (µg/L).

Bold text indicates a detected result.

< = analyte not detected; listed as less than the detection limit, unless otherwise flagged due to quality-control failures.

— = not available.

B* = Result is considered not detected due to quality control failures; see checklist for details. Flag applied by Shannon & Wilson, Inc.

J = estimated concentration, detected greater than the method detection limit and less than the reporting limit. Flag applied by the laboratory.

JL* = estimated concentration due to quality control failures. Flag applied by Shannon & Wilson, Inc.

JL* = estimated concentration, biased low due to quality control failures. Flag applied by Shannon & Wilson, Inc.

JH* = estimated concentration, biased high due to quality control failures. Flag applied by Shannon & Wilson, Inc.

R* = rejected result due to severe quality control failures; see checklist for details. Flag applied by Shannon & Wilson, Inc.



PROFILE NO. Shannon 112718
drill tailings

GENERATOR'S WASTE PROFILE QUESTIONNAIRE

GENERATOR INFORMATION		CUSTOMER INFORMATION	
Generator Name	: Earle M. Jorgensen Company (EMJ)	Company Name	: Shannon & Wilson, Inc.
Site Address	: 8531 East Marginal Way South	Company Address	: 400 North 34th Street, Suite 100
City, State, Zip	: Tukwila, Washington, 98108	City, State, Zip	: Seattle, Washington, 98103
Generator Contact	: Gil Leon	Company Contact	: Shoshana Howard
Title	: Vice President	Company Phone#	: 206-632-8020
Generator Ph#	: 323-923-6120	Treatment Code	:
Facility EPA #	:	CWT Code	:

WASTE DESCRIPTION

General Waste Description : Soil
Process Generating Waste : Soil generated during drilling borings and installing wells

Is this Waste a "Hazardous Waste"? ☒ No Based on: Lab Analysis: ☒ MSDS: ☐ Generator Knowledge: ☐

Waste Generations Rate: Per: Waste will be transported in: One Time Disposal?

Cubic Yards: Day: Roll-Off Boxes: No
Drums: To be determined Week: Vacuum Truck:
Tons: Month: Drum (Type Size): 55-gallon
Gallons: Year:

CHEMICAL COMPOSITION AND OTHER INGREDIENTS

(State for each chemical. Total maximum column must be greater than or equal to 100%). NO TRADE NAMES.

MIN MAX

See attached data tables for soil analytical results from recent sampling event.

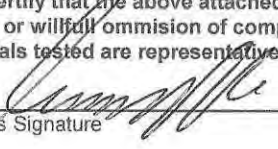
Physical State	Odor	Phases	Water	Ph
Liquid, ☐	None ☐	Homogenous ☒	<1% ☒	>2-6 ☐
Sludge ☐	Mild ☒	Bi-Layered ☐	1-5% ☐	>6-10 ☒
Solid ☒	Strong ☐	Multi ☐	80-90% ☐	>10-<12.5 ☐

Free Liquids 0 % of Volume: BTU's Per LB: Color: Brown

Notes, Additional Information or Special Handling Instructions: GENERATOR CERTIFIES THAT NO OTHER MATERIALS ARE PRESENT

CERTIFICATION

I hereby certify that the above attached description is complete and accurate to the best of my knowledge and ability to determine that no deliberate or willful omission of composition or properties exist, and that all known or suspected hazards have been disclosed I certify that the materials tested are representative of all material described by this Waste Product Questionnaire.



Generator's Signature
Gil Leon

Name (Type or Print)

Vice President

Title
2-3-21

Date

Reviewed by: OK Per TM 11/27/2018
OK Per TM 11/27/2018

Table 1

Analytical Method	Ecology PCUL ¹	Analyte	Units	SB-2020-001		SB-2020-028		SB-2020-029		SB-2020-045	
				SB-2020-001.2.2- 11/03/2020	SB-2020-001.6.5- 11/03/2020	SB-2020-028.2.3- 11/03/2020	SB-2020-028.6.8- 11/03/2020	SB-2020-029.3.2- 11/03/2020	SB-2020-029.7.5- 11/03/2020	SB-2020-045.2.5- 11/03/2020	SB-2020-045.7.2- 11/03/2020
SM2540G	NE	Total Solids	%	—	—	—	—	—	—	—	—
NWTPH-GX	30	Gasoline Range Organics	mg/kg	—	—	—	—	<6.69	<6.13	<6.79	<6.88
NWTPH-DX	260	Diesel Range Organics	mg/kg	<57.3	<53.7	<59.4	<54.4	<68.6	<54.8	<58.5	<53.9
	2,000	Residual Range Organics	mg/kg	<115	<107	<119	<109	203	<110	<117	<108
	0.00160	Tetrachloroethene (PCE)	mg/kg	—	—	—	—	—	—	<0.00143	<0.00116
SW8260D (VOCs)	0.000270	Trichloroethene (TCE)	mg/kg	—	—	—	—	—	—	<0.00143	<0.00116
	1.40	1,1-Dichloroethene (1,1-DCE)	mg/kg	—	—	—	—	—	—	<0.00143	<0.00116
	160	cis-1,2-Dichloroethene (cis-1,2-DCE)	mg/kg	—	—	—	—	—	—	<0.00143	<0.00116
	5.50E-05	Vinyl chloride	mg/kg	—	—	—	—	—	—	<0.00143	<0.00116
	5.80E-04	Benzene	mg/kg	—	—	—	—	—	—	<0.00143	<0.00116
	0.0550	Toluene	mg/kg	—	—	—	—	—	—	0.000350 J	0.000260 J
	0.0150	Ethylbenzene	mg/kg	—	—	—	—	—	—	<0.00143	<0.00116
	16,000	m,p-Xylene	mg/kg	—	—	—	—	—	—	<0.00287	<0.00233
	16,000	o-Xylene	mg/kg	—	—	—	—	—	—	<0.00143	<0.00116
	16,000	Total Xylenes	mg/kg	—	—	—	—	—	—	<0.00287	<0.00233
SW8270E-SIM (PAHs)	29.0	1-Methylnaphthalene	mg/kg	0.0045	0.00249	0.0279	0.00063	0.0596 E	0.000450 J	0.00313	0.000340 J
	0.670	2-Methylnaphthalene	mg/kg	0.00503	0.00229	0.0262	0.0005	0.0819	0.000480 J	0.00302	0.000310 J
	0.0280	Acenaphthene	mg/kg	0.000240 J	0.000110 J	0.00249	<0.000500	<0.00500	<0.000500	0.00052	<0.000500
	1.30	Acenaphthylene	mg/kg	0.000290 J	0.000160 J	0.00079	<0.000500	0.00114 J	<0.000500	0.000230 J	<0.000500
	0.0510	Anthracene	mg/kg	0.00237	0.00079	0.00416	0.000140 J	0.00096	0.0000800 J	0.00097	<0.000500
	5.70E-05	Benzo(a)anthracene	mg/kg	0.00395	0.00454	0.00544	0.000250 J	0.00826	0.000260 J	0.00168	0.000230 J
	1.50E-05	Benzo(a)pyrene	mg/kg	0.00344	0.000460 J	0.00451	0.000120 J	0.00524	0.000120 J	0.00106	0.000140 J
	2.00E-04	Benzo(b)fluoranthene	mg/kg	0.00433	0.00091	0.00722	0.000250 J	0.00625	0.000300 J	0.00162	0.000250 J
	0.670	Benzo(g,h,i)perylene	mg/kg	0.00324	0.000450 J	0.00651	0.000370 J	0.00509	0.000210 J	0.00099	0.000130 J
	3.20	Benzo(j)fluoranthene	mg/kg	0.00171 J	0.000220 J	0.00236 J	<0.000500	0.00186 J	<0.000500	0.000550 J	<0.000500
	0.00200	Benzo(k)fluoranthene	mg/kg	0.00166	0.000310 J	0.00244	<0.000500	0.00224	<0.000500	0.00053	<0.000500
	0.00640	Chrysene	mg/kg	0.00662	0.0046	0.0106	0.000450 J	0.0148	0.00069	0.00258	0.000430 J
	2.90E-05	Dibenzo(a,h)anthracene	mg/kg	0.000610 J	<0.000500	0.00108 J	<0.000500	0.00174 J	<0.000500	0.000220 J	<0.000500
	0.540	Dibenzofuran	mg/kg	0.00252	0.00223	0.0136	0.000310 J	0.0186	0.000310 J	0.00165	0.000220 J
	0.0900	Fluoranthene	mg/kg	0.00903	0.0351	0.0114	0.000450 J	0.00918	0.000480 J	0.00372	0.000370 J
	0.0290	Fluorene	mg/kg	0.00078	0.000380 J	0.00284	0.000110 J	0.00113	0.0000700 J	0.00061	<0.000500
	5.80E-04	Indeno(1,2,3-cd)pyrene	mg/kg	0.00247	0.000300 J	0.00475	<0.000500	0.00447	<0.000500	0.00065	0.0000900 J

Table 1

Analytical Method	Analyte	Ecology PCUL ¹	Units	SB-2020-001		SB-2020-028		SB-2020-029		SB-2020-045	
				SB-2020-001.2.2- 11/03/2020	SB-2020-001.6.5- 11/03/2020	SB-2020-028.2.3- 11/03/2020	SB-2020-028.6.8- 11/03/2020	SB-2020-029.3.2- 11/03/2020	SB-2020-029.7.5- 11/03/2020	SB-2020-045.2.5- 11/03/2020	SB-2020-045.7.2- 11/03/2020
SW8270E-SIM (PAHs)	Naphthalene	0.00210	mg/kg	0.0256	0.00112	0.0159	<0.000600	0.0358	<0.000600	0.0017	<0.000600
	Phenanthrene	1.50	mg/kg	0.0136	0.00959	0.0354	0.00153	0.0423	0.00162	0.00627	0.00138
	Pyrene	0.140	mg/kg	0.012	0.0263	0.0137	0.00064	0.0445	0.00059	0.00501	0.000430 J
	Total Benzo(a)fluoranthenes (SMS)	3.20	mg/kg	—	—	—	—	—	—	—	—
SW8082A (PCBs)	Aroclor-1016	2.20E-06	mg/kg	—	—	—	—	—	—	<0.00400	<0.00400
	Aroclor-1221	2.20E-06	mg/kg	—	—	—	—	—	—	<0.00400	<0.00400
	Aroclor-1232	2.20E-06	mg/kg	—	—	—	—	—	—	<0.00400	<0.00400
	Aroclor-1242	2.20E-06	mg/kg	—	—	—	—	—	—	<0.00400	<0.00400
	Aroclor-1248	2.20E-06	mg/kg	—	—	—	—	—	—	<0.00400	<0.00400
	Aroclor-1254	2.20E-06	mg/kg	—	—	—	—	—	—	<0.00400	<0.00400
SW6020	Aroclor-1260	2.20E-06	mg/kg	—	—	—	—	—	—	<0.00400	<0.00400
	Cobalt	20.0	mg/kg	6.74	3.53	10.6	3.34	3.2	4.41	3.78	3.5
	Vanadium	2.00	mg/kg	44.6	30.3	61	28.3	28.1	34.1	33.1	28.2
	Arsenic	7.30	mg/kg	6.74	2.27	10.4	1.98	1.95	2.08	2.32	1.76
	Barium	8.3	mg/kg	56.1	22.2	89.9	21.6	16.7	23.3	19.7	21
	Cadmium	0.770	mg/kg	0.4	<0.100	0.29	<0.100	<0.100	<0.110	<0.100	<0.110
SW6020A	Chromium	48.0	mg/kg	17.3	9.36	23	8.88	9.84	10.7	10	8.5
	Copper	36.36	mg/kg	25.1	7.97	43.3	7.89	7.16	8.18	8.52	7.97
	Lead	50.0	mg/kg	10.3	1.36	14.9	1.7	1.52	1.69	1.79	1.33
	Nickel	48.0	mg/kg	14.8	7.27	22.7	6.97	7.04	7.69	7.81	6.89
	Selenium	0.300	mg/kg	0.750 J	<2.03	1.48 J	0.470 J	<2.03	0.480 J	<2.09	<2.24
	Silver	0.0160	mg/kg	0.100 J	0.0300 J	0.200 J	0.0300 J	0.0300 J	0.0300 J	0.0300 J	0.0300 J
SW7471B	Zinc	85.0	mg/kg	114	21.2	69.7	19.4	18.7	22	21.1	19.3
	Mercury	0.0700	mg/kg	0.0822	0.00845 J	0.153	0.00656 J	0.0266	<0.0227	0.00655 J	0.00688 J

NOTES:

1 The most stringent soil preliminary cleanup level (PCUL) for nonpetroleum groundwater provided by Ecology (June 2016).

< Analyte was not detected, reported as less than the reporting limit (RL).

J Estimated concentration, detected greater than the method detection limit (MDL) and less than the RL. Flag applied by the laboratory.

B Estimated concentration, detected greater than the method detection limit (MDL) and less than the RL. Flag applied by the laboratory.

E Result exceeds laboratory calibration range. Flag applied by the laboratory.

— Analysis not required for this sample.

Ecology PCUL = Ecology Preliminary Cleanup Level; PAH = polycyclic aromatic hydrocarbons; PCB = polychlorinated biphenyls; mg/kg = milligram per kilogram; NE = not established; NWTPH = Northwest Total Petroleum Hydrocarbons; SIM = selective ion monitoring; VOC = volatile organic

Table 2

Analytical Method	Analyte	Ecology PCUL ¹	Units	SB-2020-004								SB-2020-005		
				2.5 ft SB-2020-004/2.5- 11062020	8 ft SB-2020-004/8- 11062020	13 ft SB-2020-004/13- 11062020	17 ft SB-2020-004/17- 11062020	21 ft SB-2020-004/21- 11062020	27 ft SB-2020-004/27- 11062020	1 ft SB-2020-005/1- 11042020	6 ft SB-2020-005/6- 11042020	12 ft SB-2020-005/12- 11042020		
SM2540G	Total Solids	NE	%	77.3	89.7	72.9	80.4	80.2	80.3	—	—	—	—	
NWTPH-GX	Gasoline Range Organics	30	mg/kg	—	—	—	—	—	—	—	—	—	—	
NWTPH-DX	Diesel Range Organics	260	mg/kg	15	4,260	<6.65	<6.08	7.56	<6.01	<62.2	<76.0	<70.1		
	Residual Range Organics	2,000	mg/kg	44.4	5,210	<13.3	<12.2	11.8	<12.0	<124	<152	<140		
	Tetrachloroethene (PCE)	0.00160	mg/kg	<0.00160	<0.00158	<0.00157	<0.00122	<0.00189	<0.00150	<0.00155	<0.00171	<0.00145		
	Trichloroethene (TCE)	0.000270	mg/kg	<0.00160	<0.00158	<0.00157	<0.00122	<0.00189	<0.00150	<0.00155	<0.00171	<0.00145		
	1,1-Dichloroethene (1,1-DCE)	1.40	mg/kg	<0.00160	<0.00130	<0.00157	<0.00122	<0.00189	<0.00150	<0.00155	<0.00171	<0.00145		
	cis-1,2-Dichloroethene (cis-1,2-DCE)	160	mg/kg	<0.00160	<0.00158	<0.00157	<0.00122	<0.00189	<0.00150	<0.00155	<0.00171	<0.00145		
SW8260D (VOCs)	Vinyl chloride	5.50E-05	mg/kg	<0.00160	<0.00130	<0.00157	<0.00122	<0.00189	<0.00150	<0.00155	<0.00171	<0.00145		
	Benzene	5.60E-04	mg/kg	0.000510 J	<0.00158	0.000730 J	<0.00122	<0.00189	<0.00150	0.000580 J	0.000630 J	0.000840 J		
	Toluene	0.0550	mg/kg	0.000620 J	0.000610 J	0.000910 J	0.000250 J	0.000370 J	<0.00150	0.000300 J	0.000330 J	0.000340 J		
	Ethylbenzene	0.0150	mg/kg	<0.00160	<0.00158	<0.00157	<0.00122	<0.00189	<0.00150	<0.00155	<0.00171	<0.00145		
	m,p-Xylene	16,000	mg/kg	<0.00321	<0.00316	<0.00313	<0.00244	<0.00378	<0.00300	<0.00311	<0.00342	<0.00291		
	o-Xylene	16,000	mg/kg	<0.00160	<0.00158	<0.00157	<0.00122	<0.00189	<0.00150	<0.00155	<0.00171	<0.00145		
	Total Xylenes	16,000	mg/kg	<0.00321	<0.00259	<0.00313	<0.00244	<0.00378	<0.00300	<0.00311	<0.00342	<0.00291		
	1-Methylnaphthalene	29.0	mg/kg	0.0135	0.0387	0.00056	0.000360 J	0.00174	0.00165	0.00246	0.0159	0.00061		
	2-Methylnaphthalene	0.670	mg/kg	0.0117	0.0343	0.000470 J	0.000300 J	0.00134	0.00246	0.00221	0.0147	0.000500 J		
	Acenaphthene	0.0280	mg/kg	<0.000450	0.0202	0.000300 J	0.0124	0.115	0.0831 E	<0.000500	0.00581	0.000150 J		
	Acenaphthylene	1.30	mg/kg	0.0062	0.00249	<0.000480	0.000600 J	0.000330 J	0.000290 J	0.000100 J	0.00222	<0.000500		
	Anthracene	0.0510	mg/kg	0.00246	0.00939	<0.000480	0.0008	0.0127	0.00741	0.00064	0.0101	0.000170 J		
	SW8270E-SIM (PAHs)	Benzo(a)anthracene	5.70E-05	mg/kg	0.0054	0.0108	0.000230 J	0.000110 J	0.000860 J	0.000320 J	0.00203	0.00866	0.0007	
Benzo(a)pyrene		1.60E-05	mg/kg	0.00421	0.00677	<0.000480	<0.000430	0.000310 J	0.000100 J	0.00102	0.00972	0.00075		
Benzo(b)fluoranthene		2.00E-04	mg/kg	0.00723	0.00509	0.000320 J	0.000160 J	0.000680 J	0.000220 J	0.00167	0.0106	0.00095		
Benzo(g,h,i)perylene		0.670	mg/kg	0.00653	0.00617	0.000160 J	0.000110 J	0.000410 J	0.000250 J	0.00131	0.00989	0.00091		
Benzo(j)fluoranthene		3.20	mg/kg	0.0025	0.00164 J	<0.000480	<0.000430	0.000310 J	<0.000440	0.000480 J	0.00425	0.000340 J		
Benzo(k)fluoranthene		0.00200	mg/kg	0.00231	0.00150 J	<0.000480	<0.000430	<0.00130	<0.000440	0.00051	0.00412	0.000370 J		
Chrysene		0.00640	mg/kg	0.0134	0.0245	0.00055	0.000230 J	0.00126 J	0.000570 J	0.00339	0.0147	0.00127		
Dibenzo(a,h)anthracene		2.90E-05	mg/kg	0.00139	<0.00194	<0.000480	<0.000430	<0.000430	<0.000440	0.000280 J	0.0016	0.000180 J		
Dibenzofuran		0.540	mg/kg	0.00634	0.0219	0.000220 J	0.000280 J	0.00118	0.00251	0.00109	0.0106	0.000190 J		
Fluoranthene	0.0900	mg/kg	0.0226	0.0231	0.000450 J	0.000390 J	0.0131	0.0246	0.00272	0.0319	0.00139			

Table 2

Analytical Method	Ecology PCUL ¹	Units	Analyte	SB-2020-004							SB-2020-005		
				2.5 ft SB-2020-004/2.5- 11062020	8 ft SB-2020-004/8- 11062020	13 ft SB-2020-004/13- 11062020	17 ft SB-2020-004/17- 11062020	21 ft SB-2020-004/21- 11062020	27 ft SB-2020-004/27- 11062020	1 ft SB-2020-005-1- 11042020	6 ft SB-2020-005-6- 11042020	12 ft SB-2020-005-12- 11042020	
SW8270E-SIM (PAHs)	0.0290	mg/kg	Fluorene	0.00443	0.0206	0.000190 J	0.0014	0.0102	0.00662	<0.000500	0.0088	0.000180 J	
	5.60E-04	mg/kg	Indeno(1,2,3-cd)pyrene	0.00425	0.00303	<0.000480	<0.000430	0.000190 J	<0.000440	0.00064	0.00735	0.00055	
	0.00210	mg/kg	Naphthalene	0.00776	0.0578	0.000570 J	0.00498	0.00551	0.0118	0.00123	0.0109	<0.000600	
	1.50	mg/kg	Phenanthrene	0.0288	0.0601	0.00203	0.0113	0.105	0.0721	0.0122	0.0361	0.00202	
	0.140	mg/kg	Pyrene	0.0198	0.0405	0.00068	0.00043	0.00771	0.0164	0.00414 B	0.0286 B	0.00157 B	
	3.20	mg/kg	Total Benzo(a)fluoranthenes (SMS)	—	—	—	—	—	—	—	—	—	
SW8082A (PCBs)	2.20E-06	mg/kg	Aroclor-1016	<0.00360	<0.0156	<0.00380	<0.00350	<0.00350	<0.00350	—	—	—	
	2.20E-06	mg/kg	Aroclor-1221	<0.00360	<0.0156	<0.00380	<0.00350	<0.00350	<0.00350	—	—	—	
	2.20E-06	mg/kg	Aroclor-1232	<0.00360	<0.0156	<0.00380	<0.00350	<0.00350	<0.00350	—	—	—	
	2.20E-06	mg/kg	Aroclor-1242	<0.00360	<0.0156	<0.00380	<0.00350	<0.00350	<0.00350	—	—	—	
	2.20E-06	mg/kg	Aroclor-1248	<0.00360	<0.0156	<0.00380	<0.00350	<0.00350	<0.00350	—	—	—	
	2.20E-06	mg/kg	Aroclor-1254	<0.00360	0.0341	<0.00380	<0.00350	<0.00350	<0.00350	—	—	—	
6020A	2.20E-06	mg/kg	Aroclor-1260	<0.00360	0.029	<0.00380	<0.00350	<0.00350	<0.00350	—	—	—	
	7.30	mg/kg	Arsenic	2.75	2.11	4.13	1.84	2.12	1.77	4.36	8.77	5.58	
	8.3	mg/kg	Barium	35	20.1	65.3	21.2	35.3	28.3	30.1	56.8	82.5	
	0.770	mg/kg	Cadmium	<0.120	<0.110	<0.130	<0.110	<0.110	<0.120	0.0500 J	0.25	<0.140	
	48.0	mg/kg	Chromium	11.5	7.53	13.9	7.47	7.98	8.78	10.8	19.5	18.9	
	20.0	mg/kg	Cobalt	4.53	3.52	5.04	4.27	4.56	3.95	4.33	8.43	6.4	
	36.36	mg/kg	Copper	10.8	7.25	22.6	8.42	9.57	8.2	14.9	38	27.3	
	50.0	mg/kg	Lead	2.23	1.41	3.05	1.05	1.23	1.22	3.55	11	6.75	
	48.0	mg/kg	Nickel	8.91	6.37	10.7	6.34	7.63	7.21	12.2	18.7	22.5	
	0.300	mg/kg	Selenium	0.650 J	0.650 J	1.05 J	0.590 J	0.680 J	0.620 J	<3.10	1.16 J	1.06 J	
SW7471B	0.0160	mg/kg	Silver	0.0500 J	0.0300 J	0.0800 J	0.0300 J	0.0300 J	0.0300 J	0.0400 J	0.160 J	0.0700 J	
	2.00	mg/kg	Vanadium	34.9	27.3	46.9	27.3	30.3	28.3	31.6	50	47.8	
	85.0	mg/kg	Zinc	24.9	20	24.6	16.7	19.9	18.4	29.1	55.4	38.5	
	0.0700	mg/kg	Mercury	0.0250 J	0.0106 J	0.046	0.0127 J	0.0125 J	0.00929 J	0.0290 J	0.143	0.0427	
SW9060M	NE	%	Total Organic Carbon	0.67	0.04	0.24	0.04	0.15	0.04	—	—	—	

NOTES:

1 The most stringent soil preliminary cleanup level (PCUL) for nonpotable groundwater provided by Ecology (June 2018).

< Analyte was not detected; reported as less than the reporting limit (RL).

J Estimated concentration; detected greater than the method detection limit (MDL) and less than the RL. Flag applied by the laboratory.

B Estimated concentration; biased high, due to a method blank detection. Flag applied by the laboratory.

E Result exceeds laboratory calibration range. Flag applied by the laboratory.

— Analysis not required for this sample.

Ecology PCUL = Ecology Preliminary Cleanup Level; PAH = polycyclic aromatic hydrocarbons; PCB = polychlorinated biphenyls; mg/kg = milligram per kilogram; NE = not established; NWTPH = Northwest Total Petroleum Hydrocarbons; SIM = selective ion monitoring; VOC = volatile organic compounds

Table 2

Analytical Method	Analyte	Ecology PCUL ¹	Units	SB-2020-007				SB-2020-008			
				1.2-2.8 ft SB-2020-007-1.2-2.8- 11042020	6-7 ft SB-2020-007-6-7- 11042020	10-10.9 ft SB-2020-007-10-10.9- 11042020	20-21.4 ft SB-2020-007-20-21.4- 11042020	2 ft SB-2020-008-2- 11052020	5.5 ft SB-2020-008-5.5- 11052020	11.5 ft SB-2020-008-11.5- 11052020	
SM2540G	Total Solids	NE	%	—	—	—	—	—	—	—	—
NWTPH-GX	Gasoline Range Organics	30	mg/kg	—	—	—	—	—	—	—	—
NWTPH-DX	Diesel Range Organics	260	mg/kg	<61.6	<68.9	<72.4	—	—	<56.5	<60.6	<61.4
	Residual Range Organics	2,000	mg/kg	<123	<138	<145	—	—	<113	<121	<123
SW8260D (VOCs)	Tetrachloroethene (PCE)	0.00160	mg/kg	—	—	—	—	—	<0.00103	0.000280 J	<0.00130
	Trichloroethene (TCE)	0.000270	mg/kg	—	—	—	—	—	<0.00103	<0.00106	<0.00130
	1,1-Dichloroethene (1,1-DCE)	1.40	mg/kg	—	—	—	—	—	<0.00103	<0.00106	<0.00130
	cis-1,2-Dichloroethene (cis-1,2-DCE)	160	mg/kg	—	—	—	—	—	<0.00103	<0.00106	<0.00130
	Vinyl chloride	5.50E-05	mg/kg	—	—	—	—	—	<0.00103	<0.00106	<0.00130
	Benzene	5.60E-04	mg/kg	—	—	—	—	—	0.00103 J	0.000690 J	<0.00130
	Toluene	0.0550	mg/kg	—	—	—	—	—	0.000300 J	0.000440 J	<0.00130
	Ethylbenzene	0.0150	mg/kg	—	—	—	—	—	<0.00103	<0.00106	<0.00130
	m,p-Xylene	16,000	mg/kg	—	—	—	—	—	<0.00207	<0.00212	<0.00261
	o-Xylene	16,000	mg/kg	—	—	—	—	—	<0.00103	<0.00106	<0.00130
SW8270E-SIM (PAHs)	Total Xylenes	16,000	mg/kg	—	—	—	—	—	<0.00207	<0.00212	<0.00261
	1-Methylnaphthalene	29.0	mg/kg	0.00876	0.00721	0.00741	—	—	0.00222	0.0023	0.00622
	2-Methylnaphthalene	0.670	mg/kg	0.00737	0.00694	0.00783	—	—	0.00218	0.00202	0.00642
	Acenaphthene	0.0280	mg/kg	<0.000500	0.00382	0.00515	—	—	0.000280 J	0.000390 J	0.00102
	Acenaphthylene	1.30	mg/kg	0.000270 J	0.00186	0.0022	—	—	0.000130 J	0.000220 J	0.000490 J
	Anthracene	0.0510	mg/kg	0.00139	0.00336	0.00847	—	—	0.000400 J	0.00117	0.00187
	Benzo(a)anthracene	5.70E-05	mg/kg	0.00252	0.00548	0.00743	—	—	0.00113	0.00273	0.00213
	Benzo(a)pyrene	1.60E-05	mg/kg	0.00117	0.00538	0.00855	—	—	0.00115	0.00291	0.00159
	Benzo(b)fluoranthene	2.00E-04	mg/kg	0.00185	0.00679	0.0102	—	—	0.00206	0.00459	0.00233
	Benzo(g,h,i)perylene	0.670	mg/kg	0.00096	0.00634	0.0107	—	—	0.00171	0.00378	0.00223
21-1-12596-012	Benzo(j)fluoranthene	3.20	mg/kg	0.00064	0.00281	0.00412	—	—	0.00057	0.00143	0.0007
	Benzo(k)fluoranthene	0.00200	mg/kg	0.00061	0.00267	0.00409	—	—	0.00066	0.0015	0.00077
	Chrysene	0.00640	mg/kg	0.00427	0.0084	0.0122	—	—	0.00216	0.00514	0.00354
	Dibenzo(a,h)anthracene	2.90E-05	mg/kg	0.000180 J	0.00103	0.00172	—	—	0.000350 J	0.00089	0.000420 J
21-1-12596-012	Dibenzofuran	0.540	mg/kg	0.00337	0.0052	0.00607	—	—	0.00091	0.00137	0.00316
	Fluoranthene	0.0500	mg/kg	0.00347	0.00948	0.0307	—	—	0.00254	0.00576	0.0065

Table 2

Analytical Method	Analyte	Ecology PCUL ¹	Units	SB-2020-007				SB-2020-008		
				1.2-2.8 ft SB-2020-007-1.2-2.8- 11042020	6-7 ft SB-2020-007-6-7- 11042020	10-10.9 ft SB-2020-007-10-10.9- 11042020	20-21.4 ft SB-2020-007-20-21.4- 11042020	2 ft SB-2020-008-2- 11052020	5.5 ft SB-2020-008-5.5- 11052020	11.5 ft SB-2020-008-11.5- 11052020
SW8270E-SIM (PAHs)	Fluorene	0.0290	mg/kg	<0.000500	0.0052	0.00711	—	0.000160 J	0.000240 J	0.00082
	Indeno(1,2,3-cd)pyrene	5.60E-04	mg/kg	0.00061	0.00455	0.00779	—	0.0012	0.0029	0.00135
	Naphthalene	0.00210	mg/kg	0.0034	0.00634	0.00917	—	0.00177	0.00169	0.00531
	Phenanthrene	1.50	mg/kg	0.0159	0.0215	0.0223	—	0.00405	0.00726	0.0154
	Pyrene	0.140	mg/kg	0.00472 B	0.0171 B	0.0284 B	—	0.00246	0.006	0.00655
	Total Benzo(a)anthracenes (SMS)	3.20	mg/kg	—	—	—	—	—	—	—
SW8082A (PCBs)	Aroclor-1016	2.20E-06	mg/kg	<0.00400	<0.00400	<0.00400	—	<0.00400	<0.00400	<0.00400
	Aroclor-1221	2.20E-06	mg/kg	<0.00400	<0.00400	<0.00400	—	<0.00400	<0.00400	<0.00400
	Aroclor-1232	2.20E-06	mg/kg	<0.00400	<0.00400	<0.00400	—	<0.00400	<0.00400	<0.00400
	Aroclor-1242	2.20E-06	mg/kg	<0.00400	<0.00400	<0.00400	—	<0.00400	<0.00400	<0.00400
	Aroclor-1248	2.20E-06	mg/kg	<0.00400	<0.00400	<0.00400	—	<0.00400	<0.00400	<0.00400
	Aroclor-1254	2.20E-06	mg/kg	<0.00400	<0.00400	0.00180 J	—	<0.00400	<0.00400	<0.00400
6020A	Aroclor-1260	2.20E-06	mg/kg	0.00240 J	0.0063	0.0096	—	<0.00400	0.00220 J	<0.00400
	Arsenic	7.30	mg/kg	3.25	5.93	7.54	3.68	2.44	10.9	3.05
	Barium	8.3	mg/kg	32.6	43.5	47.1	—	29.2	38.2	31.9
	Cadmium	0.770	mg/kg	<0.120	0.23	0.23	—	0.0400 J	0.0600 J	0.0500 J
	Chromium	48.0	mg/kg	10.2	14.1	17.6	—	10	10.9	11
	Cobalt	20.0	mg/kg	3.74	6.96	6.79	—	4.32	4.43	4.42
	Copper	36.36	mg/kg	15.4	24.9	28.9	—	10.4	21.1	11.8
	Lead	50.0	mg/kg	2.98	7.26	9.56	—	2.34	4.08	2.74
	Nickel	48.0	mg/kg	8.12	13.8	14.7	—	8.59	9.25	9.1
	Selenium	0.300	mg/kg	0.520 J	0.870 J	0.780 J	—	0.520 J	0.640 J	0.560 J
	Silver	0.0160	mg/kg	0.0500 J	0.110 J	0.130 J	—	0.0400 J	0.0400 J	0.0400 J
	Vanadium	2.00	mg/kg	27.7	35.6	41.8	—	31.7	31.6	30
SW7471B	Zinc	85.0	mg/kg	22.3	41.8	64.7	—	23.7	33.3	25.2
	Mercury	0.0700	mg/kg	0.0294	0.0801	0.081	0.0280 J	0.0592	0.0317	0.0241 J
SW9060M	Total Organic Carbon	NE	%	—	—	—	—	—	—	—

NOTES:

1 The most stringent soil preliminary cleanup level (PCUL) for nonpotable groundwater provided by Ec

< Analyte was not detected; reported as less than the reporting limit (RL).

J Estimated concentration; detected greater than the method detection limit (MDL) and less than the f

B Estimated concentration; biased high, due to a method blank detection. Flag applied by the laborat

E Result exceeds laboratory calibration range. Flag applied by the laboratory.

— Analysis not required for this sample.

Ecology PCUL = Ecology Preliminary Cleanup Level; PAH = polycyclic aromatic hydrocarbons; PCB =

Table 2

Analytical Method	Analyte	Ecology PCUL ¹	Units	SB-2020-013				SB-2020-014			
				1.5 ft SB-2020-013+1.5- 11052020	6 ft SB-2020-013&- 11052020	11.5 ft SB-2020-013+11.5- 11052020		5 ft SB-2020-014+1.5- 11052020	7 ft SB-2020-0147- 11052020	11 ft SB-2020-014+11- 11052020	
SM2540G	Total Solids	NE	%	96.1	92.8	81.3		—	—	—	
NWTPH-GX	Gasoline Range Organics	30	mg/kg	—	—	—		<8.23	<6.28	118	
	Diesel Range Organics	260	mg/kg	<5.25	<5.63	9.93		<62.8	<53.7	<74.3	
NWTPH-DX	Residual Range Organics	2,000	mg/kg	14.0	14.4	24.1		<126	<107	<149	
	Tetrachloroethene (PCE)	0.00160	mg/kg	—	—	—		<0.00144	0.00299	<0.00132	
	Trichloroethene (TCE)	0.000270	mg/kg	—	—	—		0.000770 J	0.0783	0.0128	
	1,1-Dichloroethene (1,1-DCE)	1.40	mg/kg	—	—	—		<0.00144	<0.00111	<0.00132	
	cis-1,2-Dichloroethene (cis-1,2-DCE)	160	mg/kg	—	—	—		0.00389 J	0.00270 J	0.00499 J	
	Vinyl chloride	5.50E-05	mg/kg	—	—	—		<0.00144	<0.00111	<0.00132	
SW8260D (VOCs)	Benzene	5.60E-04	mg/kg	—	—	—		<0.00144	0.000800 J	0.00166	
	Toluene	0.0550	mg/kg	—	—	—		<0.00144	0.00527	0.0033	
	Ethylbenzene	0.0150	mg/kg	—	—	—		<0.00144	0.000240 J	0.00386	
	m,p-Xylene	16,000	mg/kg	—	—	—		<0.00288	0.00589	0.0203	
	o-Xylene	16,000	mg/kg	—	—	—		<0.00144	0.00144	0.00165	
	Total Xylenes	16,000	mg/kg	—	—	—		<0.00288	0.00733	0.0219	
	1-Methylnaphthalene	29.0	mg/kg	0.000240 J	0.00308	0.00238		0.00407	0.000240 J	0.00941	
	2-Methylnaphthalene	0.670	mg/kg	0.000340 J	0.0041	0.00258		0.00387	0.000420 J	0.0135	
	Acenaphthene	0.0280	mg/kg	0.000150 J	0.000250 J	0.00082		0.00087	<0.000500	0.00112	
	Acenaphthylene	1.30	mg/kg	0.000240 J	0.000170 J	0.000350 J		0.000330 J	0.0000800 J	<0.00149	
	Anthracene	0.0510	mg/kg	0.00062	0.000400 J	0.00191		0.00211	<0.000500	0.000760 J	
	Benzo(a)anthracene	5.70E-05	mg/kg	0.0118	0.00195	0.00299		0.00359	0.000450 J	0.00212	
SW870E-SIM (PAHs)	Benzo(a)pyrene	1.60E-05	mg/kg	0.0119	0.00238	0.00221		0.00303	0.00052	0.000390 J	
	Benzo(b)fluoranthene	2.00E-04	mg/kg	0.0157	0.00317	0.0033		0.00503	0.00169	0.0013	
	Benzo(g,h,i)perylene	0.670	mg/kg	0.00724	0.00225	0.0022		0.00483	0.00199	0.00082	
	Benzo(j)fluoranthene	3.20	mg/kg	0.00576	0.0012	0.00114		0.00189	0.00053	<0.00149	
	Benzo(k)fluoranthene	0.00200	mg/kg	0.00699	0.00134	0.00145		0.00206	0.00053	<0.00149	
	Chrysene	0.00640	mg/kg	0.00953	0.00272	0.00315		0.00639	0.00159	0.014	
	Dibenzo(a,h)anthracene	2.90E-05	mg/kg	0.0021	0.00059	0.00052		0.00093	0.000180 J	0.000290 J	
	Dibenzofuran	0.540	mg/kg	0.000150 J	0.00131	0.00214		0.00222	0.000200 J	0.00226	
	Fluoranthene	0.0500	mg/kg	0.00494	0.00301	0.0127		0.00781	0.00201	0.0034	

Table 2

Analytical Method	Analyte	Ecology PCUL ¹	Units	SB-2020-013				SB-2020-014			
				1.5 ft SB-2020-013+1.5- 11052020	6 ft SB-2020-013&- 11052020	11.5 ft SB-2020-013+11.5- 11052020		5 ft SB-2020-014+1.5- 11052020	7 ft SB-2020-0147- 11052020	11 ft SB-2020-014+11- 11052020	
SW8270E-SIM (PAHs)	Fluorene	0.0290	mg/kg	0.000180 J	0.000150 J	0.00141		0.00084	0.0000800 J	0.00549	
	Indeno(1,2,3-cd)pyrene	5.60E-04	mg/kg	0.00724	0.00196	0.00178		0.00302	0.00137	0.000750 J	
	Naphthalene	0.00210	mg/kg	<0.000600	0.00336	0.00182		0.00238	0.001	0.092	
	Phenanthrene	1.50	mg/kg	0.00182	0.00476	0.0066		0.01	0.00145	0.0254	
	Pyrene	0.140	mg/kg	0.00601	0.00348	0.00981		0.00772	0.00134	0.0042	
	Total Benzo(a)anthracenes (SMS)	3.20	mg/kg	—	—	—		—	—	—	
SW8082A (PCBs)	Aroclor-1016	2.20E-06	mg/kg	<0.0199	<0.00400	<0.00400		<0.00400	<0.00400	<0.00400	
	Aroclor-1221	2.20E-06	mg/kg	<0.0199	<0.00400	<0.00400		<0.00400	<0.00400	<0.00400	
	Aroclor-1232	2.20E-06	mg/kg	<0.0199	<0.00400	<0.00400		<0.00400	<0.00400	<0.00400	
	Aroclor-1242	2.20E-06	mg/kg	<0.0199	<0.00400	<0.00400		<0.00400	<0.00400	<0.00400	
	Aroclor-1248	2.20E-06	mg/kg	<0.0199	<0.00400	<0.00400		<0.00400	<0.00400	<0.00400	
	Aroclor-1254	2.20E-06	mg/kg	0.146	0.0837	0.00160 J		<0.00400	<0.00400	0.0175	
	Aroclor-1260	2.20E-06	mg/kg	0.0233	0.0093	0.00220 J		0.00290 J	0.00350 J	0.0097	
	Arsenic	7.30	mg/kg	7.26	2.03	2.58		5.03	2.47	2.77	
	Barium	8.3	mg/kg	63.4	22.4	23.9		38.6	31.0	39.0	
	Cadmium	0.770	mg/kg	0.0600 J	0.0400 J	0.0400 J		0.29	<0.100	<0.140	
6020A	Chromium	48.0	mg/kg	30.8	13.4	7.57		13.4	10.1	11.6	
	Cobalt	20.0	mg/kg	6.55	3.57	3.48		8.89	3.54	3.9	
	Copper	36.36	mg/kg	27.3	9.42	10.3		22.5	26.1	18.7	
	Lead	50.0	mg/kg	23.1	11.5	2.24		5.27	2.37	1.99	
	Nickel	48.0	mg/kg	25.6	9.24	7.15		17.8	30.9	9.44	
	Selenium	0.300	mg/kg	1.87 J	0.650 J	0.760 J		0.870 J	0.480 J	<2.73	
	Silver	0.0160	mg/kg	0.0900 J	0.0500 J	0.0500 J		0.0800 J	0.0200 J	0.0400 J	
	Vanadium	2.00	mg/kg	35.3	24.3	25.8		35.4	27.7	37.3	
	Zinc	85.0	mg/kg	40.7	21.3	20.4		42.5	52.7	23	
	Mercury	0.0700	mg/kg	0.0163 J	0.0151 J	0.0281		0.0675	0.00914 J	0.0289	
SW9080M	Total Organic Carbon	NE	%	0.07	0.39	0.36		—	—	—	

NOTES:

1 The most stringent soil preliminary cleanup level (PCUL) for nonpotable groundwater provided by Ec

< Analyte was not detected; reported as less than the reporting limit (RL).

J Estimated concentration; detected greater than the method detection limit (MDL) and less than the f

B Estimated concentration; biased high, due to a method blank detection. Flag applied by the laborat

E Result exceeds laboratory calibration range. Flag applied by the laboratory.

— Analysis not required for this sample.

Ecology PCUL = Ecology Preliminary Cleanup Level; PAH = polycyclic aromatic hydrocarbons; PCB =

Table 2

Analytical Method	Analyte	Ecology PCUL ¹	Units	SB-2020-015					SB-2020-016			
				1 ft	7 ft	13 ft	20.5 ft	23 ft	2 ft	7 ft	12 ft	
SB-2020-015-1-11042020									SB-2020-016-2-11042020	SB-2020-016-7-11042020	SB-2020-016-12-11042020	
SM2540G	Total Solids	NE	%	—	—	—	—	—	—	—	—	—
NWTPH-GX	Gasoline Range Organics	30	mg/kg	<6.57	<6.32	<9.19	—	—	<6.28	<6.99	<10.8	
	Diesel Range Organics	260	mg/kg	<64.7	<52.5	<68.9	<59.8	—	<54.9	<53.4	<69.9	
NWTPH-DX	Residual Range Organics	2,000	mg/kg	<109	<105	<138	<120	—	<110	<107	<140	
	Tetrachloroethene (PCE)	0.00160	mg/kg	0.000560 J	0.000430 J	<0.00146	—	—	<0.00121	<0.00129	<0.00170	
	Trichloroethene (TCE)	0.000270	mg/kg	0.0157	0.00437	<0.00146	—	—	0.00156	0.0122	<0.00170	
	1,1-Dichloroethene (1,1-DCE)	1.40	mg/kg	<0.00134	<0.00126	<0.00146	—	—	<0.00121	<0.00129	<0.00170	
	cis-1,2-Dichloroethene (cis-1,2-DCE)	160	mg/kg	<0.00134	<0.00126	0.00125 J	—	—	<0.00121	0.000370 J	0.000610 J	
	Vinyl chloride	5.50E-05	mg/kg	<0.00134	<0.00126	<0.00146	—	—	<0.00121	<0.00129	<0.00170	
SW8260D (VOCs)	Benzene	5.60E-04	mg/kg	<0.00134	<0.00126	0.00109 J	—	—	<0.00121	<0.00129	0.000780 J	
	Toluene	0.0550	mg/kg	<0.00134	<0.00126	0.000580 J	—	—	<0.00121	0.000330 J	0.000420 J	
	Ethylbenzene	0.0150	mg/kg	<0.00134	<0.00126	0.00153	—	—	<0.00121	<0.00129	<0.00170	
	m,p-Xylene	16,000	mg/kg	<0.00267	<0.00252	0.00439	—	—	<0.00242	<0.00258	<0.00339	
	o-Xylene	16,000	mg/kg	<0.00134	<0.00126	0.00108 J	—	—	<0.00121	<0.00129	<0.00170	
	Total Xylenes	16,000	mg/kg	<0.00267	<0.00252	0.00547	—	—	<0.00242	<0.00258	<0.00339	
	1-Methylnaphthalene	29.0	mg/kg	0.0547	0.000200 J	0.00053	—	—	0.000390 J	0.00165	0.0008	
	2-Methylnaphthalene	0.670	mg/kg	0.0641	0.000250 J	0.00057	—	—	0.000410 J	0.0008	0.00073	
	Acenaphthene	0.0280	mg/kg	<0.000490	<0.000490	0.000120 J	—	—	<0.000500	0.000190 J	0.000220 J	
	Acenaphthylene	1.30	mg/kg	0.0063	<0.000490	<0.000490	—	—	<0.000500	0.0000900 J	<0.000500	
	Anthracene	0.0510	mg/kg	0.00526	<0.000490	0.000110 J	—	—	0.000110 J	0.00068	0.000110 J	
	Benzo(a)anthracene	5.70E-05	mg/kg	0.00928	0.000210 J	0.000260 J	—	—	0.000410 J	0.00154	0.000200 J	
SW8270E-SM (PAHs)	Benzo(a)pyrene	1.60E-05	mg/kg	0.00852	0.000170 J	0.000160 J	—	—	0.000290 J	0.00159	0.000120 J	
	Benzo(b)fluoranthene	2.00E-04	mg/kg	0.0124	0.000320 J	0.000390 J	—	—	0.000480 J	0.00223	0.000460 J	
	Benzo(g,h,i)perylene	0.670	mg/kg	0.0103	0.000280 J	0.000320 J	—	—	0.000440 J	0.0022	0.00248	
	Benzo(j)fluoranthene	3.20	mg/kg	0.00352	0.000110 J	<0.000490	—	—	0.000170 J	0.00093	0.000100 J	
	Benzo(k)fluoranthene	0.00200	mg/kg	0.00426	0.000120 J	<0.000490	—	—	0.000210 J	0.00088	<0.000500	
	Chrysene	0.00640	mg/kg	0.0125	0.000360 J	0.00069	—	—	0.00079	0.00251	0.00075	
	Dibenz(a,h)anthracene	2.90E-05	mg/kg	0.00265	<0.000490	<0.000490	—	—	<0.000500	0.00058	<0.000500	
	Dibenzofuran	0.540	mg/kg	0.0164	<0.000490	0.000230 J	—	—	0.000250 J	0.00061	0.000280 J	
	Fluoranthene	0.0500	mg/kg	0.0126	0.000290 J	0.000430 J	—	—	0.00073	0.00373	0.000440 J	

Table 2

Analytical Method	Analyte	Ecology PCUL ¹	Units	SB-2020-015					SB-2020-016			
				1 ft SB-2020-015-1- 11042020	7 ft SB-2020-015-7- 11042020	13 ft SB-2020-015-13- 11042020	20.5 ft SB-2020-015-20.5- 11042020	23 ft SB-2020-015-23- 11042020	2 ft SB-2020-016-2- 11042020	7 ft SB-2020-016-7- 11042020	12 ft SB-2020-016-12- 11042020	
SW8270E-SIM (PAHs)	Fluorene	0.0230	mg/kg	0.00058	<0.000490	0.000300 J	—	—	0.000700 J	0.000360 J	0.000300 J	
	Indeno(1,2,3-cd)pyrene	5.60E-04	mg/kg	0.00767	0.000180 J	0.000120 J	—	—	0.000260 J	0.00171	0.000120 J	
	Naphthalene	0.00210	mg/kg	0.0356	<0.000590	<0.000590	—	—	<0.000600	0.00063	0.000500 J	
	Phenanthrene	1.50	mg/kg	0.0249	0.00051	0.00175	—	—	0.00221	0.00387	0.00187	
	Pyrene	0.140	mg/kg	0.0160 B	0.000410 J B	0.000760 B	—	—	0.000960 B	0.00463 B	0.000610 B	
	Total Benzo(a)fluoranthenes (SMS)	3.20	mg/kg	—	—	—	—	—	—	—	—	
SW8082A (PCBs)	Aroclor-1016	2.20E-06	mg/kg	<0.00400	<0.00400	<0.00400	—	—	<0.00400	<0.00400	<0.00400	
	Aroclor-1221	2.20E-06	mg/kg	<0.00400	<0.00400	<0.00400	—	—	<0.00400	<0.00400	<0.00400	
	Aroclor-1232	2.20E-06	mg/kg	<0.00400	<0.00400	<0.00400	—	—	<0.00400	<0.00400	<0.00400	
	Aroclor-1242	2.20E-06	mg/kg	<0.00400	<0.00400	<0.00400	—	—	<0.00400	<0.00400	<0.00400	
	Aroclor-1248	2.20E-06	mg/kg	<0.00400	<0.00400	<0.00400	—	—	<0.00400	<0.00400	<0.00400	
	Aroclor-1254	2.20E-06	mg/kg	0.162	<0.00400	<0.00400	—	—	<0.00400	<0.00400	<0.00400	
6020A	Aroclor-1260	2.20E-06	mg/kg	0.121	<0.00400	<0.00400	—	—	0.00150 J	0.0059	<0.00400	
	Arsenic	7.30	mg/kg	3.13	1.14	6.69	4.89	—	1.71	2.77	3.95	
	Barium	8.3	mg/kg	58.5	19.5	97.6	37.5	—	19.7	35.5	78.9	
	Cadmium	0.770	mg/kg	0.80	0.43	0.0400 J	0.0600 J	—	0.0500 J	0.14	<0.130	
	Chromium	48.0	mg/kg	26	8.89	19.7	44.4	—	8.64	19.3	19.3	
	Cobalt	20.0	mg/kg	4.38	3.22	10	4.51	—	3.16	3.93	6.66	
	Copper	36.36	mg/kg	15.1	7.36	37.1	39.1	8.12	7.52	9.53	25.8	
	Lead	50.0	mg/kg	4.54	0.99	4.78	2.19	—	1.12	3.69	4.4	
	Nickel	48.0	mg/kg	59.8	16.4	19.1	140	6.6	7.19	12.9	28.9	
	Selenium	0.300	mg/kg	0.490 J	0.510 J	1.13 J	0.850 J	—	0.490 J	<2.08	0.750 J	
SW7471B	Silver	0.0160	mg/kg	0.120 J	0.0200 J	0.100 J	0.0800 J	—	0.0200 J	0.0500 J	0.0600 J	
	Vanadium	2.00	mg/kg	25.8	28.1	56.6	40.6	—	24.3	28.6	43.9	
	Zinc	85.0	mg/kg	38	19.7	34.5	25.2	—	18	23.3	31.4	
	Mercury	0.0700	mg/kg	0.0204 J	0.00480 J	0.0594	0.0382	—	0.00815 J	0.0125 J	0.0452	
SW9060M	Total Organic Carbon	NE	%	—	—	—	—	—	—	—	—	

NOTES:

1 The most stringent soil preliminary cleanup level (PCUL) for nonpotable groundwater provided by Ec

< Analyte was not detected; reported as less than the reporting limit (RL).

J Estimated concentration, detected greater than the method detection limit (MDL) and less than the f

B Estimated concentration, biased high, due to a method blank detection. Flag applied by the laborat

E Result exceeds laboratory calibration range. Flag applied by the laboratory.

— Analysis not required for this sample.

Ecology PCUL = Ecology Preliminary Cleanup Level; PAH = polycyclic aromatic hydrocarbons; PCB =

Table 3

Analytical Method	Analyte	Ecology PCUL ¹ Units	A1+02A						A2+07A				A2+16A		
			5 ft	5 ft	10 ft	12.5 ft	18 ft	25 ft	12 ft	13.5 ft	18 ft	25 ft	9.5 ft	12.5 ft	18 ft
NWTPH-GX	Gasoline Range Organics	30 mg/kg	—	—	—	—	—	—	876	68.3	61.7	<6.50	71	39.9	<7.58
	Diesel Range Organics	260 mg/kg	2,260	387	3,310	44,800	20,400	99.2	10,700	796	<65.2	<59.9	3,400	3,230	11.5
NWTPH-DX	Residual Range Organics	2,000 mg/kg	7,650	1,730	12,900	155,000	77,600	436	4,030	335	<130	<120	7,430	10,800	29.6

NOTES:

1 The most stringent soil preliminary cleanup level (PCUL) for nonpotable groundwater provided by Ecology (June 2018).

< Analyte was not detected, reported as less than the reporting limit (RL).

J Estimated concentration, detected greater than the method detection limit (MDL) and less than the RL. Flag applied by the laboratory.

B Estimated concentration, biased high, due to a method blank detection. Flag applied by the laboratory.

E Result exceeds laboratory calibration range. Flag applied by the laboratory.

— Analysis not required for this sample.

Ecology PCUL = Ecology Preliminary Cleanup Level; PAH = polycyclic aromatic hydrocarbons; PCB = polychlorinated biphenyls; mg/kg = milligram per kilogram; NE = not established; NWTPH = Northwest Total Petroleum Hydrocarbons; SIM = selective ion monitoring; VOC = volatile organic compounds

BILL OF LADING
PRODUCT TRANSPORT MANIFEST
MARINE VACUUM SERVICE, INC.
24 HOUR EMERGENCY PHONE NUMBER (206) 762-0240
FAX NUMBER 206-763-8084
TRUCK NUMBER 48 DATE 2-9-21

Nº 20379

TO
DESTINATION NAME MARINE
STREET 1516 S GRAHAM ST.
CITY/STATE SEATTLE, WA 98108

FROM
SHIPPER NAME EM5
Shannon Wilson
STREET 8531 E MARGINAL WAY
CITY/STATE SEATTLE, WA 98108

QUANTITY	PROPER SHIPPING NAME	UN (PLACARD) NUMBER
<u>39 x 55 GAL. DRUMS & Cutting</u>	<u>SOL</u>	<u>for Disposal</u>
<u>1400</u>	<u>GAL WASTE WATER</u>	
	SLUDGE	

RECEIVER	DATE	SHIPPER	DATE
<u>JAC PUN</u>	<u>2-9-21</u>	<u>[Signature]</u>	<u>2-9-21</u>

NOTE: 18 empty Drums for disposal

Customer warrants that the waste petroleum products being transferred by the above collector do not contain any contaminants including without limitations, pesticides, chlorinated solvents at concentrations greater than 1000 PPM, any detectable levels of PCBs, or any other material classified as dangerous or hazardous waste by 40 CFR Part 261, Subpart C and D (implementing the Federal Resource Conservation and Recover Act), or by any equivalent state dangerous or hazardous substance classification programs. Should laboratory tests find this waste not in compliance with 40 CFR Part 261, customer (generator) agrees to pay for all disposal costs incurred.

STRAIGHT BILL OF LADING

ORIGINAL — NOT NEGOTIABLE

Shipper No. **23426**

Carrier No. _____

Page _____ of _____

Marine Vacuum Service Inc.

Date **8-17-21**

(Name of carrier)

(SCAC)

On Collect on Delivery shipments, the letters "COD" must appear before consignee's name or as otherwise provided in Item 430, Sec. 1.

TO: **Marine Vacuum Service Inc.**

Street **1516 South Graham Street**

City **Seattle** State **WA** Zip Code **98108**

FROM: **Shannon Wilson**
 Street **8531 E Marginal Way S**
 City **Seattle** State **WA** Zip Code _____
 ChemTel 1-800-255-3924
 Contract MIS3627926
 24 hr. Emergency Contact Tel. No. _____

Route _____ Vehicle Number **048, 432**

No. of Units & Container Type	HM	BASIC DESCRIPTION UN or NA Number, Proper Shipping Name, Hazard Class, Packing Group	TOTAL QUANTITY (Weight, Volume, Gallons, etc.)	WEIGHT (Subject to Correction)	RATE	CHARGES (For Carrier Use Only)
1 TT	X	(DOT Spec Tank Required) UN1863 Fuel Aviation, Turbin Engine, Class 3, PG I				
1 TT	X	(DOT Spec Tank Required) UN1863 Fuel Aviation, Mixture, Class 3, PG I				
1 TT	X	(DOT Spec Tank Required) UN1203 Gasoline, Mixture Class 3, PG II				
1 TT	X	(DOT Spec Tank Required) UN1203 Gasoline, Class 3, PG II				
1 TT	X	NA1993 Diesel Mixture, Class 3, PG III				
1 TT	X	NA1993 Diesel, Class 3, PG III				
1 TT	X	NA1270 Petroleum Oil, Class 3, PG I				
1 TT	X	NA1270 Petroleum Oil, Mixture, Class 3, PG I				
1 TT		Oily Waste Water Non Reg by DOT	400	gals.		
1 TT		Waste Water Non Reg by DOT				
1 TT		Used Oil Non Reg by DOT	60	gals.		
1 TT		Used Coolant Non Reg by DOT				
		2 drum disposal				
		1 drum soil	15	gallons		

PLACARDS TENDERED: YES ☐ NO ☒

Note — (1) Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property, as follows: "The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding _____ per _____."
 (2) Where the applicable tariff provisions specify a limitation of the carrier's liability absent a release or a value declaration by the shipper and the shipper does not release the carrier's liability or declare a value, the carrier's liability shall be limited to the amount provided by such provisions. See NMFC Item 172.
 (3) Commodities requiring special or additional care or attention in handling or stowing must be so marked and packaged as to ensure safe transportation. See Section 2(a) of Item 350, Bills of Lading, Freight Bills and Statements of Charges and Section 1(a) of the Contract Terms and Conditions for a list of such articles.

I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.

Signature _____

REMIT
C.O.D. TO:
ADDRESS

COD

Am't: \$

C.O.D. FEE
PREPAID ☐
COLLECT ☐

TOTAL CHARGES \$

FREIGHT CHARGES

FREIGHT PREPAID ☐ Check box if charges are to be collected

RECEIVED, subject to the classifications and tariffs in effect on the date of the issue of this Bill of Lading, the property described above in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned, and delivered as indicated above which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed as to each carrier at all or any of, said property over all or any portion of said route to said destination and as to each party at any time transferred in all or any said property, that every service to be performed hereunder shall be subject to all the bill of lading terms and conditions in the governing classification on the date of shipment.

Shipper hereby certifies that he is familiar with all the lading terms and conditions in the governing classification and the said terms and conditions are hereby accepted for himself and his assigns.

SHIPPER **EMJ**

PER **Rev Behrnt of EMJ**

CARRIER **Mar Vac**

PER **Ewing**

DATE **8-17-21**

Permanent post-office address of shipper.

DRAFT FOR PUBLIC COMMENT



Hazardous WAM Approval

Requested Management Facility: **Chemical Waste Management (Hazardous Waste Facility)**

Profile Number: **OR349654**

Waste Approval Expiration Date: **03/17/2023**

APPROVAL DETAILS

Hazardous Classification: **State Hazardous**

Profile Renewal: ☐ Yes ☒ No

Management Method: **Solidification/Liquifix**

Generator Name: **Earle M. Jorgensen Company**

Material Name: **IDW Water**

Management Facility Precautions, Special Handling Procedures or Limitation on approval:

Generator Conditions

- An EPA form 8700-22 must be used for all hazardous shipments and may be ordered from an authorized vendor or your TSC.
- Approval number must accompany shipment.
- Drummed waste must be marked with profile number on top & side of the containers & bear only the appropriate labeling under RCRA and/or DOT provisions
- Chemical Waste Management has all the necessary permits and licenses for the waste that has been characterized and identified by this approved profile.
- Must meet applicable OSHA, DOT packaging, labeling, shipping and manifesting requirements per 49 CFR.
- The WM decision is based on specific parameters defined within this waste profile. Waste received that is non-conforming in any way will need to be re-evaluated and managed in accordance with all RCRA and State regulations. If alternative treatment is not available and the waste cannot be managed it will be rejected back to the generator.
- OR - Section 13 of the manifest will require Oregon state code.

Must be scheduled. Please contact Bob Mulholland (rmulholl@wm.com), 541-454-3265, or Tina Weiser (tweiser@wm.com).

WM Authorization Name: **Leslie Fichera**

Title: **Waste Approval Manager**

WM Authorization Signature: *Leslie Fichera*

Date: **03/17/2022**

Agency Authorization (if Required):

Date:



Requested Facility: Chemical Waste Management (Hazardous Waste Facility) ☐ Unsure Profile Number: OR349654
☐ Multiple Generator Locations (Attach Locations) ☒ Request Certificate of Disposal ☐ Renewal? Original Profile Number: _____

A. GENERATOR INFORMATION (MATERIAL ORIGIN)

1. Generator Name: Earle M. Jorgensen Company
2. Generator Site Address: 8531 East Marginal Way South
(City, State, ZIP) Tukwila WA 98108
3. County: King
4. Contact Name: Gil Leon
5. Email: _____
6. Phone: (323) 923-6120 7. Fax: _____
8. Generator EPA ID: _____ ☒ N/A
9. State ID: _____ ☒ N/A

B. BILLING INFORMATION☐ SAME AS GENERATOR

1. Billing Name: Shannon & Wilson, Inc.
2. Billing Address: 400 N 34th St, Suite 100
(City, State, ZIP) Seattle WA 98103
3. Contact Name: Shoshana Howard
4. Email: shoshana.howard@shanwil.com
5. Phone: (206) 695-6811 6. Fax: _____
7. WM Hauled? ☒ Yes ☐ No
8. P.O. Number: 21-1-12596-023
9. Payment Method: ☒ Credit Account ☐ Cash ☐ Credit Card

C. MATERIAL INFORMATION

1. Common Name: IDW Water
Describe Process(es) Generating Material: ☐ See Attached
Sitewide groundwater sampling for site investigation. Various compounds detected including PFAS.
2. Material Composition and Contaminants: ☐ See Attached

1. water	100 %
2.	
3.	
4.	
Total comp. must be equal to or greater than 100%	≥100%

3. State Waste Codes: X004 ☐ N/A
4. Color: clear
5. Physical State at 70°F: ☐ Solid ☒ Liquid ☐ Other: _____
6. Free Liquid Range Percentage: 100 to 100 ☐ N/A
7. pH: 6.8 to 7.2 ☐ N/A
8. Strong Odor: ☐ Yes ☒ No Describe: _____
9. Flash Point: ☐ <140°F ☐ 140°–199°F ☒ ≥200° ☐ N/A

D. REGULATORY INFORMATION

1. EPA Hazardous Waste? ☐ Yes* ☒ No
Code: _____
2. State Hazardous Waste? ☒ Yes ☐ No
Code: X004
3. Is this material non-hazardous due to Treatment, Delisting, or an Exclusion? ☐ Yes* ☒ No
4. Contains Underlying Hazardous Constituents? ☐ Yes* ☒ No
5. From an industry regulated under Benzene NESHAP? ☐ Yes* ☒ No
6. Facility remediation subject to 40 CFR 63 GGGGG? ☐ Yes* ☒ No
7. CERCLA or State-mandated clean-up? ☐ Yes* ☒ No
8. NRC or State-regulated radioactive or NORM waste? ☐ Yes* ☒ No
***If Yes, see Addendum (page 2) for additional questions and space.**
9. Contains PCBs? → If Yes, answer a, b and c. ☒ Yes ☐ No
a. Regulated by 40 CFR 761? ☐ Yes ☒ No
b. Remediation under 40 CFR 761.61 (a)? ☐ Yes ☒ No
c. Were PCB imported into the US? ☐ Yes ☒ No
10. Regulated and/or Untreated Medical/Infectious Waste? ☐ Yes ☒ No
11. Contains Asbestos? ☐ Yes ☒ No
→ If Yes: ☐ Non-Friable ☐ Non-Friable – Regulated ☐ Friable

E. ANALYTICAL AND OTHER REPRESENTATIVE INFORMATION

1. Analytical attached ☒ Yes
Please identify applicable samples and/or lab reports:
Other Test Results=2017 data. PFAS Results=results for samples taken from the IDW drums. Other files=samples taken from wells during sampling event (IDW is mixture of water from wells).
2. Other information attached (such as MSDS)? ☐ Yes

F. SHIPPING AND DOT INFORMATION

1. ☒ One-Time Event ☐ Repeat Event/Ongoing Business
2. Estimated Quantity/Unit of Measure: 6
☐ Tons ☐ Yards ☒ Drums ☐ Gallons ☐ Other: _____
3. Container Type and Size: 55-gal metal
4. USDOT Proper Shipping Name: ☒ N/A

G. GENERATOR CERTIFICATION (PLEASE READ AND CERTIFY BY SIGNATURE)

By signing this EZ Profile™ form, I hereby certify that all information submitted in this and all attached documents contain true and accurate descriptions of this material, and that all relevant information necessary for proper material characterization and to identify known and suspected hazards has been provided. Any analytical data attached was derived from a sample that is representative as defined in 40 CFR 261 - Appendix 1 or by using an equivalent method. All changes occurring in the character of the material (i.e., changes in the process or new analytical) will be identified by the Generator and be disclosed to Waste Management prior to providing the material to Waste Management.

☒ I am an Authorized Agent signing on behalf of the Generator, and I have confirmed with the Generator that information contained in this profile, as well as supporting documents provided, are accurate and complete.

Name (Print): E. GILBERT Date: 5-24-22
Title: VP, CFO
Company: EMJ

Certification Signature

THINK GREEN.

QUESTIONS? CALL 800 963 4776 FOR ASSISTANCE Revised November 06, 2020 © 2020 WM Intellectual Property Holdings, L.L.C.



Only complete this Addendum if prompted by responses on EZ Profile™ (page 1) or to provide additional information. Sections and question numbers correspond to EZ Profile™.

Profile Number: OR349654

C. MATERIAL INFORMATION

Describe Process Generating Material (Continued from page 1):

If more space is needed, please attach additional pages.

Material Composition and Contaminants (Continued from page 1):

If more space is needed, please attach additional pages.

5.		
6.		
7.		
8.		
9.		
Total composition must be equal to or greater than 100%		≥100%

D. REGULATORY INFORMATION

Only questions with a "Yes" response in Section D on the EZ Profile™ form (page 1) need to be answered here.

1. EPA Hazardous Waste

a. Please list all USEPA listed and characteristic waste code numbers:

b. Is the material subject to the Alternative Debris standards (40 CFR 268.45)?

☐ Yes ☐ No

c. Is the material subject to the Alternative Soil standards (40 CFR 268.49)? → If Yes, complete question 4.

☐ Yes ☐ No

d. Is the material exempt from Subpart CC Controls (40 CFR 264.1083)?

☐ Yes ☐ No

→ If Yes, please check **one** of the following:

☐ Waste meets LDR or treatment exemptions for organics (40 CFR 264.1082(c)(2) or (c)(4))

☐ Waste contains VOCs that average <500 ppmw (CFR 264.1082(c)(1)) – will require annual update.

2. State Hazardous Waste → Please list all state waste codes:

3. For material that is Treated, Delisted, or Excluded → Please indicate the category, below:

☐ Delisted Hazardous Waste

☐ Excluded Waste under 40 CFR 261.4 → Specify Exclusion: _____

☐ Treated Hazardous Waste Debris

☐ Treated Characteristic Hazardous Waste → If checked, complete question 4.

4. Underlying Hazardous Constituents → Please list all Underlying Hazardous Constituents:

5. Industries regulated under Benzene NESHAP include petroleum refineries, chemical manufacturing plants, coke by-product recovery plants, and TSDFs.

a. Are you a TSDF? → If yes, please complete Benzene NESHAP questionnaire. If not, continue.

☐ Yes ☐ No

b. Does this material contain benzene?

☐ Yes ☐ No

1. If yes, what is the flow weighted average concentration?

_____ ppmw

c. What is your facility's current total annual benzene quantity in Megagrams?

☐ <1 Mg ☐ 1–9.99 Mg ☐ ≥10 Mg

d. Is this waste soil from a remediation?

☐ Yes ☐ No

1. If yes, what is the benzene concentration in remediation waste?

_____ ppmw

e. Does the waste contain >10% water/moisture?

☐ Yes ☐ No

f. Has material been treated to remove 99% of the benzene or to achieve <10 ppmw?

☐ Yes ☐ No

g. Is material exempt from controls in accordance with 40 CFR 61.342?

☐ Yes ☐ No

→ If yes, specify exemption: _____

h. Based on your knowledge of your waste and the BWON regulations, do you believe that this waste stream is subject to treatment and control requirements at an off-site TSDF?

☐ Yes ☐ No

6. 40 CFR 63 GGGGG → Does the material contain <500 ppmw VOHAPs at the point of determination?

☐ Yes ☐ No

7. CERCLA or State-Mandated clean up → Please submit the Record of Decision or other documentation with process information to assist others in the evaluation for proper disposal. A "Determination of Acceptability" may be needed for CERCLA wastes not going to a CERCLA approved facility.

8. NRC or state regulated radioactive or NORM Waste → Please identify Isotopes and pCi/g: _____



Hazardous WAM Approval

Requested Management Facility: **Chemical Waste Management (Hazardous Waste Facility)**

Profile Number: **OR349655**

Waste Approval Expiration Date: **03/17/2023**

APPROVAL DETAILS

Hazardous Classification: **State Hazardous**

Profile Renewal: ☐ Yes ☒ No

Management Method: **Direct Landfill**

Generator Name: **Earle M. Jorgensen Company**

Material Name: **Soil IDW**

Management Facility Precautions, Special Handling Procedures or Limitation on approval:

Generator Conditions

- Absorbent materials for landfill must be made of non-biodegradable material, as defined by EPA and applicable State regulations
- Drums containing solids for direct landfill must be at least 90% full
- Drummed waste must be marked with profile number on top & side of the containers & bear only the appropriate labeling under RCRA and/or DOT provisions
- Approved for non-bulk packaging only.
- No free liquids
- Must meet applicable OSHA, DOT packaging, labeling, shipping and manifesting requirements per 49 CFR.
- Chemical Waste Management has all the necessary permits and licenses for the waste that has been characterized and identified by this approved profile.
- The WM decision is based on specific parameters defined within this waste profile. Waste received that is non-conforming in any way will need to be re-evaluated and managed in accordance with all RCRA and State regulations. If alternative treatment is not available and the waste cannot be managed it will be rejected back to the generator.
- OR - Section 13 of the manifest will require Oregon state code.

Must be scheduled. Please contact Bob Mulholland (rmulholl@wm.com), 541-454-3265, or Tina Weiser (tweiser@wm.com).

WM Authorization Name: **Leslie Fichera**

Title: **Waste Approval Manager**

WM Authorization Signature: *Leslie Fichera*

Date: **03/17/2022**

Agency Authorization (if Required):

Date:



Requested Facility: Chemical Waste Management (Hazardous Waste Facility) ☐ Unsure Profile Number: OR349655
☐ Multiple Generator Locations (Attach Locations) ☐ Request Certificate of Disposal ☐ Renewal? Original Profile Number: _____

A. GENERATOR INFORMATION (MATERIAL ORIGIN)

1. Generator Name: Earle M. Jorgensen Company
2. Generator Site Address: 8531 East Marginal Way South
(City, State, ZIP) Tukwila WA 98108
3. County: King
4. Contact Name: Gil Leon
5. Email: _____
6. Phone: (323) 923-6120 7. Fax: _____
8. Generator EPA ID: _____ ☒ N/A
9. State ID: _____ ☒ N/A

C. MATERIAL INFORMATION

1. Common Name: Soil IDW
Describe Process(es) Generating Material: ☐ See Attached
Soil investigation in area with known PCB and TPH-D/O contamination.
2. Material Composition and Contaminants: ☐ See Attached

1. Soil	100 %
2.	
3.	
4.	
Total comp. must be equal to or greater than 100%	≥100%
3. State Waste Codes: X004 ☐ N/A
4. Color: Brown
5. Physical State at 70°F: ☒ Solid ☐ Liquid ☐ Other: _____
6. Free Liquid Range Percentage: 0 to 0 ☐ N/A
7. pH: 6.8 to 7.2 ☐ N/A
8. Strong Odor: ☐ Yes ☒ No Describe: _____
9. Flash Point: ☐ <140°F ☐ 140°–199°F ☒ ≥200° ☐ N/A

E. ANALYTICAL AND OTHER REPRESENTATIVE INFORMATION

1. Analytical attached ☒ Yes
Please identify applicable samples and/or lab reports:
Applicable samples include Drum-Comp-10042021 (taken from drum to be disposed of). Analyzed for PCBs, Dx, and metals. TCLP for chromium added.
2. Other information attached (such as MSDS)? ☐ Yes

G. GENERATOR CERTIFICATION (PLEASE READ AND CERTIFY BY SIGNATURE)

By signing this EZ Profile™ form, I hereby certify that all information submitted in this and all attached documents contain true and accurate descriptions of this material, and that all relevant information necessary for proper material characterization and to identify known and suspected hazards has been provided. Any analytical data attached was derived from a sample that is representative as defined in 40 CFR 261 - Appendix 1 or by using an equivalent method. All changes occurring in the character of the material (i.e., changes in the process or new analytical) will be identified by the Generator and be disclosed to Waste Management prior to providing the material to Waste Management.

- ☒ I am an Authorized Agent signing on behalf of the Generator, and I have confirmed with the Generator that information contained in this profile, as well as supporting documents provided, are accurate and complete.

Name (Print): Earle M. Jorgensen Date: 3-29-22
Title: VP. CFO
Company: EMJ

B. BILLING INFORMATION☐ SAME AS GENERATOR

1. Billing Name: Shannon & Wilson, Inc.
2. Billing Address: 400 N 34th St, Suite 10
(City, State, ZIP) Seattle WA 98103
3. Contact Name: Shoshana Howard
4. Email: shoshana.howard@shanwil.com
5. Phone: (206) 695-6811 6. Fax: _____
7. WM Hauled? ☒ Yes ☐ No
8. P.O. Number: 21-1-12596-023
9. Payment Method: ☒ Credit Account ☐ Cash ☐ Credit Card

D. REGULATORY INFORMATION

1. EPA Hazardous Waste? ☐ Yes* ☒ No
Code: _____
 2. State Hazardous Waste? ☒ Yes ☐ No
Code: X004
 3. Is this material non-hazardous due to Treatment, Delisting, or an Exclusion? ☐ Yes* ☒ No
 4. Contains Underlying Hazardous Constituents? ☐ Yes* ☒ No
 5. From an industry regulated under Benzene NESHAP? ☐ Yes* ☒ No
 6. Facility remediation subject to 40 CFR 63 GGGGG? ☐ Yes* ☒ No
 7. CERCLA or State-mandated clean-up? ☐ Yes* ☒ No
 8. NRC or State-regulated radioactive or NORM waste? ☐ Yes* ☒ No
- *If Yes, see Addendum (page 2) for additional questions and space.**
9. Contains PCBs? → If Yes, answer a, b and c. ☒ Yes ☐ No
a. Regulated by 40 CFR 761? ☐ Yes ☒ No
b. Remediation under 40 CFR 761.61 (a)? ☐ Yes ☒ No
c. Were PCB imported into the US? ☐ Yes ☒ No
 10. Regulated and/or Untreated Medical/Infectious Waste? ☐ Yes ☒ No
 11. Contains Asbestos? ☐ Yes ☒ No
→ If Yes: ☐ Non-Friable ☐ Non-Friable – Regulated ☐ Friable

F. SHIPPING AND DOT INFORMATION

1. ☒ One-Time Event ☐ Repeat Event/Ongoing Business
2. Estimated Quantity/Unit of Measure: 1
☐ Tons ☐ Yards ☒ Drums ☐ Gallons ☐ Other: _____
3. Container Type and Size: 55-gal metal
4. USDOT Proper Shipping Name: ☒ N/A

Certification Signature

THINK GREEN:**QUESTIONS? CALL 800 963 4776 FOR ASSISTANCE**

Revised November 06, 2020 © 2020 WM Intellectual Property Holdings, L.L.C.



Only complete this Addendum if prompted by responses on EZ Profile™ (page 1) or to provide additional information. Sections and question numbers correspond to EZ Profile™.

Profile Number: OR349655

C. MATERIAL INFORMATION

Describe Process Generating Material (Continued from page 1):

If more space is needed, please attach additional pages.

Material Composition and Contaminants (Continued from page 1):

If more space is needed, please attach additional pages.

5.		
6.		
7.		
8.		
9.		
Total composition must be equal to or greater than 100%		≥100%

D. REGULATORY INFORMATION

Only questions with a "Yes" response in Section D on the EZ Profile™ form (page 1) need to be answered here.

1. EPA Hazardous Waste

a. Please list all USEPA listed and characteristic waste code numbers:

b. Is the material subject to the Alternative Debris standards (40 CFR 268.45)?

☐ Yes ☐ No

c. Is the material subject to the Alternative Soil standards (40 CFR 268.49)? → If Yes, complete question 4.

☐ Yes ☐ No

d. Is the material exempt from Subpart CC Controls (40 CFR 264.1083)?

☐ Yes ☐ No

→ If Yes, please check **one** of the following:

☐ Waste meets LDR or treatment exemptions for organics (40 CFR 264.1082(c)(2) or (c)(4))

☐ Waste contains VOCs that average <500 ppmw (CFR 264.1082(c)(1)) – will require annual update.

2. State Hazardous Waste → Please list all state waste codes:

3. For material that is Treated, Delisted, or Excluded → Please indicate the category, below:

☐ Delisted Hazardous Waste

☐ Excluded Waste under 40 CFR 261.4 → Specify Exclusion:

☐ Treated Hazardous Waste Debris

☐ Treated Characteristic Hazardous Waste → If checked, complete question 4.

4. Underlying Hazardous Constituents → Please list all Underlying Hazardous Constituents:

5. Industries regulated under Benzene NESHAP include petroleum refineries, chemical manufacturing plants, coke by-product recovery plants, and TSDFs.

a. Are you a TSDF? → If yes, please complete Benzene NESHAP questionnaire. If not, continue.

☐ Yes ☐ No

b. Does this material contain benzene?

☐ Yes ☐ No

1. If yes, what is the flow weighted average concentration?

_____ ppmw

c. What is your facility's current total annual benzene quantity in Megagrams?

☐ <1 Mg ☐ 1–9.99 Mg ☐ ≥10 Mg

d. Is this waste soil from a remediation?

☐ Yes ☐ No

1. If yes, what is the benzene concentration in remediation waste?

_____ ppmw

e. Does the waste contain >10% water/moisture?

☐ Yes ☐ No

f. Has material been treated to remove 99% of the benzene or to achieve <10 ppmw?

☐ Yes ☐ No

g. Is material exempt from controls in accordance with 40 CFR 61.342?

☐ Yes ☐ No

→ If yes, specify exemption:

h. Based on your knowledge of your waste and the BWON regulations, do you believe that this waste stream is subject to treatment and control requirements at an off-site TSDF?

☐ Yes ☐ No

6. 40 CFR 63 GGGGG → Does the material contain <500 ppmw VOHAPs at the point of determination?

☐ Yes ☐ No

7. CERCLA or State-Mandated clean up → Please submit the Record of Decision or other documentation with process information to assist others in the evaluation for proper disposal. A "Determination of Acceptability" may be needed for CERCLA wastes not going to a CERCLA approved facility.

8. NRC or state regulated radioactive or NORM Waste → Please identify Isotopes and pCi/g:

481783

NON-HAZARDOUS WASTE MANIFEST		1. Generator ID Number EXEMPT	2. Page 1 of 1	3. Emergency Response Phone (800) 424-9300	4. Waste Tracking Number EMJ33022-ESP1	
5. Generator's Name and Mailing Address EARLE M JORGENSEN CO 8531 E MARGINAL WAY SOUTH TUKWILA WA 98103 Generator's Phone: (323) 923-6120			Generator's Site Address (if different than mailing address)			
6. Transporter 1 Company Name CHEMICAL WASTE MANAGEMENT, INC.			U.S. EPA ID Number ORD089452353			
7. Transporter 2 Company Name UPRR			U.S. EPA ID Number NED001782910			
8. Designated Facility Name and Site Address CHEMICAL WASTE MANAGEMENT, INC. 17828 CEDAR SPRINGS LANE ARLINGTON OR 97912-9709 Facility's Phone: (541) 454-2843			U.S. EPA ID Number ORD089452353			
9. Waste Shipping Name and Description		10. Containers		11. Total Quantity	12. Unit Wt./Vol.	
		No.	Type			
1. MATERIAL NOT REGULATED BY D.O.T. OR349855		1	DM	200	P	
2. MATERIAL NOT REGULATED BY D.O.T. OR349854		6	DM	2,000	P	
3.						
4.						
13. Special Handling Instructions and Additional Information 1. OR349855 2. OR349854 WMXU 970875						
14. GENERATOR'S/OFFEROR'S CERTIFICATION: I hereby declare that the contents of this consignment are fully and accurately described above by the proper shipping name, and are classified, packaged, marked and labeled/placarded, and are in all respects in proper condition for transport according to applicable international and national governmental regulations.						
Generator's/Offeror's Printed/Typed Name Rose Vogt		Signature Rose Vogt		Month 3	Day 30	Year 22
15. International Shipments ☐ Import to U.S. ☐ Export from U.S. Port of entry/exit: Date leaving U.S.:						
16. Transporter Acknowledgment of Receipt of Materials						
Transporter 1 Printed/Typed Name KEE LABAN		Signature [Signature]		Month 3	Day 30	Year 22
Transporter 2 Printed/Typed Name ALAN HANKE		Signature [Signature]		Month 3	Day 30	Year 22
17. Discrepancy						
17a. Discrepancy Indication Space ☐ Quantity ☐ Type ☐ Residue ☐ Partial Rejection ☐ Full Rejection						
Manifest Reference Number:						
17b. Alternate Facility (or Generator) U.S. EPA ID Number						
Facility's Phone:						
17c. Signature of Alternate Facility (or Generator) Month Day Year						
FFA						
18. Designated Facility Owner or Operator: Certification of receipt of materials covered by the manifest except as noted in Item 17a						
Printed/Typed Name Alan Donly		Signature [Signature]		Month 4	Day 19	Year 22

BMS



Chemical Waste Management of the NorthWest
17629 Cedar Springs Lane
Arlington, OR, 97812
Ph: (541) 454-2643

Reprint
Ticket# 52417

Customer Name SHANNON AND WILSON SHANNON & Carrier UNION PACIFIC UNION PACIFIC RAILROAD
Ticket Date 04/30/2022 Vehicle# RAIL Volume
Payment Type Credit Account Container
CWM Load# 487783-2 Driver
Hauling Ticket# Check#
Route Billing # 0000093
State Waste Code Gen EPA ID
Manifest EMJ33022-ESP
Destination Grid
PO 21-1-12596-023
Profile OR349654 (IDW Water)
Generator 168-EARLE M JOGENSEN CO EARLE M JOGENSEN COMPANY 8531 EAST MARGINAL WAY SOUT

	Time	Scale	Operator	Inbound	Gross	2001 lb*
In	04/30/2022 11:07:14	MANUAL WT	pslider1		Tare	1 lb*
Out	04/30/2022 11:07:14		pslider1		Net	2000 lb
Comments			* Manual Weight		Tons	1.00

Product	LD%	Qty	UOM	Rate	Tax	Amount	Origin
1 NONH DRM-Each DM55 100		6.00	Each	157.00	2.00	\$942.00	WA-TUKWILA
2 CERT-CERTIFICATE D 100		1.00	Each	35.00		\$35.00	WA-TUKWILA
3 LTL EA-LTL TRANS E 100		6.00	Each	52.00		\$312.00	WA-TUKWILA

Total Tax	\$2.00
Total Ticket	\$1291.00

Driver`s Signature



Chemical Waste Management of the NorthWest
17629 Cedar Springs Lane
Arlington, OR, 97812
Ph: (541) 454-2643

Reprint
Ticket# 52416

Customer Name SHANNON AND WILSON SHANNON & Carrier UNION PACIFIC UNION PACIFIC RAILROAD
Ticket Date 04/30/2022 Vehicle# RAIL Volume
Payment Type Credit Account Container
CWM Load# 487783-1 Driver
Hauling Ticket# Check#
Route Billing # 0000093
State Waste Code Gen EPA ID
Manifest EMJ33022-ESP
Destination Grid
PO 21-1-12596-023
Profile OR349655 (Soil IDW)
Generator 168-EARLE M JOGENSEN CO EARLE M JOGENSEN COMPANY 8531 EAST MARGINAL WAY SOUT

	Time	Scale	Operator	Inbound	Gross	201 lb*
In	04/30/2022 11:02:25	MANUAL WT	pslider1		Tare	1 lb*
Out	04/30/2022 11:02:25		pslider1		Net	200 lb
Comments			* Manual Weight		Tons	0.10

Product	LD%	Qty	UOM	Rate	Tax	Amount	Origin
1 NONH DRM-Each DM55 100		1.00	Each				WA-TUKWILA
2 LTL EA-LTL TRANS E 100		1.00	Each				WA-TUKWILA

Total Tax
Total Ticket

Driver`s Signature



CHEMICAL WASTE MANAGEMENT OF THE NORTHWEST

17629 Cedar Springs Lane
Arlington, OR 97812

CWM OF THE NORTHWEST
Federal EPA ID: ORD089452353
17629 CEDAR SPRINGS LANE
ARLINGTON, OR 97812

EARLE M JORGENSEN CO
ATTN: MANIFEST SECTION
WAZ000011724
8531 E MARGINAL WAY SOUTH
TUKWILA WA 98108

CERTIFICATE OF DISPOSAL

CWM OF THE NORTHWEST, EPA ID: ORD089452353, has received waste material from EARLE M JORGENSEN CO on 04/18/22 as described on Shipping Document number EMJ33022-ESP.

Profile Number: OR349654
CWM Tracking ID: 48778302
CWM Unit #: 1*0 thru 6*0
Disposal Date: 04/21/22

I certify, on behalf of the above listed treatment facility, that to the best of my knowledge, the above-described waste was managed in compliance with all applicable laws, regulations, permits and licenses on the date listed above.

A handwritten signature in blue ink, appearing to read 'J. Weise', is written over a horizontal line.

CWMNW RECORDS DEPARTMENT
Certificate # 262187
04/26/22



CHEMICAL WASTE MANAGEMENT OF THE NORTHWEST

17629 Cedar Springs Lane
Arlington, OR 97812

CWM OF THE NORTHWEST
Federal EPA ID: ORD089452353
17629 CEDAR SPRINGS LANE
ARLINGTON, OR 97812

EARLE M JORGENSEN CO
ATTN: MANIFEST SECTION
WAZ000011724
8531 E MARGINAL WAY SOUTH
TUKWILA WA 98108

CERTIFICATE OF DISPOSAL

CWM OF THE NORTHWEST, EPA ID: ORD089452353, has received waste material from EARLE M JORGENSEN CO on 04/18/22 as described on Shipping Document number EMJ33022-ESP.

Profile Number: OR349655
CWM Tracking ID: 48778301
CWM Unit #: 1*0
Disposal Date: 04/20/22

I certify, on behalf of the above listed treatment facility, that to the best of my knowledge, the above-described waste was managed in compliance with all applicable laws, regulations, permits and licenses on the date listed above.

CWMNW RECORDS DEPARTMENT
Certificate # 262186
04/26/22



RD-B74

PFAS

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1.0 SCOPE AND APPLICABILITY

The procedures described herein define per- and polyfluoroalkyl substances (PFAS) specific sampling and handling techniques for various media, outline special considerations for communications about PFAS to clients and the general public, and provide additional guidance for projects involving PFAS. These techniques are necessary to prevent cross-contamination of water and soil samples collected for PFAS analysis and to navigate a rapidly changing and controversial regulatory environment.

This reference document (RD) is subject to change as new information becomes available. This RD is supplemental to current Shannon and Wilson, Inc. (SWI) RDs as befits the project. Additional RDs are listed in Section 8.0.

This RD defines a standard set of procedures applicable to a range of site conditions and projects. These procedures may be modified according to equipment limitations or project needs. Modifications to this RD will be described in a project-specific Work Plan or other document, and documented in the field notes, as applicable.

2.0 RESPONSIBILITY

The *Project Manager* (PM) is responsible for overseeing and ensuring that analytical samples are collected at required locations and with the appropriate frequency. The PM will ensure environmental samples are collected in accordance with this RD and any site-specific or project specific planning documents (e.g. approved Work Plan or Scope of Work).

It is the responsibility of the *Field Technician* (FT) to request the appropriate laboratory containers, coordinate with the analytical laboratory, and collect analytical water samples in accordance with this RD.

3.0 DEFINITIONS

PFAS are a group of man-made chemicals that include PFOA, PFOS, PFHxS, PFHpA, GenX, and many other compounds. These chemicals are considered an emerging contaminant.



4.0 REQUIRED MATERIALS / EQUIPMENT

The materials needed for this RD are project dependent. Materials may include but are not limited to the following:

- Field note paper and notebook
- Camera
- Residential Well Sampling Log (project specific)
- Well survey (project specific)
- Field Activities Daily Log
- Conversation record documents
- Business cards
- Chain of custody records (COCs)
- Sample cooler
- Gel ice packs
- YSI
- Nitrile gloves
- Sample labels
- Residential sampling bucket (green)
- Purge cup
- Ziploc baggies
- Paper towels
- Filter wrench(es)
- Plastic cups
- Extra buckets
- Garden hose
- Trash bags
- Toolbox (optional)
- Project specific sample jars or bottles
- Cell phone
- Public information packets, if applicable
- Clipboard
- Water sample bottles containing Trizma* (drinking-water samples)
- Water sample bottles without preservative (groundwater)
- Soil sample jars
- Plastic spoons (or other soil collection tool)
- PFAS-free water for field or equipment blanks
- Spare batteries
- Headlamp
- Peri-pump or whale pump and controller box
- Pump tubing
- Battery for pumps
- Water sounder
- Measuring tap
- Decontamination set-up

*see specific project details for water sample preservation requirements. Requirements may vary by state regulations and analyses requested.

4.1 Special considerations for materials when sampling for the presences of PFAS

Investigations of the presence of PFAS in consumer products are ongoing. Future



testing may change the general cautions outlined in this section. This list is not comprehensive. See *Special Considerations for PFAS Sampling* document.

- 4.1.1 Sunblock and insect repellent ingredients should be verified PFAS-free prior to use during sampling.
- 4.1.2 Clothing and personal protective equipment (PPE) treated for water, fire, or stain resistance, or UV protection should not be worn during sampling. Clothing should not be new or recently washed with fabric softeners.
- 4.1.3 Food and food packaging should be avoided during sampling or near sampling areas.
- 4.1.4 Do not use waterproof paper or notebooks.
- 4.1.5 Use aluminum clipboards and ball point pens that are known to be PFAS free. Some felt-tip pens are known to have PFAS. Confirm Sharpie or other felt tip, erasable, or waterproof pens are PFAS free prior to use.
- 4.1.6 Glues may contain PFAS, sticky type note pads (Post-it), adhesive labels, and tape should be verified PFAS free prior to use.
- 4.1.7 Chemical ice packs should be verified PFAS free and placed in liner bags for use in sample coolers. Sample jars and/or bottles should not be allowed to touch the ice packs.
- 4.1.8 Disposable, powderless, nitrile gloves should be worn during sampling and handling activities. Gloves should be changed frequently especially when potential contamination has occurred (i.e. touching clothing, skin, hair, or consumer products in the sampling area).
- 4.1.9 If sampling during rain, snow, or cold, confirm that weather-protection gear is PFAS free or take extra care to avoid touching clothing and shoes.
- 4.1.10 Pumps and pump tubing should be verified PFAS free.



5.0 PROCEDURES

5.1 General Sampling Procedures

- 5.1.1 All sample containers should be provided by the laboratory and made of polypropylene (PP) or high-density polyethylene (HDPE). PFAS are known to attach to the sample containers made of glass and other materials.
- 5.1.2 Any required sample preservatives should be laboratory provided and stored in PFAS-free containers.
- 5.1.3 If reusable equipment is used for sampling, proper decontamination is necessary before and after each sample. See *RD-B13- Equipment Decontamination*.
 - 5.1.3.1 Decontamination reagents must be PFAS free.
 - 5.1.3.2 Water used for final decontaminations rinse should be certified PFAS free by the laboratory, or a source water sample should be submitted for analysis.
 - 5.1.3.3 Verify decontamination reagents are effective at removing PFAS. See project manager to confirm effective decontamination agent.
- 5.1.4 Personal body products such as shampoos, moisturizers and cosmetics may contain PFAS. Limit or avoid use of such products on sampling days.
- 5.1.5 Equipment blanks should be used at the frequency described in the work plan or scope of work. Water used to collect equipment and field blanks should be certified PFAS-free water, provided by a laboratory.
- 5.1.6 Care should be taken to avoid cross contamination in PFAS samples, where samples for other analytes are also being collected. Gloves should be changed prior to collecting PFAS samples and PFAS samples should be bagged separately to avoid touching other sample jars and/or bottles.
- 5.1.7 Only handle sample containers while wearing gloves. Samples labels should be filled out prior to donning gloves for sample collection.
- 5.1.8 Avoid touching clothing, skin, hair, and/or consumer products while wearing gloves. Gloves should be changed frequently. A fresh pair should be donned immediately prior to collecting PFAS samples.
- 5.1.9 Sample containers should be stored in closed boxes or coolers when not in use. Storage boxes should be labeled as containing PFAS sampling equipment. Storing sample containers in plastic baggies is recommended to prevent inadvertent



exposure to potential contaminants. If leaving a storage container for long periods of time, a custody seal should be added.

- 5.1.10 Laboratory provided sample containers do not need to be and should not be rinsed prior to collection.

5.2 Groundwater Sampling Procedures

See *RD-B41 Analytical Water Sample Collection*, *RD-B42- Monitoring Well Sampling*, or *RD-B44- Potable Water (Private) Well Sampling* for general groundwater sample collection techniques.

- 5.2.1 Confirm purging requirements (e.g. three well volumes versus parameter stabilization) prior to collecting samples.
- 5.2.2 If a monitoring well has permanent fixtures that may contain PFAS, the sample results may need to be flagged or rejected in the analytical database at the discretion of the project manager.
- 5.2.2.1 If dedicated tubing or fixtures that may contain PFAS can be removed from a monitoring well, extra precautions should be taken. This may include removal of equipment fourteen days prior to sample, or doubling purge requirements. Please confirm procedures with a project manager prior to sampling.
- 5.2.3 Do not filter samples prior to PFAS analysis.
- 5.2.4 Do not collect a sample through a hose or reusable tubing. Note on the sampling sheet if a sample was collected through a hose. Results may need to be flagged in the analytical database at the discretion of the project manager.
- 5.2.5 When collecting samples from private or public water-supply wells, note any fixtures or hardware that may contain PFAS that cannot be removed or bypassed for sample collection (Teflon plumbing tape, piping of unknown material, etc.). In residential/public spaces, it can be difficult or impossible to remove products that may contain PFAS from the sampling area. Take extra precautions to avoid touching products in the area and note any potential contamination sources in the sampling area. Where possible, locate a different sampling location.
- 5.2.6 If transfer containers are necessary, use PFAS-free plastic cups. Thoroughly rinse the transfer container with the water source being sampled prior to filling the sample bottles.
- 5.2.7 For private well samples, collect samples upstream of water treatment such as water softeners, chlorine systems, and filtration units. For some projects, we do



not consider small (i.e., less than 18 inches in height) particulate filters to be treatment. Discuss with your project manager prior to sample collection.

- 5.2.7.1 If a pre-treatment location cannot be accessed, samples results may need to be flagged in the analytical database at the discretion of the project manager.

5.3 Surface Water Sampling Procedures

See *RD-B45-Surface-Water Sampling* for general surface water sample collection techniques.

- 5.3.1 If transfer bottles are necessary to collect surface water, they must be PFAS-free and made of the same material as laboratory provided containers. Transfer bottles should be rinsed in the water to be sampled prior to filling the sample containers.
- 5.3.2 Avoid standing in the water you are sampling. If necessary, stand downstream of your sample collection point (in flowing water), and wait for disturbed sediment to settle prior to collecting the sample.
- 5.3.3 If collecting from a boat, wearing waders or waterproof footwear, using water column samplers or other equipment that may contain PFAS, sample results may need to be flagged in the analytical database at the discretion of the project manager. You should note on the sample log when these items are used.

5.4 Soil Sampling Procedures

Techniques may vary. See *RD-B31- Analytical Soil Sample Collection* for general soil sample collection techniques.

- 5.4.1 Surface soil samples should be collected using decontaminated stainless steels spoons, shovels, laboratory-provided sampling tools, or disposable PFAS free plastic spoons.
- 5.4.2 Equipment used for subsurface sampling or soil borings should be PFAS free.
- 5.4.3 Samples should be collected near the surface immediately below vegetation, where present.

6.0 HEALTH AND SAFETY

A Site Safety & Health Plan (SSHP) and/or Job Safety Analysis worksheet (JSA) will be prepared for each project and will discuss safety issues involved. Any staff working on the project must read and abide by the SSHP and sign the SSHP acknowledgement form.



Personnel using this procedure will utilize PPE in accordance with these plans.

The SSHP will provide Safety Data Sheets (SDSs) for any chemicals that will be used on the project or that are known possible exposure risks for the site. Personnel using this procedure must be trained on the information contained in the SDSs, any engineering controls, and any required PPE.

7.0 QUALITY ASSURANCE / QUALITY CONTROL

QC activities are designed to allow self-verification of the quality and consistency of the work.

7.1 Interferences and Potential Problems

- 7.1.1 Inability to locate or access pre-treatment sampling location.
- 7.1.2 Presence of PFAS or PFAS-containing products in sampling area, monitoring well structure, drilling equipment, plumbing, pumps, or other equipment. In these cases, a field blank may need to be collected along with the project sample.
- 7.1.3 Inability to achieve stable parameters in residential well sampling situations.

7.2 Applicable Quality Assurance Manual procedures:

- 7.2.1 QP 05 Preparation of Field Activity Reports
- 7.2.2 QP 13 Document Control and Retention

8.0 OTHER REFERENCES

- *RD-A11- Field notes and Documentation*
- *RD-A12- Field Instrument Calibration*
- *RD-B11- Environmental Sample Handling*
- *RD-B13- Equipment Decontamination*
- *RD-B15- Environmental Database Operations*
- *RD-B25- Equipment Use - YSI-SW*
- *RD-B31- Analytical Soil Sample Collection*
- *RD-B34-Contaminated Soil Stockpiling and Sampling*
- *RD-B41-Analytical Water Sample Collection*
- *RD-B42- Monitoring-Well Sampling*
- *RD-B43-Well-Point Sampling*



- *RD-B44- Potable Water (Private) Well Sampling*
- *RD-B45-Surface-Water Sampling*
- *RD-B46- Pore-Water Sampling*
- *RD-B51-Monitoring Well Installation*
- *RD-B52- Monitoring Well Maintenance*
- *RD-B54- Water Supply Well Decommissioning*
- *RD-B72- Sediment Sampling*
- *Special Considerations for PFAS Sampling*
- Denly E, Occhialini J, Bassignani P, Eberle M, Rabah N. Per- and polyfluoroalkyl substances in environmental sampling products: Fact or fiction? *Remediation*. 2019;29:65–76.
<https://doi.org/10.1002/rem.21614>

9.0 DOCUMENTATION

9.1 Review

The Project Manager will review the field-work records pertaining to the activities under their supervision. The elements of this review will include technical content, consistency, and compliance with the project plans, and RDs.

9.2 Archive

At the completion of the project, all original field logbooks and records will be stored in the project files in accordance with project procedures. Project file lifetime is established according to standard Shannon & Wilson file-retention procedures, or sometimes controlled and spelled out in contractual agreements with clients.

Correspondence (including email, telephone, and in-person conversations) with the clients, sub-contractors, and the public will be documented and stored in accordance with project procedures.

10.0 TRAINING AND PREREQUISITES

In order to perform sampling activities without supervision, the Field Technician must accomplish the following:

- Read this RD.
- Familiarize themselves with the applicable QAM procedures (listed in Section 7.2) as well as the references applicable to the project (Section 8.0).
- Complete supervised, on-the-job instruction with experienced field technicians or



project managers. Number of hours and days will differ for each individual, determined by a project manager or experienced field technicians.

- Residential sampling program training prior to sampling alone.

Environmental sampling will be performed by a State of Alaska Qualified Sampler (18 AAC 75.333[c] and 18 AAC 78.088[c]) and/or Qualified Environmental Professional (18 AAC 75.333[b], 18 AAC 78.088[b]), or a supervised individual in training to become a Qualified Sampler. Per ADEC, a Qualified Sampler will, at a minimum, hold a “completed degree in environmental science or another related scientific field... [and have] at least three months of experience in environmental sampling under the direct supervision of a qualified environmental professional.”

Before performing this procedure, field staff will also be trained in analytical sample collection by an experienced staff member. Training will entail at least one day of supervised, on-the-job instruction.

11.0 ATTACHMENTS

A selection of relevant forms as of the publication date of this RD and are included here for reference only. Always obtain necessary forms from the project folder or project manager.

- Chain-of-Custody Form
- Well sampling log
- Field Activity Daily Log
- Monitoring well log
- Soil sample collection log



12.0 DOCUMENT HISTORY AND VERSION CONTROL

Version: 1.0 Date: 03/25/2020 Approved by:KRF

Version	Date	Reason/Description of Change(s)	Author	Reviews
1.0	3/25/2020	New.	ARM	KRF

Appendix D

Cultural Resources Report

CONTENTS

- Draft report provided by Stell, January 2023

CULTURAL RESOURCES REPORT COVER SHEET

Author: Anne Parfitt, James W. Brown, Jordan Cooper, Nichole Padovano, and Sarah M.H. Steinkraus

Title of Report: 8531 East Marginal Way South Remedial Investigation Project Cultural Resources Monitoring Report

Date of Report: January 27, 2023

County(ies): King Section: 33 Township: 23, 24 Range: 4E

Quad: Seattle North Acres: 20.7

PDF of report submitted (REQUIRED) ☒ Yes

Historic Property Inventory Forms to be Approved Online? ☐ Yes ☒ No

Archaeological Site(s)/Isolate(s) Found or Amended? ☐ Yes ☒ No

TCP(s) found? ☐ Yes ☒ No

Replace a draft? ☐ Yes ☒ No

Satisfy a DAHP Archaeological Excavation Permit requirement? ☐ Yes # ☒ No

Were Human Remains Found? ☐ Yes DAHP Case # ☒ No

Archaeological Site #:

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43 **DRAFT: 8531 EAST MARGINAL WAY SOUTH**
44 **REMEDIAL INVESTIGATION PROJECT CULTURAL**
45 **RESOURCES MONITORING REPORT**

46 **King County, Washington**

47
48
49 January 27, 2023

50
51
52 Prepared for:



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54 Shannon & Wilson, Inc.
55 400 N 34th Street, Suite 100
56 Seattle, WA 98103

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66 and Sarah M.H. Steinkraus, MS.

67
68 Stell Project No.: SHW002/SHW005

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APPENDICES

Appendix A: Monitoring and Inadvertent Discovery Plan

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Acronyms and Abbreviations

APE	Area of Potential Effect
BP	Before Present
cm	centimeter(s)
DAHP	Washington Department of Archaeology and Historic Preservation
EPA	United States Environment Protection Agency
GLO	Government Land Office
m	meter(s)
NA	Not Applicable
NRHP	National Register of Historic Places
Project, the	8531 East Marginal Way South Remedial Investigation Project Cultural Resources Monitoring
SEPA	State Environmental Policy Act
Stell	Stell Environmental Enterprises, Inc.
U.S.	United States
USDA	United States Department of Agriculture
USGS	United States Geological Survey
WISAARD	Washington Information System for Architectural and Archaeological Records Data

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EXECUTIVE SUMMARY

Stell Environmental Enterprises, Inc. was contracted by Shannon & Wilson, Inc. to conduct cultural resources monitoring for the 8531 East Marginal Way South Remedial Investigation Project, King County, Washington (the Project). The area of potential effect (APE) is located on the right (eastern) bank of the Duwamish River, approximately 4 miles upstream from the mouth of the Duwamish River. A literature review of the Washington Information System for Architectural and Archaeological Records Data, as well as other cultural and environmental documents, revealed that a total of 21 cultural resource surveys, 10 archaeological sites, 2 cemeteries, 5 registered historic properties, and 1,504 historic properties have been previously recorded within 1 mile of the APE. None of the archaeological sites were identified as being within the APE. A Monitoring and Inadvertent Discovery Plan was developed and followed for this Project (Steinkraus 2020; **Appendix A**). Archaeological monitoring was conducted from November 3 to 6, 2020; October 4, 2021; from November 4 to 7, 2022; and December 20, 2022 (a total of 8 days of monitoring during this period). **No significant cultural resources were discovered during monitoring.**

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1 INTRODUCTION

1.1 PROJECT INFORMATION

Stell Environmental Enterprises, Inc. (Stell) was contracted by Shannon & Wilson, Inc. to conduct cultural resources monitoring for the 8531 East Marginal Way South Remedial Investigation Project, King County, Washington project (the Project) (**Figure 1-1**); see **Appendix A** for the Monitoring and Inadvertent Discovery Plan. This Project was conducted on behalf of Earle M. Jorgensen, who owned the property from 1965 to 1992. The remedial investigation was completed under an Agreed Order with the Washington State Department of Ecology (AO DE 14143).

1.2 PROJECT LOCATION

The area of potential effect (APE) is on the right (eastern) bank of the Duwamish River, approximately 4 miles upstream from the mouth of the Duwamish River, in Section 33 of Township 24 North, Range 4 East, Willamette Meridian (**Figure 1-2**). The Project is located in Parcel No. 000160-0023, King County, Washington (see **Figure 1-1**). The total acreage of the APE is 20.7 acres near the Duwamish River; this report documents the monitoring of discrete sampling areas within the Project APE (see **Appendix A**).

1.3 PROJECT BACKGROUND

The APE is in Tukwila, Washington. The Duwamish River and adjacent upland areas have served as Seattle's major water-dependent industrial corridor since the river was created by widening and straightening much of the Duwamish River in the early 1900s. The Duwamish River flows north through Tukwila and Seattle, splitting at the southern end of Harbor Island to form the East and West Waterways, which discharge into Elliott Bay in Seattle, Washington.

1.4 REGULATORY ENVIRONMENT

This project is subject to the State Environmental Policy Act (SEPA), which mirrors the National Environmental Policy Act. SEPA requires that all major actions sponsored, funded, permitted, or approved by Washington State and/or local agencies consider the impacts of the planned action on the environment and properties of historical, archaeological, scientific, or cultural importance (Washington Administrative Code 197-11-960). Especially those that are or could be listed on the National Register of Historic Places (NRHP) or other historic registers, including the Washington Heritage Register or King County Landmarks. The Department of Archaeology and Historic Preservation (DAHP) is the lead agency for considering the effects of a proposed action on cultural resources and provides formal recommendations to local governments and other Washington State agencies for appropriate treatments or actions.

Historic properties that could be eligible for the NRHP include any artifacts, records, and remains that are related to such a district, site, building, structure, or object (16 United States Code 470[5]). The quality of significance in American history, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects of state and local importance that possess integrity of location, design, setting, materials, workmanship, feeling, and association. They also:

- are associated with events that have made a contribution to the broad pattern of our history;
- are associated with the lives of people significant in our past;
- embody the distinct characteristics of a type, period, or method of construction, represent the work of a master, possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction; or

- have yielded, or are likely to yield, information important for understanding prehistory or history (36 Code of Federal Regulations 60.4).

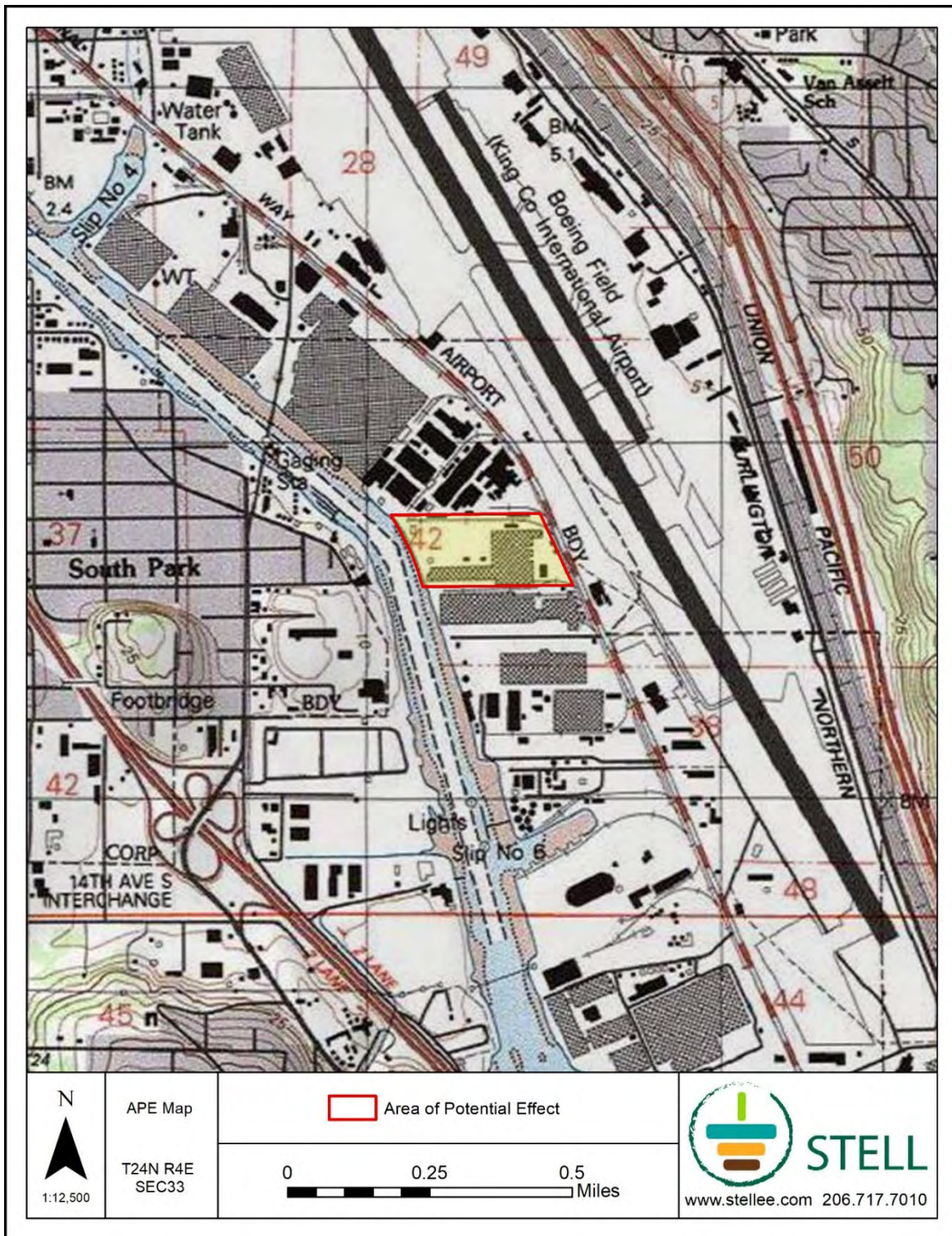


Figure 1-1 Topographic map of the APE



Figure 1-2. Aerial map of the APE

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2 ENVIRONMENT AND CULTURAL SETTING

This section describes the environmental context of the APE. Elements of the environmental context include geology, soils, plants, and animal habitats. Knowledge of the geologic processes associated with the landforms in this area can assist in locating archaeological resources. Geographic features, such as shorelines, rivers, lakes, and terraces, are often correlated with the archaeological record. Throughout prehistory, these locations provided an abundance of plant resources and fish and often attracted terrestrial animals. As a result, sites tend to be found at locations along shorelines, within active floodplains, or along associated terraces. The depth of soils and potential for buried deposits can be derived from soil surveys and geomorphologic descriptions of the landscape. Understanding the extent of native plant and ecological habitats provides a context for interpreting archaeological sites and activity locations.

2.1 ENVIRONMENTAL CONTEXT

Environmental data for the APE was gathered from geologic and soil maps and reports of recent geological and geomorphological investigations describing subsurface conditions and the post-depositional processes that may have impacted the APE's cultural deposits.

2.1.1 PHYSIOGRAPHIC PROVINCE

The Project is within the Puget Sound Area of the western hemlock (*Tsuga heterophylla*) vegetation zone within the Puget-Willamette Lowland physiographic province (Franklin and Dyrness 1988). The Western Hemlock Zone is the most extensive vegetation zone in western Washington and Oregon (Franklin and Dyrness 1988). It extends from British Columbia through the Olympic Peninsula, Coast Ranges, Puget Trough, and both Cascade physiographic provinces in western Washington (Franklin and Dyrness 1988). Major forest tree species in this zone are Douglas-fir (*Pseudotsuga menziesii*), western hemlock, and western red cedar (*Thuja plicata*). Less common conifers include grand fir (*Abies grandis*), Sitka spruce (*Picea sitchensis*), and western white pine (*Pinus monticola*). Western white pine and lodgepole pine (*Pinus contorta*) are common on glacial drift in the Puget Sound area. The APE presently contains standing structures, asphalt, and manicured garden areas and lawns.

2.1.2 GEOMORPHOLOGY

The Project is located in the southern Puget Lowlands. The Puget Lowlands are a north-south-trending geological and physiographic province bordered by the Cascade Mountains on the east and the Olympic Mountains on the west (Franklin and Dyrness 1988; Troost and Stein 1995). It was shaped by at least four periods of extensive glaciation during the Pleistocene epoch (Easterbrook 2003; Lasmanis 1991). The bedrock was depressed and deeply scoured by glaciers, and sediments were deposited and often reworked as the glaciers advanced and retreated. This can be seen in the overall rolling, low-relief topography of the area that is deeply incised by large troughs/ravines. The elevation of the area is generally within 500 feet above mean sea level (Troost and Stein 1995). The scoured troughs left by the glaciers are currently occupied by the Puget Sound and freshwater lakes, such as Lake Washington and Lake Sammamish (Galster and Laprade 1991; Liesch et al. 1963; Yount et al. 1993).

A mantle of glacial drift and outwash deposits were left across much of the Puget Lowland at the end of the Fraser Glaciation (the last of the four glacial periods) (Booth et al. 2003; Easterbrook 2003). The Vashon Stade of the Fraser Glaciation began around 18,000 years before present (BP) with an advance of the Cordilleran Ice Sheet into the lowlands (Porter and Swanson 1998). The

Puget Lobe rapidly advanced into the Puget Lowland and reached its maximum extent near what is now the town of Centralia by about 15,000 BP. The glacier remained this way for approximately 1,000 years until the ice began to retreat. The retreating Puget Lobe reached Seattle by about 13,600 BP (Borden and Troost 2001; Porter and Swanson 1998). The Puget Lobe was thicker towards the north and thinned towards its terminus in the south.

The APE is located within the Geologic unit Quaternary alluvium (Qal), indicating alluvium ranging from a few meters to 30 meters (m) deep (United States [U.S.] Geological Survey [USGS] 2005). The Duwamish River is part of the greater Duwamish-Green River system, which is within a glacial trough formed by melting and incision beneath the Puget Lobe (Montgomery et al. 2003). This river system, along with other sub-glacial river systems in the region, aggraded throughout the Holocene and developed long, meandering channels running through what were often far-reaching wetland environments (Montgomery and Wohl 2004). The Duwamish-Green River delta reached its present position via repeated lahar events deriving from Mount Rainier, which helped shape and provide delta expansion material over the past 5,700 years (Dragovich et al. 1994). A lahar is a sediment-laden debris and/or mudflow that originates from the flanks of a volcano (Smith and Lowe 1991). The largest of these events was the Osceola mudflow. Approximately 5,700 years ago, it flowed from the summit and northeastern flank of Mount Rainier down the White River drainage into the Green and Puyallup river drainages, covering a total area of 195 square miles (Dragovich et al. 1994). This lahar event, and subsequent, smaller lahar events, extended the Puyallup and Duwamish River deltas out into the marine embayments for these rivers and provided material for future delta advancement as the rivers downcut into the lahar material and deposited the sediment further downstream (Dragovich et al. 1994). Today, the sea level is approximately 5 feet higher than it was 5,700 years ago when the Duwamish deltas first began prograding into its current location, resulting in a slight increase in the elevation of the lower Duwamish floodplain (Steinkraus and Hodges 2018). In the 1800s, the Duwamish delta exhibited a complicated series of streams and channels extending across it (Collins and Sheikh 2005).

2.1.3 PALEOECOLOGY

Pollen samples collected through lake and wetland coring throughout the Puget Sound area suggest that paleoecology varied greatly over time (Tsukada 1982; Whitlock 1992). Lodgepole pine, bracken fern (*Pteridium aquilinum*), and red alder (*Alnus rubra*) were the first to populate the landscape after the glaciers receded. These were followed by Douglas-fir a few centuries later (Barnosky 1985).

At the beginning of the Holocene (10,000 BP–present), the climate continued to warm, and grasslands, as well as oak (*Quercus* sp.) and hazel (*Corylus* sp.) woodlands, established themselves on the landscape between 10,000 and 5000 BP. Douglas-fir became the dominant tree species in the area. At this time, precipitation became more seasonal, and summers saw increased droughts, increasing fire frequency, and expanding prairies. Cedar (*Thuja* sp.) and Hemlock (*Tsuga* sp.) populations increased between 7000 and 5000 BP, as canopy forests dominated the landscape and weather conditions became cool and moist (Tsukada 1982; Whitlock 1992). Since this time, the climate has remained fairly stable with small fluctuations between warmer/drier and cooler/moister conditions (Leopold et al. 1982).

2.1.4 SOILS

As defined by the U.S. Department of Agriculture (USDA) soil survey, the soils within the APE comprise urban land and water. The urban land comprises all the soils surrounding the APE. No subsurface characteristics are defined for these soils (USDA 2021).

2.2 CULTURAL CONTEXT

This section describes the cultural context of the APE, which will inform the evaluation of findings from any future field investigations performed as part of this Project. Elements of the cultural context include cultural chronologies developed for the precontact occupation through archaeological research, information derived from oral histories, and documented historic events and land use patterns. Reviewing archival archaeological, historical, and ethnographic documents provides insight toward developing hypotheses and a research design. The completion of this section included reviewing information from the DAHP, the Washington State Archives, General Land Office (GLO) records, King County records, the University of Washington Libraries, and multiple historic imagery sources.

2.2.1 ARCHAEOLOGICAL CONTEXT

The first human occupation of western Washington may date back about 14,000 BP, as evidenced at the Manis Mastodon site in Sequim, where a bone point and the spirally fractured bones of a mastodon suggest possible human hunting and butchering (Gustafson et al. 1979; Waters et al. 2011). Artifacts of the Clovis period, which began between 13,500 and 13,000 BP elsewhere in North America, have been found in isolated locales in southern and central Puget Sound. Still, no occupation sites of this period have yet been found in Washington. The Richey Roberts site, a cache of Clovis blades, is the sole in-situ discovery of Clovis archaeology in Washington (Gramly 1991; Mehringer 1985). Several similar early sites that are coeval and possibly predating Clovis in the region are presented in recent literature (Huckleberry et al. 2003). While archaeologists have traditionally assumed that Clovis peoples focused heavily on big game for subsistence, there is increasing evidence that Clovis groups also relied on plants and smaller animals and had considerable dietary variability across North America (Cannon and Meltzer 2004).

As early as 9000 BP, as the climate stabilized, cultural complexes with distinct lithic technological assemblages emerged in the region (Carlson 1990; Fladmark 1979). These assemblages demonstrate a “foraging” economy based on generalized resource procurement for immediate consumption and high-residential group mobility (Ames 1981; Binford 1978). One of these distinct technologies is named the Old Cordilleran Tradition (Butler 1961). In western Washington, the Old Cordilleran Tradition manifestations are recognized by unifacial pebble and cobble tools and chopper-like cores (Butler 1961).

Other contemporary technologies include the Northwest Coast Microblade Tradition, identified by a rather diverse assemblage that includes microblade and microblade cores, leaf-shaped bifaces, and bifacial cores (Borden 1975; Fladmark 1979). The variety of technologies found in the archaeological record suggests the establishment of multiple well-defined cultural groups populating the Northwest Coast vicinity early on in prehistory. The post-Clovis prehistory of Western Washington is commonly divided into three cultural periods—Early, Middle, and Late—defined by a series of technological characteristics found at archaeological sites.

2.2.1.1 Early Period

The Early period, which lasted from approximately 12,000 to 7000 BP, is classified archaeologically by the Old Cordilleran Tradition (Matson and Coupland 1995), with regional manifestations defined as the Olcott Complex in the Puget Sound and the western Cascade Range regions and the Cascade Phase east of the Cascade Range. Sites of this period in western Washington typically occur on high marine and river terraces, sometimes at significant distances from modern watercourses; they consist of concentrations of cobble cores; flakes; large, ovate

knives; and broad-stemmed and leaf-shaped projectile points (Wessen 1990). These people are thought to have relied more on inland hunting than on fishing and shellfish procurement for subsistence. However, finds along the British Columbia coast indicate aquatic resources were sometimes important (Blukis Onat 1987).

2.2.1.2 Middle Period

The Middle period, lasting from 7000 to 4500 BP, incorporates a continuation of the Old Cordilleran Tradition and the emergence of a distinct Northwest Coastal culture; however, few sites in Washington can be attributed to this time interval (Blukis Onat et al. 2001; Morgan 1999). Toward the end of this period, as sea levels stabilized, the focus of subsistence activity seems to have changed from reliance on terrestrial to marine resources; most sites appear along the coasts or major river systems. It is thought that this adaptation may have occurred earlier in the Gulf of Georgia and Fraser Valley regions of Canada (Stein 2000).

Archaeological sites associated with this cultural period are found to be technologically more complex and more diverse. They often include tools and ornaments of bone and antler, along with flaked stone. In the Puget Sound and western Washington, the Middle period is a transitional time represented archaeologically by a shift toward marine resource utilization (Morgan 1999).

2.2.1.3 Late Period

Human lifeways changed radically in the Late period (4500 to 250 BP), as people focused even more strongly on marine resources; during this time period, the number and diversity of sites markedly increased (Matson and Coupland 1995). People maintained permanent villages on the coast and along the lower reaches of inland rivers. They used these as home bases and storage warehouses for fish, shellfish, game, and plant foods systematically amassed during the warm seasons (Matson and Coupland 1995). Cemeteries and petroglyph sites are often associated with significant places, such as villages and seasonal habitation areas; petroglyphs also occur occasionally in higher montane settings. Blazed cedars, stripped of bark for basketry or with planks removed from their living trunks, can still be found throughout the region. Seasonal habitation areas and task-specific locations have been documented in the lowlands and up into the subalpine zone of the mountains. Still, they usually remain close to larger, permanent sources of water. These places typically are concentrated along trade routes that linked communities living on both sides of the Cascade Mountains.

2.2.2 ETHNOGRAPHIC BACKGROUND

Prior to the arrival of Europeans, the Northwest coast was one of the most densely populated nonagricultural areas in the world. Between the mid-1700s and late 1800s, numerous outbreaks of infectious diseases, including smallpox and measles, decimated the population of the Northwest coast (Boyd 1990). Despite the massive reduction of the local population, when the first Euroamerican settlers arrived at Alki Point in 1851, at least 17 Duwamish villages, including over 90 longhouses, were present along Elliott Bay and local river systems (Duwamish Tribe 2008).

The Duwamish people primarily utilized the APE and surrounding area. Neighboring groups, including members of what are now the Suquamish, Puyallup, and Yakima Tribes, also traditionally utilized this region. The Duwamish Tribe is a Southern Coast Salish group who speak the southern dialect of the Lushootseed language (Suttles and Lane 1990). Duwamish, or *Dkh^w'Duw'Absh* in the Lushootseed language, means “the people of the inside.” The name refers to Elliott Bay, the Duwamish River, and the other waterways that connect the people to the land.

Upon the arrival of the first European explorers, the Duwamish people occupied at least 17 winter villages, living in over 90 longhouses throughout the Duwamish River basin and surrounding landscape (Speer 2004). Winter villages were the nexus of natural resources, political power, and ideological systems. These winter villages, including nearby seasonal habitation areas and spiritual places, were linked to the broader geographic community through kinship, trade, and diplomacy (Thrush 2007). Indigenous peoples in the area hunted deer, elk, and bears across the land, and ducks, geese, and other waterfowl from the estuarine environment. They fished for salmon, cod, and halibut; harvested clams; gathered berries, camas, and other plants for food and medicine.

Although some of these places have undergone a complete transformation with the industrial development of the Duwamish River watershed in the twentieth century, these locations and resources remain important to the Duwamish people. They are significant in the understanding of the development of Seattle. The area surrounding the Lower Duwamish Superfund APE still holds significance for the Duwamish people. The following place names are from Thomas T. Waterman's ethnographic book *Puget Sound Geography* (2001) and are written using his linguistic characters (**Figure 2-1**). One such place is Lwalb, which means "abandoned" (Waterman 2001 [1920]:120). Lwalb refers to an abandoned river channel on the southwestern side of the Duwamish. Another place name is T³ a'Lt³aLusid or "where there is something overhead across the path" (Waterman 2001 [1920]:120). This place was on the western side of the river, which now is filled in. hŪtesa'tci or "cut in two with reference to the hand," has a malevolent connotation with the Duwamish people (Waterman 2001 [1920]:120–121). As Waterman retells the legend, an evil supernatural being's mangled hand rose from the water. Waterman is unsure where exactly this spot is located along the Duwamish.

The closest Duwamish villages located to the APE are Tuqwe'Ltid or "a large open space" (Waterman 2001 [1920]:45, 121). There is some debate about where the village of Tuqwe'Ltid was located, but it is accepted it was near the South Park Bridge (Berger and Hartmann 2013:5; Blukis Onat et al. 2008:21). "A brace supporting a rafter," or TEtc³gwEs, is for an area where trees fell over a trail, possibly caused by a landslide, on the northern side of the Duwamish River (Waterman 2001 [1920]:121). This place is now somewhere underneath the King County International Airport.

The area where the Duwamish River narrowed and made a sharp turn was called cka'lapsEb or "neck" (Waterman 2001 [1920]:121). This area was once where the Duwamish people could collect lily bulbs (Waterman 2001 [1920]:121). Hwa'pitcld means "where one throws something," for this area was wide and flat near an old river channel (Waterman 2001 [1920]:121). Qiyawa'lapsEd, or "eel's throat," is a place name for three knolls situated on the western side of the Duwamish River, which is in the South Park neighborhood (Waterman 2001 [1920]:121). Xo'bxobti, or "canoe paddles," is where the Duwamish people harvested ash trees to make paddles (Waterman 2001 [1920]:121). This area is described as a flat bend of the river on the eastern side of the Duwamish River. The last placename is tsitskad'b, which refers to a small promontory that stuck out in the river (Waterman 2001 [1920]:121). This could refer to Turn Basin Number 3.

Another Duwamish village sqoa'l-qo, or "meeting of rivers," was approximately 3 miles upstream from the APE (Berger and Hartmann 2013:5; Waterman 2001 [1920]:45). This village was near where the Black and White rivers met. Waterman claimed there were additional villages near the Duwamish River, but the names were not known to him (Berger and Hartmann 2013:5; Waterman 2001 [1920]:45).

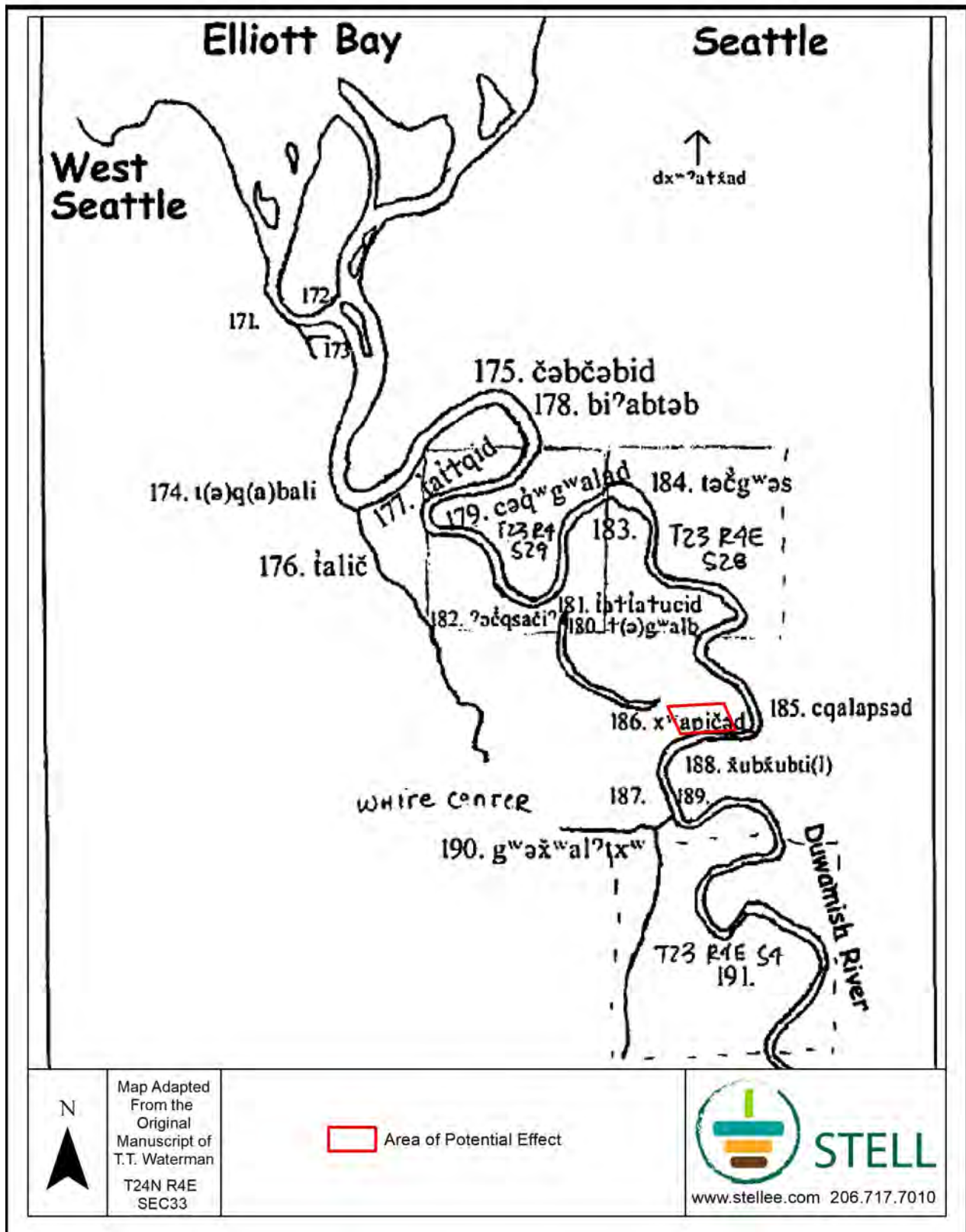


Figure 2-1. Waterman (2001 [1920]) place names map with project APE

Once non-native settlers moved into this area, the Duwamish people were pushed out of their traditional lands, especially after the 1855 Treaty of Point Elliott. The Sackman and Dewatto Duwamish communities chose to stay within the area and formed new communities with other tribes in the area (Tollefson 1992:214–216). These communities were forced to live outside of the city of Seattle. They were able to retain some of their seasonal gathering, hunting, and fishing traditions that helped supplement their diet (Tollefson 1992:214–216).

2.2.3 HISTORIC BACKGROUND

Following the arrival of non-Native settlers in the Pacific Northwest (by the mid-1850s), many Native village/habitation sites were subsequently homesteaded or platted as towns. This was especially true for locations near water, at river confluences, or along traditionally utilized travel corridors/trails, many of which were in use into the historical period, if not into modern times. Extensive logging and mining activity took place throughout the region from the mid-1800s to the present. The construction and expansion of transportation corridors associated with railroads and roadways had a profound effect on the landscape in this area (Marino 1990).

2.2.3.1 History of King County

The first Euroamerican explorers to visit King County were Colonel Isaac Ebey and, later, John Holgate. European settlement of the area started in 1852, with lumber, hops, coal, and fish constituting the area's first industries (Long 2006). King County was formed on December 22, 1852, by the Oregon Territorial Legislature and, 3 months later (in 1853), was included in the newly created Washington Territory. The county was originally named for William Rufus DeVane King, a senator from Alabama who was elected as the U.S. vice president in 1853 and died shortly after the election. In 1986, this was officially changed to honor the Rev. Dr. Martin Luther King Jr. (Long 2006).

The first settlers of King County were a group of farmers led by Luther Collins, who claimed land inland along the Duwamish River on September 14, 1851 (later called Georgetown). A week after the Collins party claimed their land, the initial vanguard of the Denny Party (the group credited with the founding of Seattle) arrived on Alki Point (near what is now West Seattle). The rest of the Denny Party arrived on November 13, 1851 (Long 2006).

The major industries in King County in the late 1800s were logging and coal mining. By the 1880s, sawmills and shingle mills were main industries in many towns throughout the Puget Sound (Long 2006). Throughout this decade, hops were a major King County crop until hop lice/aphid infestations that started in 1889 prompted growers to turn to dairy farming, orchards, and other crops (Bagley 1929; Long 2006). Native Americans provided much of the labor for harvests in King County. The hop lice crisis was exacerbated by a national economic depression in the 1890s. Overall, King County recovered quickly due to the 1897 Klondike Gold Rush, during which Seattle and King County merchants provided supplies to those headed north to the goldfields (Long 2006).

2.2.3.2 History of the APE

Seattle's earliest non-native settlers first arrived in the Puget Sound via canoes floating down the Duwamish River from Nisqually. They were the Collins Party and settled along the Duwamish River in late September 1851, about 2 miles south of the mouth of the Duwamish River. Eventually, Luther Collins filed for a Donation Land Claim. Other parties of settlers were quick to join the Collins Party in acquiring lands around Elliott Bay. These included John Holgate, William

Latimer, the Denny Party, and others (Lange 2000). The Duwamish River was a river that meandered in curves through the valley floor and eventually discharged into the southern end of Elliott Bay through a delta of intertidal marshlands (**Figure 2-1**).

Much of the surrounding land was submerged at high water and plus tides. Seattle was incorporated on December 2, 1869, and by the 1890s, the population was well established, and maritime traffic became a common site on Elliott Bay. Steamboats could navigate the Duwamish River as far as Kent, but ocean-going vessels could not use the river. Eugene Semple, in 1895, proposed a plan of public works, which included digging a canal from Elliott Bay to Lake Washington, filling the tide flats west of Beacon Hill (**Figure 2-2**), and straightening the Duwamish River. The Washington State Legislature authorized the formation of diking and dredging districts in that same year. By 1901, Semple began construction, sluicing the soils of Beacon Hill and transporting soil from Seattle regrade projects for filling the tide flats south of downtown Seattle.



Figure 2-2. East Marginal Way, view to the southwest. Dated: February 24, 1916 (Source: Seattle Municipal Archive [1916] Photograph Collection # 941).

In 1909, City Engineer R. H. Thomson formed the Duwamish Waterway Commission to sell bonds for rechanneling the river. The straightening and dredging of the Duwamish River began on October 14, 1913 (Wilma 2001; **Figure 2-3** and **Figure 2-4**). The channel would allow larger ships to access the reclaimed land and alleviate the flooding that frequently occurred throughout the valley.

Dredging began at the County Poor Farm in Georgetown, filling the meanders, except for a few recessed in the channel to accommodate high water levels and turning ships. By 1920, the Duwamish Waterway reached a depth of 50 feet for 4.5 miles (Wilma 2001). All of the original meanders were filled except for one—a short section of the original course of the Duwamish delta channels, which is still present along the southwestern shore of Kellogg Island (Thrush 2007).

It is known that dredge spoils were used for the creation of Harbor Island, which was finished in 1909 by the Puget Sound Bridge and Dredging Company. At the time, Harbor Island was the

largest artificial island in the world. Soil from the Beacon Hill, Denny Hill, Yesler Hill, Jackson Hill, and Dearborne Street regrades were used in the construction of Harbor Island, in addition to the filling of the greater Duwamish delta tidelands (Stein and Goodman 2001; Wilma 2001).



Figure 2-3. Historic photograph of the Seattle tidelands looking southeast. Taken from Centennial Mill in 1902 (University of Washington digital archives, Asahel Curtis Photo Company Photographs Collection, # CUR118)

By 1920, the indigenous people, who traditionally utilized resources from the Duwamish River, could no longer safely gather food from that area (Thrush 2006:110). The channelization of the Duwamish River was complete and industrial factories were established along its banks. The 1949 USGS Seattle, South Quadrangle 7.5-minute series shows structures of all sizes up and down the Duwamish River.

2.2.3.3 APE Background

The APE is first seen in an 1862 GLO Cadastral survey map (GLO 1862) (**Figure 2-5**) and an 1863 GLO Cadastral survey map (GLO 1863) (**Figure 2-6**). Both of these maps show the APE prior to any channeling of the river, with the APE being present east of the river course. The APE does not appear in 1862 to be in an area that is privately owned; however, just to the northeast private landowners had claimed portions of the land along the river.

The following year in 1863, the APE was located within lands owned by Mr. John Buckley. Based on later maps, it appears that Buckley owned the property that the APE is located in from 1863 through to 1907. Between 1863 and 1907, there were at least four different John Buckleys listed in King County census records. Two of these people were born in Wisconsin, one was born in Connecticut, and one was born in Washington. The first person from Wisconsin was 21 in 1889, and the other was 20 in 1892. The John Buckley from Connecticut is listed in the 1870 Census as being 72 years of age and appears again in the 1871 Census. His wife is also listed in both census records: while the 1870 Census name for her is unreadable, she is listed as E. Buckley in the 1871 Census.



Figure 2-4. Map showing route of Duwamish Waterway, Commercial Waterway, Commercial Waterway District No. 1, revised September 1, 1919 (King County Road Services Map Vault Image No. 20100824-17370)



Figure 2-5. GLO Cadastral Survey from 1862 with the APE overlaid (GLO 1862)



Figure 2-6. GLO Cadastral Survey from 1863 with the APE overlaid (GLO 1863)

Another John Buckley from Washington was one of four children whose parents are listed as A. Buckley and Martha Buckley; he is listed in both the 1887 Census (aged 7) and 1889 Census (aged 9). Between 1896 and 1957, six John BUCKLEYS passed away within King County. One of these passed away at 75 years in 1912, while another passed away at 70 in 1932. The others are likely either too young or old to have been associated with the ownership of the property. In 1868, a John Buckley married an Eliza Horton in King County. Another marriage certificate from 1919 also mentions a John Buckley, who married Nathalia Ryan. A frontier justice divorce record also mentions a Jane Buckley, who divorced a John Buckley in 1867 in King County.

A 1907 Anderson map shows the Duwamish River still following a natural channel but with multiple landowners occupying the surrounding area (**Figure 2-7**). John Buckley still owns the land that the APE is located within at this point in time.

A 1912 Kroll map shows the Duwamish River remaining in its natural channel; however, the course appears to have shifted slightly west on the bend of the river that the APE is located within, indicating that the southeast portion of the river was likely underwater at this point in time (Kroll 1912) (**Figure 2-8**). Many of the landowners changed in this period. The large property owned by Mr. John Buckley is no longer present; instead, much of this area had been divided up. Landowners that appear are Dan Shea and T. F. Burns. Only two T. F. Burns are mentioned in the Washington Census records for King County. The earliest mention is from 1896 and references a T. F. Burns, who was 26 and born in California. There is another mention in 1910 of a T. F. Burns, born in Washington, who was 38 at the time of the census and lived in Meadow Gardens, the same area in which the APE is located. This T. F. Burns is listed as the head of household along with two brothers, J. J. and James P., and a boarder, James W. Agnew. There is also a death record for a Thomas F. Burns, who died in 1926 at age 69, in Pierce, Washington, and a Thomas Burns, who died at 62 in King County in the year 1935. This latter death certificate matches closely with the age of the T. F. Burns mentioned in the 1910 Census, although the birth locations of the two people are different.

A 1926 Kroll map shows the Duwamish River as being fully canaled and removed from its original channel north of the APE; however, the river within the vicinity of the APE still follows a natural course (**Figure 2-9**). The 1926 Kroll map does show the proposed path of the Duwamish Canal as it is labeled on the map. Many landowners on the 1926 map remain consistent with the 1912 map; however, many parcels were further divided amongst landowners. Large tracts of land were still listed as “The Meadows and Moore’s 5 Acre Tracts.” The city limits of South Park were expanded from the 1912 map.

The 1936 Metsker map shows a landscape similar to what is seen today around the APE, with the Duwamish River in its current orientation and many roads seen today (**Figure 2-10**). To the east of the APE, Boeing Field was present. Many of the large parcels that had been previously noted are no longer located on this map, with many smaller parcels having taken their place. The parcel that the APE is located in appears to be owned by King County. A parcel along the east bank of the river was listed as being owned by the Fisher Body Company; Fisher Body was an automobile coachbuilder founded in Detroit in 1908 (Jackson 2021). The Fisher Body Company had a Seattle Division leased to the Boeing Company. Additional parcels are listed as being owned by multiple lumber companies, including the Newell-Bissell Lumber Company. This company was formed when the Newell Mill & Lumber Company changed its name in 1917 (Lumber World Review 1917).

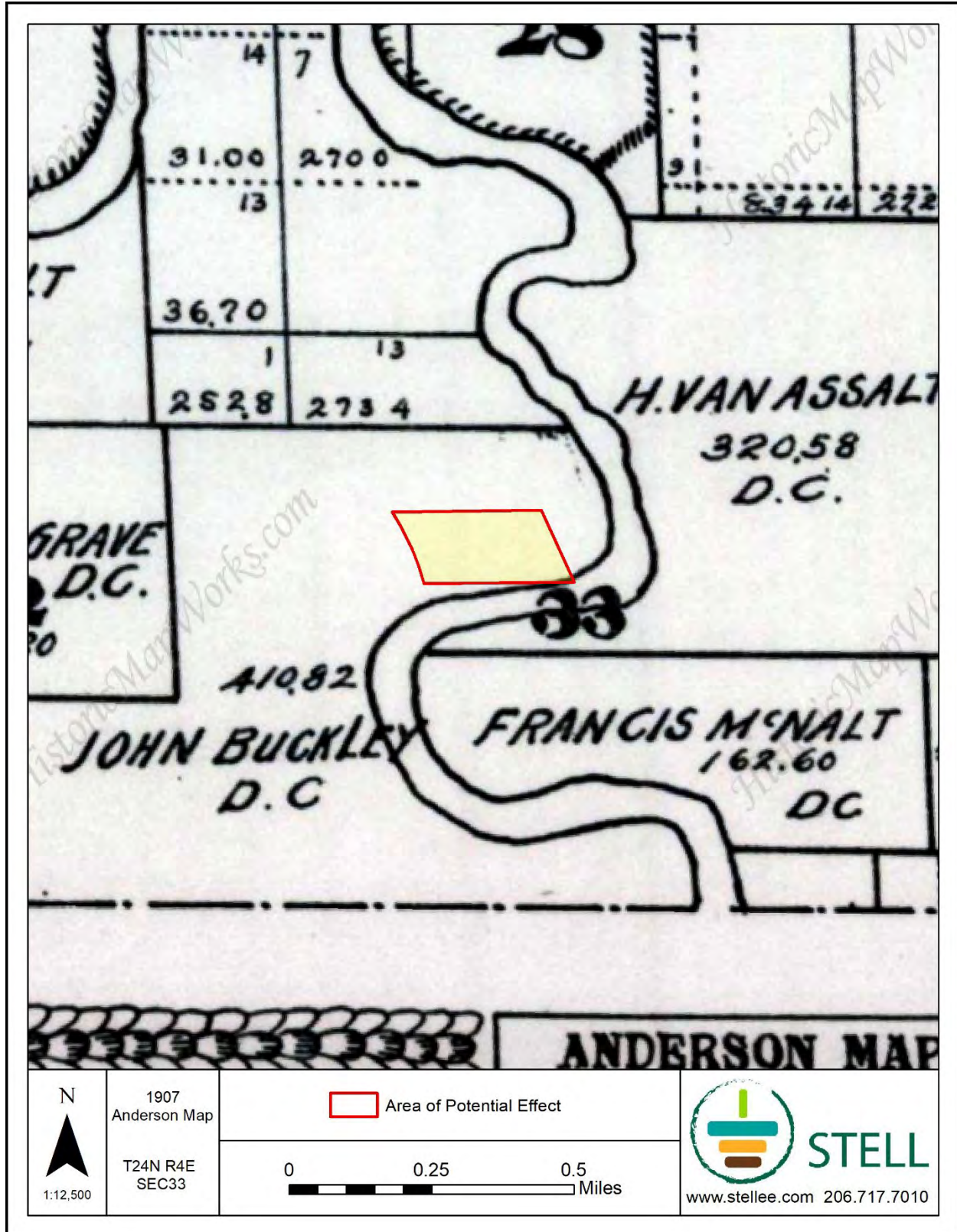


Figure 2-7. 1907 Anderson map with APE overlayed (Anderson 1907)

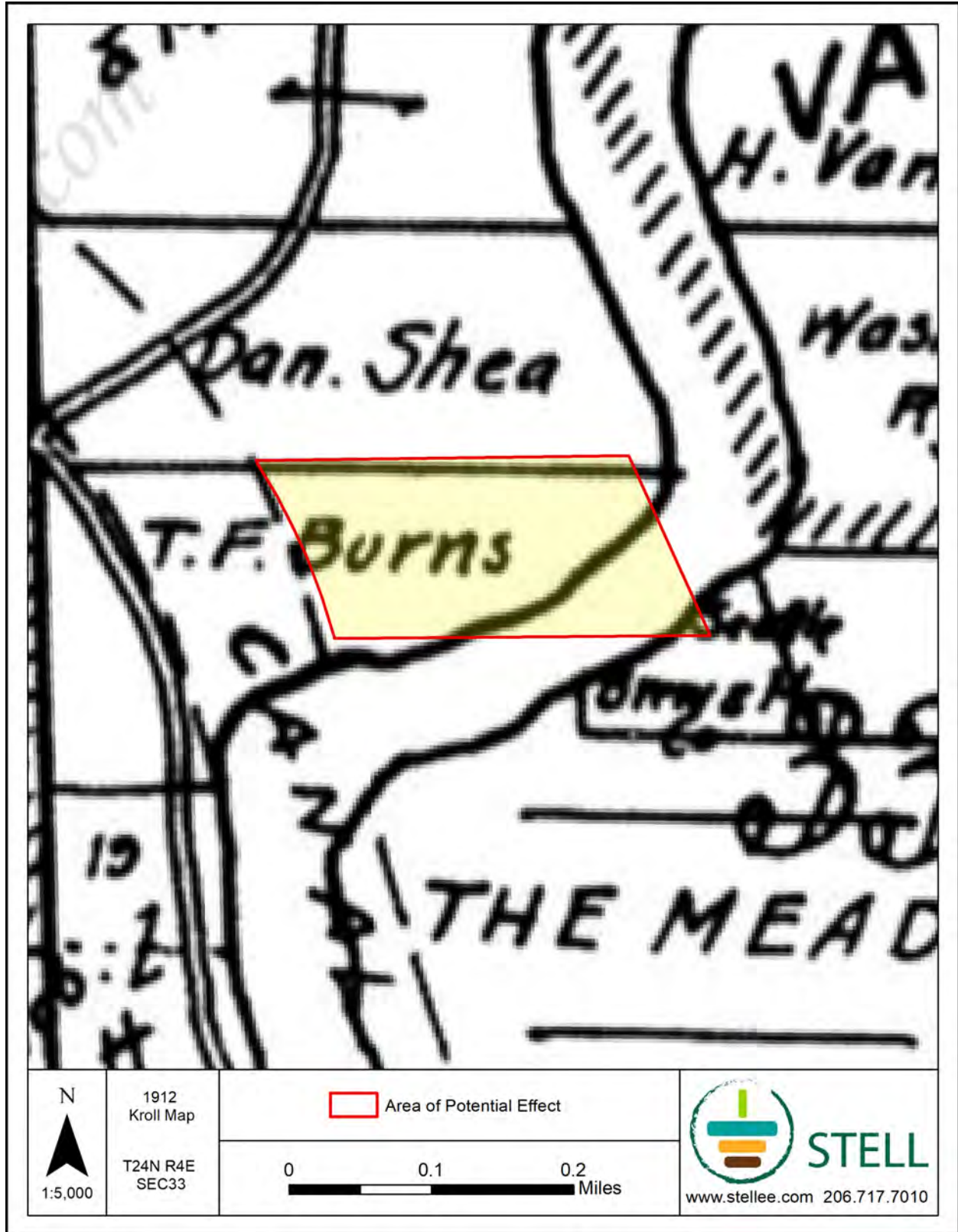


Figure 2-8. 1912 Kroll map with APE overlaid (Kroll 1912)



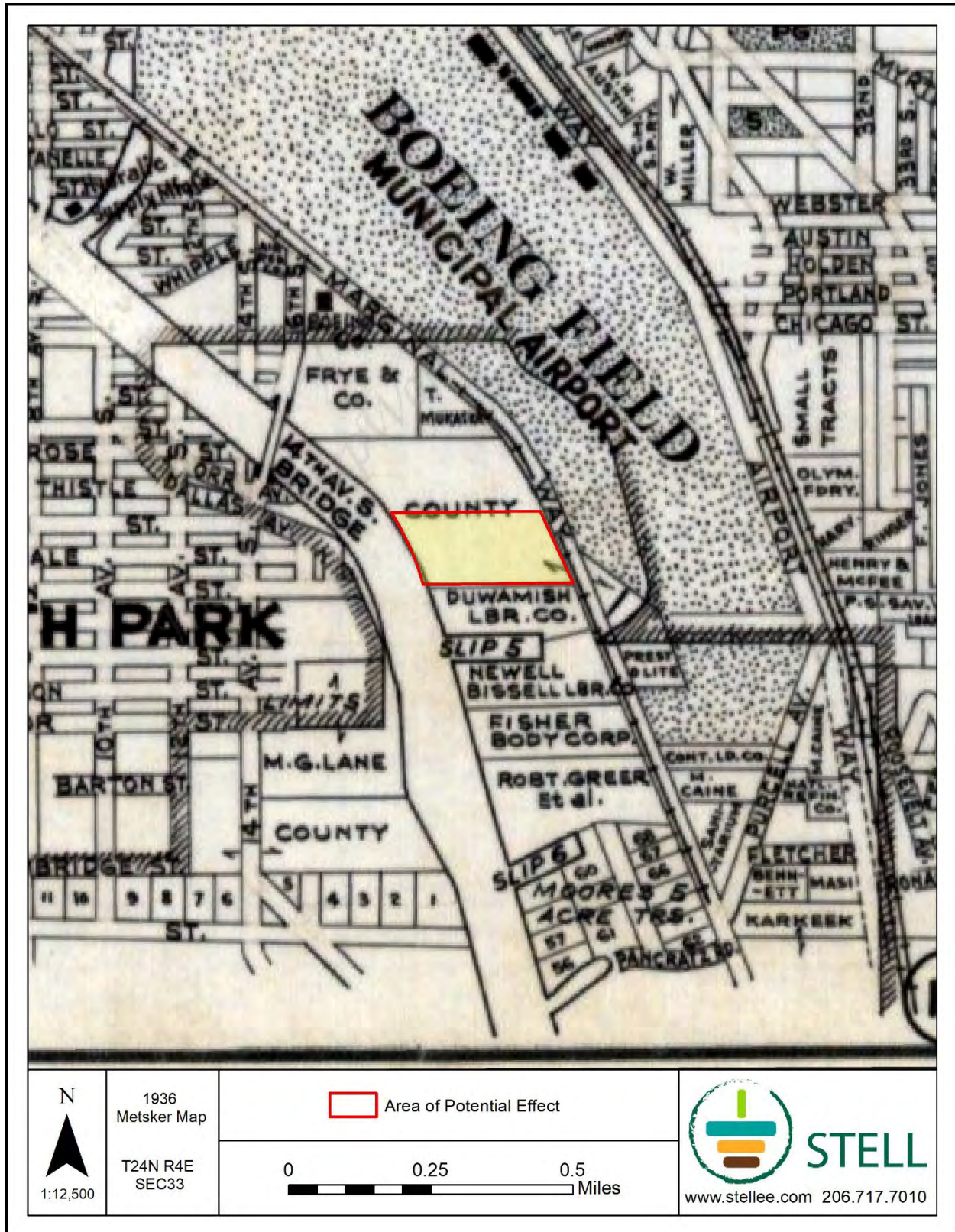


Figure 2-10. 1936 Metsker map with APE overlaid (Metsker 1936)

The 1937 aerial imagery shows the development of South Park to the west of the river. More open large tracts of land to the east of the river were noted in these images (**Figure 2-11**). To the east of the Duwamish River, it appears as though East Marginal Way and railroad lines are present in their modern layout. A portion of the APE appears to have been inundated by the river in 1937, with a large semi-circular area covered by water.

In 1940, the APE was bought by Issacson Iron Works. Issacson Iron Works began in 1908 as a small smith shop on King Street in Seattle, founded by Swedish immigrant John Issacson (Caldbrick 2020; Earley and Heideman 2019). The property at 8531 E Marginal Way, known as Issacson Plant No. 2, was adjacent to Boeing's main factory. Issacson Plant No. 2, built by the U.S. Navy and run by Issacson, was the largest steel manufacturing plant on the west coast and became a major supplier of precision parts for U.S. military operations during World War II. During the height of the war, it employed 1,200 workers (**Figure 2-12**), and its output included propellor shafts and precision parts for Navy vessels (Caldbrick 2020), and bulldozer blades and other parts for the Seabees which were used to construct runways in the Pacific (Earley and Heideman 2019). The company also built a steel melt plant next to Plant No. 2 in 1943 to decrease reliance on outside steel suppliers (Earley and Heideman 2019).

In March 1961, Issacson Iron Works became full owners of the property when they bought the buildings built by the U.S. Navy in 1942 (**Figure 2-13**; Caldbrick 2020). In 1965, they divided Plant No. 2 and sold the melting, forging, and machining half of the plant to the Earle M. Jorgensen Company while retaining the fabrication part of the plant to the south. While the Issacson Iron Works company went out of business in 1983, selling the fabrication plant to Boeing at that time (Earley and Heideman 2019), the Earle M. Jorgenson Company owned and operated the forge until 1992, when they sold it to a number of the managers who subsequently continued operation of the forge (Caldbrick 2020). In May 2016, Jorgenson Forge came under the ownership of Constellation Enterprises LLC, which then filed for bankruptcy. In August 2016, the forge fell under the ownership of CE Star Holdings and became Star Forge (Caldbrick 2020). One of the conditions of this sale was that Star Forge would work with the U.S. Environmental Protection Agency (EPA) to clean up the Jorgenson Forge property, which is part of the Lower Duwamish Waterway Superfund site, and which has contributed heavily to the pollution in the Duwamish River and floodplains over the course of its 70 years as a metal forging plant. In April 2018, Star Forge's owners announced that they would be closing the plant to redevelop the land (Caldbrick 2020).

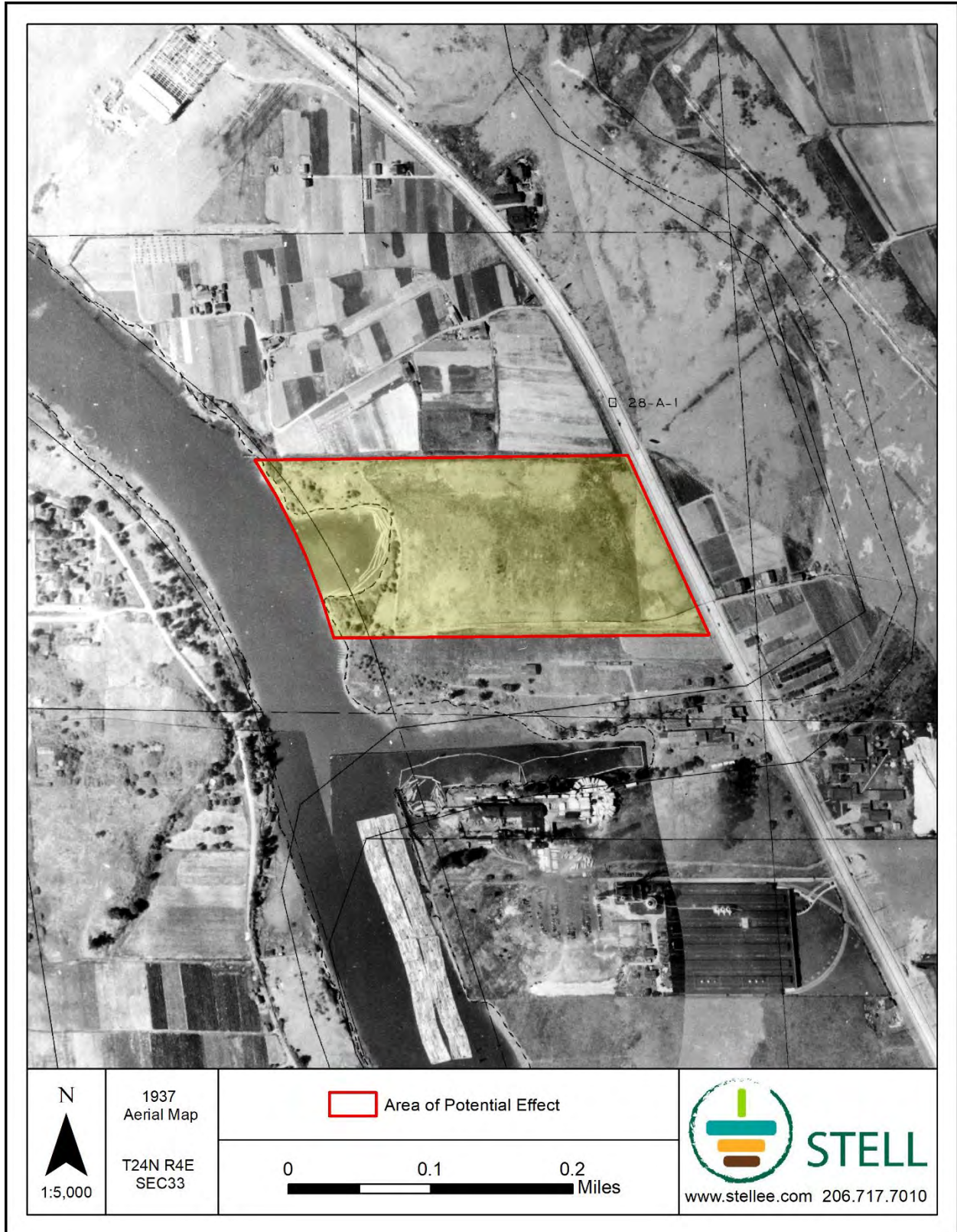


Figure 2-11. 1937 Aerial imagery with APE overlay (King County Road Services 2023 Map Vault Image No. 240433)



Figure 2-12. Workers at Issacson Iron Works in 1943 (University of Washington Libraries Digital Collections, IND0085).

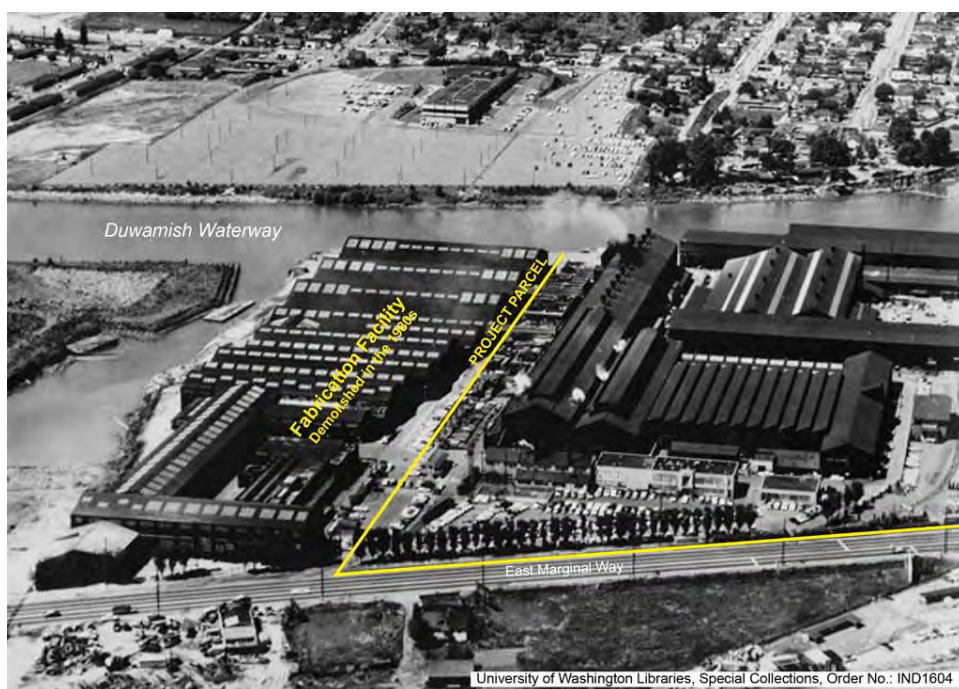


Figure 2-13. Aerial view of the Jorgenson Forge, early 1960s (University of Washington Libraries Digital Collections, IND1604)

3 RECORD SEARCH AND LITERATURE REVIEW

Stell conducted a literature review and record search for this Project by consulting the DAHP Washington Information System for Architectural and Archaeological Records Database (WISAARD), reviewing historical land records and maps, and online archives.

3.1 PROJECT BACKGROUND

The DAHP Predictive Model places the APE at very high risk for locating cultural materials. This model is based primarily on the distance to water and soil types.

Within 1 mile of the APE, there are 21 cultural resource surveys, 10 archaeological sites, 2 cemeteries, 5 registered historic properties, and 1,504 structures.

3.2 PREVIOUS ARCHAEOLOGICAL INVESTIGATIONS

3.2.1 PREVIOUSLY RECORDED CULTURAL RESOURCES WITHIN 1 MILE OF THE APE

Twenty- one archaeological investigations have occurred within 1 mile of the APE. The earliest cultural survey within a mile of the APE was completed in 1997, in which a historic property survey report was conducted for Georgetown, resulting in the identification of 34 historic properties (Krafft and Wickwire 1997). In 2001, two investigations were conducted, one by Kurt Roedel for the South Park Bridge Project, and one by Roedel and others (2001) for the Boeing Field Runway Safety Area. No significant archaeological resources were identified during either project (Roedel 2001; Roedel et al. 2001). In 2004, Historical Research Associates indicated there was a moderate potential for archaeological resources on either side of the South Park Bridge. They identified 12 NRHP-eligible structures (Historical Research Associates 2004).

Jennifer Gilpin monitored work in 2006 along Slip 6 and observed a possible historic trash dump. It was determined the historic trash dump was in a disturbed context and held no archaeological integrity (Gilpin 2006). It was determined that no additional archaeological investigation was necessary. Demuth and others (2008) returned in 2008 and documented three prehistoric archaeological sites along the western bank of the Duwamish River. The sites, 45KI815, 45KI816, and 45KI817, were determined to be precontact shell middens that contained mammal bones, fire-modified rock, and charcoal. These shell middens were determined to reside in an old meander of the Duwamish River. The 45KI815 shell-midden deposit was identified between 50 and 240 centimeters (cm) below surface at 1430 S. Thistle Street (Demuth et al. 2008).

In 2013, two surveys occurred along the Lower Duwamish River. Margaret Berger surveyed the Duwamish Substation North Property located between Highway 99 and the Duwamish River, and did not observe any above-ground cultural resources during the survey (Berger and Hartmann 2013). Downstream from Berger's survey, Jason Cooper monitored sediment removal along the eastern bank of the Duwamish River at Township 24, Range 4, Section 33 on the Boeing property (Cooper 2013). During the monitoring process, Mr. Cooper observed a wooden wagon wheel being dredged up. The area where the wagon wheel was recovered was given a site number, 45KI1142 (Cooper 2013).

In 2014, archaeologists monitored hydraulic work between Michigan Ave and 8th Avenue in the South Park neighborhood (Lockwood and Hoyt 2014:1–8). One resource was recorded during their work, 45KI1183. It was determined to be an isolated find consisting of bricks, whiteware, and charcoal (Lockwood and Hoyt 2014:3–7). This area was once within the Duwamish River. Later that year, another monitored survey was conducted by Jaqueline Marcotte, monitoring the

infrastructure improvement efforts along South Portland Street and 8th Avenue South Street (Marcotte and Johnson 2014). No intact buried archaeological deposits were recorded, and the APE was outside the Lower Duwamish Superfund boundary. Carol Schultze monitored the South Park Bridge replacement project in 2014. Schultze extended the site boundary for 45KI815, the shell midden that was identified in 2008 (Schultze et al. 2014). 45KI815 is 46 m south of the Duwamish River. A geoarchaeological boring survey was conducted north of the APE at the 8th Avenue Terminals. No archaeological material was recovered, but it was recommended that deep excavations take place to understand the soil morphology of the river and to identify any cultural deposits (Hodges 2015).

In 2016, a wooden stave pipe associated with the Georgetown Steam Plant was uncovered by accident, requiring monitoring (Carrilho and Rink 2016), but no other cultural resources were found. Also, in 2016, Jason Cooper recorded a subsurface debris concentration associated with the historic Butler Hotel, which was previously located on Pioneer Square in Seattle. The debris concentration measured 6 square meters and was 30–50 cm below the surface and likely dates to 1913 based on the Hotel Butler logo present on a number of ceramic plate fragments. It included 20 metal objects, over 100 bone fragments, over 75 oyster and clam shell fragments, 55 glass vessel fragments, and 316 ceramic tableware fragments. The Hotel Butler debris concentration is approximately 550 m north of the Project APE. In addition, a concentration of nine cow bones was discovered at the King County International Airport during the excavation of a utility trench in 2016. While the depth of the cow bones was unknown, one was saw cut, and the concentration was determined by Amec-Wheeler to be older than 50 years. This concentration is 659 m north of the Project APE.

The last survey that occurred within the Lower Duwamish Superfund APE happened in 2017. Jana Boersema resurveyed a portion of the Duwamish Substation North Property for the Technical Training Center and wetland mitigation (Boersema and Cagle 2017). No precontact or significant cultural material was identified within the Duwamish APE.

Within 1 mile of the APE, there are 21 cultural resource surveys, 10 archaeological sites, 2 cemeteries, 5 registered historic properties, and 1,504 structures.

For additional information, please see **Table 3-1**, **Table 3-2**, **Table 3-3**, and **Table 3-4**.

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Table 3-1. Previous Cultural Resources Investigations within 1 Mile of the APE

Author(s)	Date	NADB No.	Title	Survey Distance from APE Boundary (All Outside of APE)	Findings Relevant to the Current Project
Cooper, Jason	06/2013	1683973	Archaeological Monitoring Program Synopsis Construction Season 1: Duwamish Sediment Other Area and Southwest Bank Corrective Measure and Habitat Project	0.6 miles northwest of APE	No archaeological material was identified; isolate: one historic object (45KI1142) was recorded.
Historical Research Associates	8/1/2004	1344408	South Park Bridge Project Cultural and Historical Resources Technical Report	434 m northwest of APE	Moderate potential for the presence of intact subsurface archaeological resources. No archaeological sites have been previously recorded in the APE. 80 historic resources; South Park Bridge is listed on NRHP; 12 others are NRHP eligible, of those, 2 are located along the Duwamish (Boeing Property and Red Brick Road are potentially eligible).
Lockwood, Chris, and Brian Hoyt	4/17/2014	1691098	Archaeological Monitoring of South Park Hydrological Investigations, GSI Project - West Michigan and 8th Avenue, King County, Washington	0.6 miles west of APE	South Park Basin is considered to have a very high likelihood for deeply buried precontact and historic archaeological resources. Isolate 45KI1183 comprised fragments of 3 to 5 bricks and one non-diagnostic whiteware sherd, associated with bash and dispersed charcoal. The isolate is in an area that was formally a meander of the Duwamish River.

Author(s)	Date	NADB No.	Title	Survey Distance from APE Boundary (All Outside of APE)	Findings Relevant to the Current Project
Demuth, Kimberly, Craig Smith, Robin Hoffman, Kirk Ranzetta, Jennifer Flathman, David Harvey, Jeannie Czesla, Lucy Zuccotti, Astrida Onat, and Timothy Cowan	6/1/2008	1351645	Cultural Resources Survey for the South Park Bridge Project	611 m northwest of APE	3 precontact archaeological sites identified on the southern side of the Duwamish waterway: 45KI815, 45KI816, and 45KI817. One site is within the APE and two are outside of the APE. It is likely they are connected to the abandoned meander channel. Three Historic Properties within the APE: Boeing Building, Brick Road, and South Park Bridge.
Schultze, Carol, Amy Jordan, Justin Butler, Jennifer Gebhardt, Angus Tierney, and Daniel Schau	09/2014	1686020	Archaeological Monitoring Report for the South Park Bridge Replacement Project	450 m west of APE	45KI815: during monitoring, 8 additional locations associate with site extended the site boundary. New boundaries identified.
Roedel, Kurt W.	6/6/2001	1339904	Letter to Ronda Smith Regarding Archaeological Resources Monitoring for the South Park Bridge Project	482 m west of APE	No significant archaeological resources were identified during excavation monitoring.
Gilpin, Jennifer	10/5/2006	1348322	Archaeological Monitoring at 9229 E. Marginal Way, Tukwila	643 m south of APE	No sites recorded, a pocket of historic artifacts including ceramics and glass was observed as likely remnants of a historic trash dump with no identifiable integrity.
Berger, Margaret, and Glenn Hartmann	4/8/2013	1691049	Cultural Resources Assessment of the Duwamish Substation North Property	0.6 miles southwest of APE	No above-ground cultural resources were identified within the subject property.
Boersema, Jana, and Anthony Cagle	8/3/2017	1689679	Cultural Resources Assessment for the Seattle City Light Technical Training Center, King County, Washington	0.6 miles south of APE	No precontact or significant cultural material was discovered in the APE. The only cultural material found during this survey was scattered debris within the fill deposit that was not directly datable.

Author(s)	Date	NADB No.	Title	Survey Distance from APE Boundary (All Outside of APE)	Findings Relevant to the Current Project
Marcotte, Jaqueline and Paula Johnson	12/2014	1686226	West Duwamish Trail Extension Project, Seattle, Results of Archaeological Monitoring	0.76 miles northwest of APE	No significant archaeological resources were identified during excavation monitoring.
Hodges, Charles	01/30/2015	1686270	Results of Geoarchaeological Monitoring at 8th Avenue	0.75 miles north-northwest of APE	Multiple boring locations east of Slip 4. Possible buried archaeological deposits, but boring results are unclear and not consistent.
Zuccotti, Lucy, Jennifer Flathman, Kimberly Demuth, and Robin Hoffman	11/4/2008	1352098	Cultural Resources Section 106 Technical Report Georgetown Steam Plant Flume Project, EOA Slip 4 Early Action Area, Lower Duwamish Waterway Superfund Site, Seattle	0.85 miles northwest of APE	Surface and subsurface surveys did not locate any archaeological resources. Five historic properties in the APE: Boeing Buildings 3-323 and 3-346, the Steam Plant building, holding tank, and flume.
Carrilho, Yonara, and Brandy Rink	06/17/2016	1689109	Pipe Documentation at the Georgetown Steam Plant, Seattle	0.89 miles northwest of APE boundary	Wooden stave pipe associated with the Georgetown Steam Plant was uncovered, requiring monitoring
Jacqueline Marcotte, Bryan Hoyt, Chris Lockwood, and Paula Johnson	05/17/2013	1684370	West Duwamish Trail Extension Project	0.78 miles northwest of APE	No buried archaeological resources uncovered during monitoring. Three historic-aged properties (all commercial warehouses) identified within the APE.
Lockwood, Chris, and Tom Ostrander	03/21/2014	1691097	Archaeological Monitoring of Geotechnical Boring and Monitoring Well Installation, West Michigan and 8th Avenue, King County, Washington	0.7 miles west-northwest of APE	No prehistoric or historic archaeological resources observed during monitoring.
Krafft, Katheryn, and Cathy Wickwire	09/30/1997	1350146	Historic Property Survey Report: Georgetown (Seattle, Washington)	0.97 miles northwest of APE	34 historic properties within APE
Roedel, Kurt, Leonard Forsman, Dennis Lewarch, and Lynn Larsen	07/05/2001	1681071	Boeing Field Runway Safety Area Compliance Archaeological Resources and Traditional Cultural Places Assessment	0.9 miles north of APE	No significant archaeological deposits

Author(s)	Date	NADB No.	Title	Survey Distance from APE Boundary (All Outside of APE)	Findings Relevant to the Current Project
Stropes, Tracy, J.R.K. Stropes, and Brian Smith	10/08/2019	1695191	A Cultural Resources Assessment for the 8801 East Marginal Way Project, City of Tukwila, King County, Washington	265 m south of APE	No archaeological resources identified; four historic properties identified: warehouse building, office facility, water tower, groundwater treatment facility.
Foutch, Amy, Michele Punke, Jon Held, Elizabeth O'Brien, and John Fagan	07/01/2009	1353867	Cultural Resources Study for the SR 99 Intelligent Transportation System Improvements Project	0.6 miles southwest of APE	No archaeological deposits identified. One historic resource identified: North 46th Street/SR 99 Overcrossing.
Cole, Steve	5/14/2001	1339898	Heritage Resources Investigation of the South Park Cell # 41982 Tower	0.6 miles west-southwest of APE	No archaeological or historic deposits identified.
Kopperl, Robert, and Charles Hodges	02/15/2017	1694843	Archaeological Resources Assessment for the 8430 Dallas Ave Warehouse Project, King County, Washington	482 m west of APE	No archaeological or historic deposits identified.

Note:

NADB = National Archaeological Database

No. = Number

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Table 3-2. Previously Recorded Archaeological Sites within 1 Mile of the APE

Site Trinomial	Description	Cultural Resource Distance from APE Boundary	Comments
45KI1142	Wooden Wagon Wheel	0.6 miles northwest of APE	Isolate
45KI815	Lwalb Old Channel One	482 m west-northwest of APE	Precontact Site: Shell midden, bird bone, mammal bone, fish bone, and fire-cracked rock; depth: 50–240 cm; Determined NRHP eligible by officer of the DAHP.
45KI816	Lwalb Old Channel Two	627 m west-northwest of APE	Precontact Site: shell midden, fire-cracked rock, mammal bone, bird bone, fish bone; depth: 24–195 cm.
45KI817	Site Three	579 m west of APE	Precontact Site: charcoal, shell, bird bone, fish bone, and mammal bone; depth: 190–225 cm.
45KI01149	Hamm Creek Pilings	0.6 miles south of APE	Historic Site: Waterfront structure remnants.
45KI1183	Not applicable	0.6 miles northwest of APE	Isolate: single whiteware fragment and 3 to 5 red brick fragments.
45KI1280	Wood-stave Pipe Segment at the Georgetown Steam Plant	0.89 miles northwest of APE	A wood-stave pipe associated with the Seattle Electric Company Georgetown Steam Plant. 23.5 m of the pipe was exposed in a utility trench.
45KI1352	King County International Airport Historic Debris	659 m north of APE	Concentration of nine cow bones found during the excavation of a utility trench from an unknown depth. One of the bones exhibited a saw cut.
KI01351	Hotel Butler Historic Debris Concentration	515 m north of the APE	A subsurface debris concentration 30-50 cm below the surface, measuring 6 m ² . Associated with Hotel Butler, dating to 1913, and includes historic ceramics, glass, animal bone, oyster shells, and metal plate/cup fragments.

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Table 3-3. Previously Recorded Cemeteries within 1 Mile of the APE

Site Trinomial	Description	Distance from APE	Comments
45KI01526	Rose Street	0.7 miles west-northwest of APE	Human Remains found in 1925. The remains found at a depth of 18 inches in sandy clay soil.
45KI00910	Maple Grave/Memorial	0.67 miles north of APE	A monument and urn of the ashes of John and Samuel, son, Maple.

Table 3-4. Historic Register-Listed Properties within 1 Mile of the APE

Site Trinomial	Listing Number	Property Name	Register	Address
45KI138	78002755	Seattle Electric Company Georgetown Steam Plant	National Historic Landmark	6605 13th Ave S, Seattle, Washington
45KI136	NA	Maple Donation Claim	Washington Heritage Register	Airport Way South, Seattle, Washington
45KI139	71000872	Building No. 105, Boeing Airplane Company	National Register; Washington Heritage Register	Purcell Avenue, Tukwila, Washington
45KI259	82004228	14th Avenue South Bridge - Seattle	National Register; Washington Heritage Register	Spans Duwamish River, Seattle, Washington
45KI1440	100004460	Eng, Jimmie & Betty, House	National Register; Washington Heritage Register	8310 Beacon Ave. S, Seattle, Washington 98118

Note:
NA = Not Applicable

4 METHODS

Stell Archaeologists Mark Steinkraus, MS; James Brown, MS; Jordan Cooper, BA; and Nichole Padovano, BA, conducted archaeological monitoring that observed percussion coring for sediment sampling. The ground-disturbing activity consisted of sample collection for the chemical analysis of sediment. Sample collection occurred within the Project APE to define the extent of soil contamination. Monitoring took place November 3–6, 2020; October 4, 2021; November 4–7, 2022; and December 20, 2022.

All other monitoring activities were conducted following the monitoring plan developed by Stell (Steinkraus 2020). See **Appendix A** for a full copy of the Monitoring and Inadvertent Discovery Plan.

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5 RESULTS

Monitoring was conducted November 3–6, 2020; October 4, 2021; November 4–7, 2022; and December 20, 2022. Monitoring was not a daily occurrence. Monitoring was conducted by Stell archaeologists Mark Steinkraus, MS; James Brown, MS; Jordan Cooper, BA; and Nichole Padovano, BA, as needed based on the monitoring plan (**Appendix A**). Monitoring of cores focused on observing the opening and sampling of the cores; observation of sample collection was conducted as well. A total of eight days were monitored. The only cultural material observed was one wire nail recovered from a core and historic brick noted while monitoring excavation. While wire nails first began to be produced as early as 1819, they were not mass-produced until the 1880s (Adams 2002), and they have been used up until the present day, making it difficult to determine whether this nail is historic or modern. Because the wire nail is not diagnostic, Stell archaeologists were not able to determine ages for it. See **Table 5-1** for additional details.

Table 5-1. Monitoring Table

Date	Monitor	Cultural Materials (Y/N)	Cultural Materials Description	Work Undertaken	Photo
11/3/2020	Mark Steinkraus	Y	1 wire nail found 6 inches below concrete	Core processing and sampling	
11/4/2020	Mark Steinkraus	N	NA	Core processing and sampling	

Date	Monitor	Cultural Materials (Y/N)	Cultural Materials Description	Work Undertaken	Photo
11/5/2020	Mark Steinkraus	N	NA	Core processing and sampling	
11/6/2020	Mark Steinkraus	N	NA	Core processing and sampling	
10/4/2021	James Brown	N	NA	Core processing and sampling	
11/4/22	Jordan Cooper	N	NA	Core processing and sampling	

Date	Monitor	Cultural Materials (Y/N)	Cultural Materials Description	Work Undertaken	Photo
11/7/22	Jordan Cooper	N	NA	Core processing and sampling	 A photograph showing a dark, cylindrical core sample lying on a light-colored wooden surface. A white folding ruler is placed horizontally next to the core for scale. In the background, there are some papers and a red object.
12/20/22	Nichole Padovano	N	NA	Core processing and sampling	 A photograph showing several long, dark, cylindrical core samples arranged horizontally on a wooden surface. A yellow folding ruler is placed below the samples for scale. The samples appear to be made of a dark, possibly organic material.

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6 INTERPRETATIONS AND CONCLUSIONS

Shannon and Wilson, Inc. contracted Stell to conduct cultural resource monitoring for the 8531 East Marginal Way South Remedial Investigation Project. The APE is in King County in the city of Tukwila. The APE covers 20.7 acres; discrete areas within this APE were used for sampling. A wire nail was identified during monitoring; however, this was deemed modern as there is no temporally diagnostic evidence of the nail being older than 50 years of age. Additionally, this nail was not deeply buried; instead, it was found only 6 inches below the base of the concrete. Based upon the fact that the wire nail is not temporally diagnostic and its shallow deposition, Stell archaeologists determined it was modern.

The findings of this report concur with prior cultural resource investigations within the vicinity that identified large fill deposits and that, likely, any intact precontact or early historic-era cultural resources will be deeply buried. In the next 10–20 years, many of the cultural resources situated around the Project APE will be considered archaeological in nature, most of which would be associated with early industry along the riverway—particularly the development of the Boeing Company.

Archaeological fieldwork was conducted from November 3–6, 2020; October 4, 2021; November 4–7, 2022; and December 20, 2022, with a total of eight days of monitoring taking place during that period. **This report is a summary of monitoring activities. No significant cultural resources were discovered during monitoring.**

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APPENDIX A

Monitoring and Inadvertent Discovery Plan

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CULTURAL RESOURCES REPORT COVER SHEET

Author: Sarah M.H. Steinkraus

Title of Report: Cultural Resources Monitoring and Inadvertent Discovery Plan for
8531 East Marginal Way South, King County, Washington

Date of Report: March 20, 2020

County(ies): King Section: 33 Township: 4 Range: 4E

Quad: Seattle North Acres: 20.7

PDF of report submitted (REQUIRED) ☒ Yes

Historic Property Inventory Forms to be Approved Online? ☐ Yes ☒ No

Archaeological Site(s)/Isolate(s) Found or Amended? ☐ Yes ☒ No

TCP(s) found? ☐ Yes ☒ No

Replace a draft? ☐ Yes ☒ No

Satisfy a DAHP Archaeological Excavation Permit requirement? ☐ Yes # ☒ No

Were Human Remains Found? ☐ Yes DAHP Case # ☒ No

Archaeological Site #:

HPI 720360

HPI 720357

HPI 720359

8531 East Marginal Way South Remediation Project
Cultural Resources Monitoring
and Inadvertent Discovery Plan
King County, Washington

March 20, 2020

Prepared for:



Shannon & Wilson, Inc.
400 N 34th Street, Suite 100
Seattle, WA 98103

DAHP Project #2019-10-08126

Prepared by:



Stell
6100 219th St. SW, Suite 480
Mountlake Terrace, WA 98043

By Sarah M.H. Steinkraus, MS, RPA

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1 INTRODUCTION

1.1 PROJECT INFORMATION

Stell was contracted by Shannon & Wilson, Inc. to create a cultural resources monitoring and inadvertent discovery plan for the 8531 East Marginal Way South Remediation Project, King County, Washington project (Project) (Figure 1) (see Appendix A for Inadvertent Discovery Plan).

The current project will include:

- Laser-induced fluorescence (LIF) investigation – This will use direct-push probe drilling but will NOT remove soil from the subsurface (a windowed probe with fiber optics is used).
- Direct-push soil sampling (2 inch)
- Hollow-stem auger (HSA) soil sampling (2 inch)
- Installation of wells in above-mentioned HSA boreholes
- Groundwater sampling from existing and new wells

The project area is within an area designated as very highly likely to yield cultural materials by the Department of Archaeology and Historic Places (DAHP) predictive model. A total of 19 Cultural Resources surveys have been conducted within 0.5 miles of the project area and a total of 9 archaeology sites (including precontact, historic-era, and multicomponent sites) have been documented within 1 mile of the project area.

1.2 PROJECT AREA

The Project area is located on the right (eastern) bank of the Lower Duwamish Waterway (LDW), approximately four miles upstream from the mouth of the Duwamish River, in Section 33 of Township 24 North, Range 4 East, Willamette Meridian. The project is located in King County Parcel No. 000160-0023, in King County, Washington (see Figure 1).



Figure 1. Project area location map projected on the USGS (2019) topographic quadrangle (from Earley and Heideman 2019).

1.3 PROJECT BACKGROUND

A cultural resources review of the project (which did not include any fieldwork) was conducted in October of 2019 by Perteet (Earley and Heideman 2019). In the report, one of the recommendations made was that a Monitoring and Inadvertent Discovery Plan (this document) be created. The DAHP Project Number is 2019-10-08126. This number should be attached to all cultural resources documentation and DAHP communications associated with this project. Please see Earley and Heideman (2019) for background information of the project area.

1.4 REGULATORY ENVIRONMENT

This project is subject to the State Environmental Policy Act (SEPA), which mirrors the National Environmental Policy Act. SEPA requires that all major actions sponsored, funded, permitted, or approved by Washington State and/or local agencies consider the impacts of the planned action on the environment and properties of historical, archaeological, scientific, or cultural importance (Washington Administrative Code 197-11-960). Especially those that are or could be listed on the National Register of Historic Places (NRHP) or other historic registers including the Washington Heritage Register or King County Landmarks. The Department of Archaeology and Historic Preservation (DAHP) is the lead agency for considering the effects of a proposed action on cultural resources and provides formal recommendations to local governments and other Washington State agencies for appropriate treatments or actions.

Historic properties that could be eligible for the NRHP include any artifacts, records, and remains that are related to such a district, site, building, structure, or object (16 United States Code [USC] 470[5]). The quality of significance in American history, architecture, archaeology, and culture is present in districts, sites, buildings, structures, and objects of state and local importance that possess integrity of location, design, setting, materials, workmanship, feeling, and association. They also:

- a) Are associated with events that have made a contribution to the broad pattern of our history;
- b) Are associated with the lives of people significant in our past;
- c) Embody the distinct characteristics of a type, period, or method of construction, represent the work of a master, possess high artistic values, or represent a significant and distinguishable entity whose components may lack individual distinction; or
- d) Have yielded, or are likely to yield, information important for understanding prehistory or history (36 Code of Federal Regulations [CFR] 60.4).

2 ARCHAEOLOGICAL MONITORING PLAN

To satisfy the requirements of Washington State DAHP, Stell will provide on-site monitoring, daily logs during monitoring activities, and a technical report at the close of monitoring for the 8801 East Marginal Way South Project. Sarah M.H. Steinkraus, MS, RPA will be the lead archaeologist on this project. Ms. Steinkraus meets the Secretary of the Interior's, and thus Washington State's, criteria for a Professional Archaeologist. Ms. Steinkraus has extensive experience in conducting archaeological surveys, assessments, and monitoring in the Puget Sound region.

2.1 ON-SITE MONITORING

The archaeological monitor will watch any ground disturbing activities within the Project area. The monitor will closely look for any organic or shell midden deposits, signs of soil oxidation, lithic or bone artifacts, or animal or human bones. Nine historic buildings are located within the project area. Two were recommended as potentially eligible for the National Register of Historic Places (Earley and Heideman 2019). A total of three HPs that are potentially eligible for the National Register of Historic Places are located within the project area (see Appendix B). Aside from these two buildings no previously recorded cultural resources are located within the project area. If artifacts or other potential archaeological deposits are observed, the archaeological monitor will direct the contractor to temporarily cease work in the immediate vicinity while the monitor conducts a close inspection.

The archaeological monitor may from time to time request a temporary halt to work activities in order to document archaeological materials or for a closer inspection of the trench sidewall. Such documentation usually takes a few minutes (entailing photographs and written descriptions) but may take longer. The archaeologist will give an estimate of the amount of time needed to document materials to the equipment operator and/or foreman and will update them of any changes to the estimate.

If potentially significant archaeological deposits are discovered during construction while the archaeological monitor is on site, the monitor will direct the contractor to cordon off the area within 30 feet of the discovery and initiate the find reporting and evaluation processes described in the Inadvertent Discovery Plan (Attachment A). If evidence of cultural resources is found in exposed surfaces within the Project Area, it will be further investigated to establish whether it is eligible for listing in the National Register of Historic Places (NRHP).

If human remains are encountered, the King County Sheriff and Medical Examiner will be immediately notified (Attachment A). If the remains are determined not to be associated with a criminal investigation, the DAHP will be immediately contacted, as well as any affected tribes, if applicable (Attachment A).

2.1.1 MONITORING LOG

The archaeological monitor will complete a monitoring log for each monitoring session to document time in the field, the day's progress and findings, and any difficulties encountered, and actions proposed or taken to alleviate them.

2.1.2 MONITORING REPORT

Following the conclusion of archaeological monitoring activities, Stell will prepare a report describing the conduct and findings of this work effort. The report will include a discussion of the

project, the methods used in monitoring, and observations about site geology, environmental history, and any cultural resources that were observed. Photographs, sketches, or maps may be included, as needed. The report will be submitted to Shannon & Wilson, Inc. in complete draft form prior to it being sent to the Washington State DAHP and affected tribes for review.

2.1.3 HEALTH AND SAFETY

The archaeological monitor will be working under an approved health and safety plan provided by the Client's Contractor. That individual will at all times be in compliance with the health and safety plan of the contractor. Staff will be briefed on that plan and will at all times comply with it. Field staff will have all necessary training and certification prior to commencing monitoring activities.

3 REFERENCES

Earley, Amber, and Eileen Heideman

2019 *Cultural Resources Assessment of the Star Forge Development Project, King County, Washington*. Prepared for Star Forge LLC. Prepared by Perteet, Seattle, Washington.

APPENDIX A: INADVERTENT DISCOVERY PLAN

Inadvertent Discovery Plan for the 8531 East Marginal Way South Remediation Project King County, Washington

1 INTRODUCTION

Shannon & Wilson, Inc. plans to environmental testing within the project area in King County, Washington. This will include laser-induced fluorescence investigation (using direct-push probe drilling but will NOT remove soil from the subsurface. A windowed probe with fiber optics is used); direct-push soil sampling (2 inch); hollow-stem auger (HSA) soil sampling (2 inch); installation of wells in above-mentioned HSA boreholes; groundwater sampling from existing and new wells. The following Inadvertent Discovery Plan (IDP) outlines procedures to follow, in accordance with federal laws, if archaeological materials or human remains are discovered.

State laws are in place which protect archaeological resources. The Archaeological Sites and Resources law (RCW Chapter 27.53) outlines the protection of archaeological resources. Shannon & Wilson, Inc. will act in accordance with State laws in dealing with the treatment of cultural resources and the consultation of concerned parties. Potentially concerned parties include: the Duwamish Tribe, Suquamish Tribe, Snoqualmie Tribe, Tulalip Tribes, Muckleshoot Tribe, Stillaguamish Tribe, and the Department of Archaeology & Historic Preservation (DAHP), and the City of Tukwila.

The DAHP Project Number for the Project is 2019-10-08126. This number should be attached to all cultural resources documentation and DAHP communications associated with this project.

The monitoring archaeologist will have the ability to halt construction if they observe or identify any cultural materials and will have adequate time to assess, record, and potentially analyze any resources that might be uncovered. DAHP will be notified of all discoveries that occur during the course of the Project. The results of this monitoring effort will be documented at the completion of the project.

This document serves as the plan for dealing with any discoveries of human skeletal remains, artifacts, sites, or any other cultural resources that are potentially eligible for listing in the National Register of Historic Places (NRHP). This plan is intended to provide guidance to Shannon & Wilson, Inc. so they can:

1. Comply with applicable local and State laws and regulations, particularly Title 27 Revised Codes of Washington Chapter 27.44 Indian Graves and Records, Chapter 27.53 Archaeological Sites and Resources, and Title 68 Chapter 60.050 Protection of historic graves,
2. Describe to regulatory and review agencies the procedures that Shannon & Wilson, Inc. will follow to prepare for and deal with inadvertent discoveries, and
3. Provide direction and guidance to project personnel on the proper procedures to be followed should an inadvertent discovery occur.

2 RECOGNIZING CULTURAL MATERIALS

A cultural resource discovery could be from the precontact or historic eras. Examples include:

- An accumulation of shell, burned rocks, or other food related materials;
- Bones or small pieces of bone;
- An area of charcoal or very dark stained soil with artifacts;
- Stone tools or waste flakes (i.e. an arrowhead, or stone chips);
- Clusters of tin cans or bottles, logging or agricultural equipment that appears to be older than 50 years;
- Buried railroad tracks, decking, or other industrial materials; and
- Historic structures, portions of historic structures, or associated utilities aged 40 years or older.

When in doubt, assume the material is a cultural resource.

3 ON-SITE RESPONSIBILITIES

STEP 1: STOP WORK. If any Shannon & Wilson, Inc. employee, contractor, or subcontractor believes that they have uncovered a cultural resource at any point during the project, all work adjacent to the discovery must stop. The discovery location should be secured at all times.

STEP 2: NOTIFY MONITOR. If there is an archaeological monitor for the project, notify that person. If there is a monitoring plan in place, the monitor will follow its provisions. If there is no archaeological monitor in place the Project Manager should be notified at which time they should contact a professional archaeologist to examine the find and determine if it is a cultural resource or not and provide significance recommendations.

STEP 3: NOTIFY AND CONSULT WITH DAHP. Immediately contact DAHP to assist in the significance evaluation of all inadvertent discoveries of cultural resources. Any discovery deemed eligible for listing in the National Register of Historic Places (NRHP) will be assessed and treated per the provisions set forth in this document (Attachment A). If the state agency representatives determine that the discovery is an eligible cultural resource, they and the affected tribe(s), will consult to determine appropriate treatment to be presented and agreed upon in a Memorandum of Agreement (MOA) or other appropriate documentation.

Mitigation measures will be developed in consultation with City of Tukwila, DAHP, and the affected tribes (where appropriate), which could include avoidance through redesign, conducting data recovery and/or relocating materials or remains. Agreed upon treatment measures performed by Shannon & Wilson, Inc. may include protecting in place or data recovery such as mapping, photography, limited probing, and sample collection, or other measures. This information is covered by the Public Records Act (RCW 42.17.250) and specific components of the records are exempt from disclosure (RCW 42.17.310(1)(k)) to avoid the looting or depredation of such sites.

4 PROTOCOL FOR TREATMENT OF HUMAN REMAINS

As per RCW 68.50.645, in the event that human remains, or material evidence of burial sites are encountered within the Project Area, whether during planned maintenance and construction activities, authorized archaeological excavations, or as a result of natural processes, the following protocol will be strictly followed:

1. If human skeletal remains are located within the Project Area, then all activity that may cause further disturbance to the remains will cease within at least 30 feet.
2. The area of the find will be secured and protected from further disturbance.
3. The finding of human skeletal remains will be reported to the King County Medical Examiner and local law enforcement in the most expeditious manner possible. The remains will not be touched, moved, or further disturbed.
4. The county medical examiner will assume jurisdiction over the human skeletal remains and make a determination of whether those remains are forensic or non-forensic. If the county medical examiner determines the remains are non-forensic, then they will report that finding to the Department of Archaeology and Historic Preservation (DAHP) who will then take jurisdiction over the remains.
5. The DAHP will notify any appropriate cemeteries and all affected tribes of the find.
6. The State Physical Anthropologist will make a determination of whether the remains are Indian or Non-Indian and report that finding to any appropriate cemeteries and the affected tribes.
7. The DAHP will then handle all consultation with the affected parties as to the future preservation, excavation, and disposition of the remains.

Failure to follow this human remains protocol is a misdemeanor in Washington State.

5 PROTOCOL FOR RESPONSE TO VANDALISM

Vandalism consists of disturbance to historic properties, including unauthorized digging into archaeological sites or collection of artifacts. The probability for vandalism within the project is low; however, if at any time, employees or contractors encounter unauthorized visitors who appear to be digging or collecting materials from the ground surface, or are in possession of excavation equipment, or if a Shannon & Wilson, Inc. representative encounters evidence of recent unauthorized excavations or abandoned digging equipment (such as screens or shovels), the following protocol will be implemented.

1. If a possible vandal or looter is present, the Shannon & Wilson, Inc. representative will note information about the person, their equipment, and their vehicle and immediately relay the information to the work supervisor, who will confirm the information and notify the King County Sheriff's Office.
2. If the Shannon & Wilson, Inc. representative notes abandoned excavations or digging equipment, they will notify within 24 hours the cultural resources coordinator, who will notify the King County Sheriff's Office and the DAHP. The cultural resources coordinator will visit the site as soon as possible to assess any damage.
3. If a Native American site has been vandalized, the cultural resources coordinator will notify representatives of the affected tribes and the DAHP about this assessment and will invite them to attend the site inspection.
4. The assessment of impact will be described in a formal letter report from Shannon & Wilson, Inc. to the City of Tukwila, affected tribes, and DAHP, if applicable.
5. In consultation with the City of Tukwila, affected tribes, and DAHP, Shannon & Wilson, Inc. will identify what actions, if any, should be taken to mitigate damage to an affected site and/or prevent further damage.
6. Any act of vandalism or looting that involves human remains will also trigger the protocol for the treatment of human remains outlined above.
7. All acts of vandalism or looting will be referred to the King County Sheriff for investigation and possible prosecution.

6 PROTOCOL FOR EMERGENCY RESPONSE

A number of events can occur within the Project that require a rapid response in order to safeguard facilities, provide for protection of wildlife habitat, protect public and private property, and prevent serious injury or loss of human life. These include, but are not limited to; wild fire, wind and electrical storms, mass wasting events (erosion), flood, earthquake, and dam or other Project facility failure. The emergency response protocol is designed to be implemented after such events have occurred.

1. The supervisor of response will notify the cultural resources coordinator of the location and nature of the emergency activities.
2. The cultural resources coordinator will check relevant databases for historic properties in the vicinity of the emergency.
3. If historic properties are in the area of the emergency or the response (for example, both the area of the wild fire and the location of the construction of a fire line), then the cultural resources coordinator will be responsible for conducting a professional review by a qualified person of the condition of those properties.
4. The cultural resources coordinator will use existing documentation as a comparison to a field visit to determine if historic properties and/or cultural resources have been destroyed, damaged, or endangered by the emergency event or the response. If any of these conditions exist, then the cultural resources coordinator will document them in the field with mapping, photographs, and, in the case of imminent loss, collection of artifacts. The cultural resources coordinator will prepare a report documenting the nature and location of the emergency event, the nature of the response, the impact on the historic properties and/or cultural resources, and any proposals to prevent further damage to the properties and to mitigate for the loss. This report will be submitted to the City of Tukwila, affected tribes, and DAHP within 4 months of the event for review and comment. After a 30-day comment period, the comments of all of the consulting parties will be incorporated into a final report and copies will be sent to all of the participating parties.
5. If no alteration to the condition of the properties has occurred, a letter to that effect noting the date(s) of the field visit(s) will be placed on file in lieu of the formal report.

7 AGENCY CONTACTS

Shannon & Wilson, Inc.

Primary Contact: Shoshana Howard

Mobile: 206-695-6811

Cultural Resources Specialist, Stell

Primary Contact: Sarah Steinkraus, Principal Investigator/ Senior Archaeologist

Mobile: 360-620-5840

Washington Dept. of Ecology

Primary Contact: Erin Hobbs

Mobile: 425-649-7231

King County Medical Examiner

Contact Number: 206-731-3232

King County Sheriff

Contact Number: 206-296-3311 or 911

City of Tukwila Police Department

Contact Number: 206 433-1808

City of Tukwila

Primary Contact:

Office:

Department of Archaeology & Historic Preservation Office

Primary Contact: Stephanie Jolivet, Local Government Archaeologist

Office: 360-586-3088

Secondary Contact: Dr. Guy Tasa, State Physical Anthropologist

Office: 360-586-3534

Tribal Contacts:Duwamish Tribe

Primary Contact: Cecile Hansen, Chairwoman

Office: 206-431-1582

Suquamish Tribe

Primary Contact: Dennis Lewarch, Tribal Historic Preservation Officer

Office: 360-394-8529

Snoqualmie Nation

Primary Contact: Steve Mullen-Moses, Director of Archaeology and Historic Preservation

Office: 425-495-6097

Tulalip Tribes

Primary Contact: Richard Young, Cultural Resources Director

Office: 360-716-2652

Muckleshoot Indian Tribe

Primary Contact: Laura Murphy, Archaeologist

Office: 253-876-3272

Stillaguamish Tribe

Primary Contact: Kerry Lyste, Tribal Historic Preservation Officer

Office: 360-652-7362 ext. 226

APPENDIX B- HPI FORMS



Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357

Location



Address: 8531 E Marginal Way S, Seattle, WA, 98108, USA

Geographic Areas: King Certified Local Government, King County, T24R04E33, SEATTLE SOUTH Quadrangle

Information

Number of stories: N/A

Construction Dates:

Construction Type	Year	Circa
Built Date	1942	☐
Addition	1943	☐
Addition	1962	☐
Addition	1965	☐
Addition	1966	☐
Addition	1967	☐
		☒

Historic Use:

Category	Subcategory
Industry/Processing/Extraction	Industry/Processing/Extraction - Manufacturing Facility
Industry/Processing/Extraction	Industry/Processing/Extraction - Manufacturing Facility



Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357

Historic Context:

Category

Industry/Manufacturing

Military

Maritime - Protecting our Shores

Architect/Engineer:

Category

Name or Company

Thematics:

Local Registers and Districts

Name	Date Listed	Notes
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Project History

Project Number, Organization, Project Name	Resource Inventory	SHPO Determination	SHPO Determined By, Determined Date
2019-10-08126, , Star Forge	10/25/2019	Determined Eligible	Holly Borth, 11/21/2019
2019-10-08126, , Star Forge	2/6/2020	Survey/Inventory	

Historic Property Report

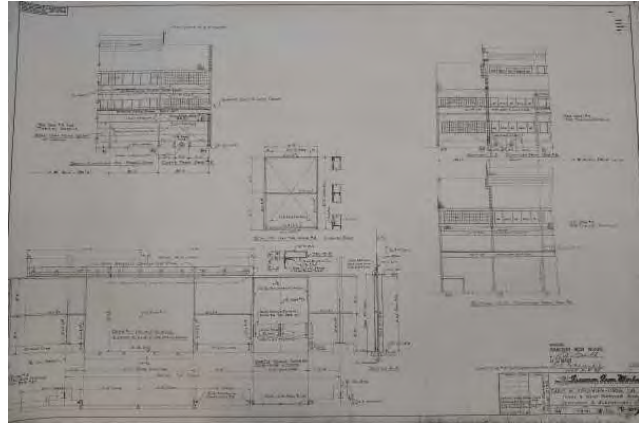
Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357

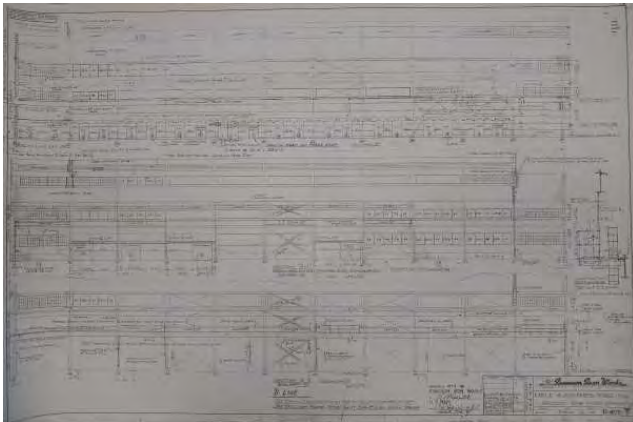
Photos



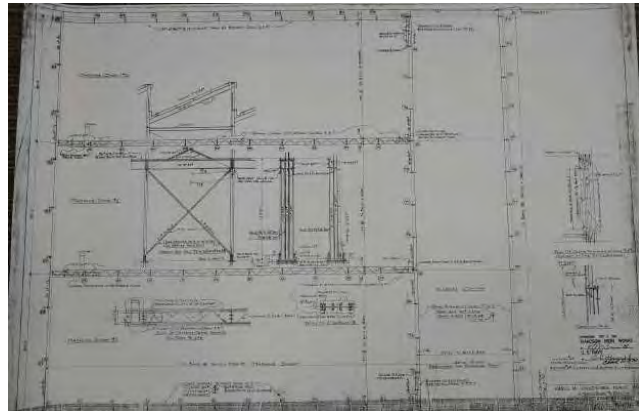
East end of Billet Yard, Forge Shop and Heat Treat (left to right), view to the northwest.



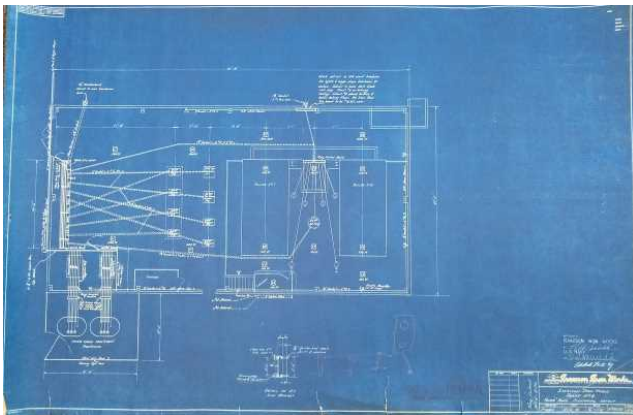
Isaacson Plant Number Two Forge & Heat Treat Sections - 1942.jpg



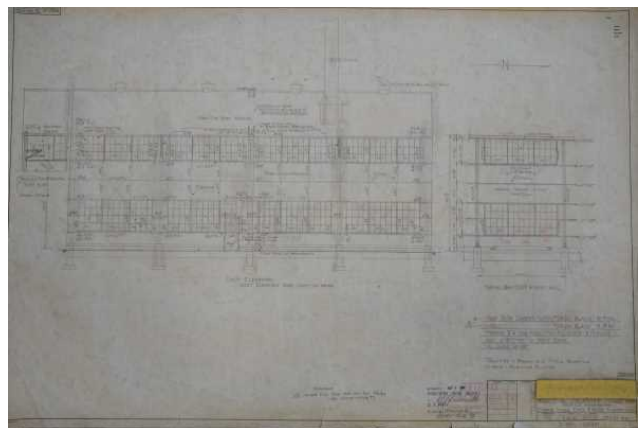
Isaacson Forge & Heat Treat Elevations - 1941.jpg



Isaacson Plant Number Two Framing Plan Machine & Erection Shop - 1941.jpg



Isaacson Power House Electrical - 1941.jpg

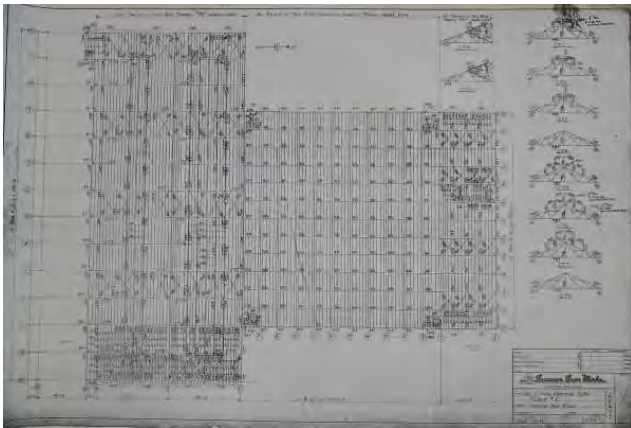


Isaacson Power House E&W Elev - 1941.jpg

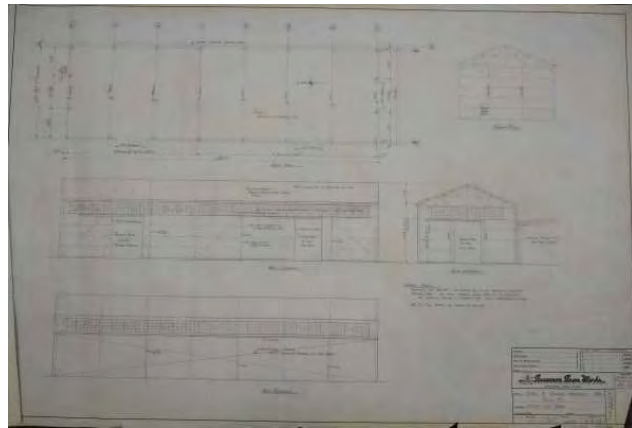
Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

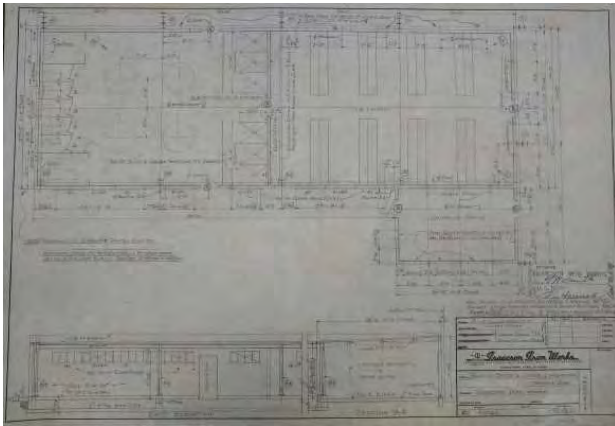
Property ID: 720357



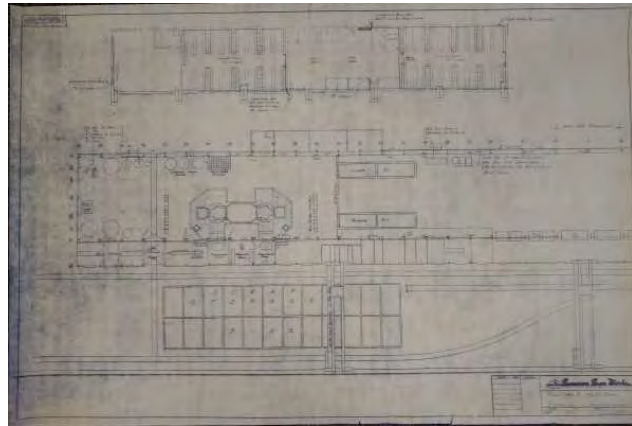
Isaacson Plant Number Two Top Chord Framing Plan - 1942.jpg



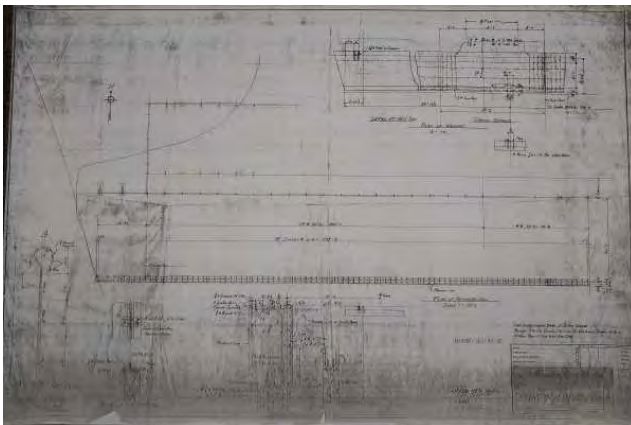
Isaacson Plant Number Two Stores & Anchor Warehouse - 1953.jpg



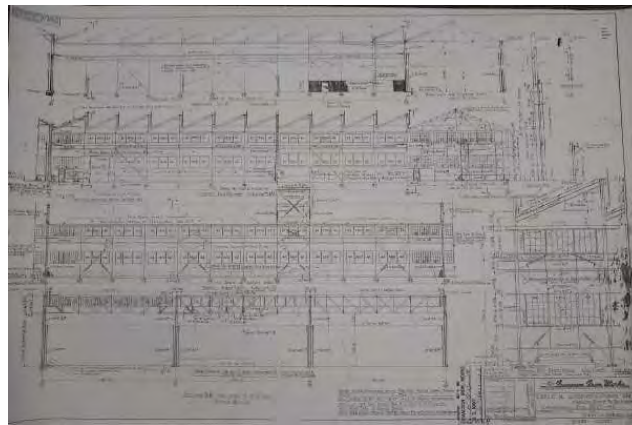
Isaacson Plant Number Two Shipping Office & Locker Rooms - 1942.jpg



Isaacson Plant Number Two Melt Shop Steam & Oil Lines - 1943.jpg



Isaacson Plant Number Two Melt Shop Retaining Wall Details - 1942.jpg

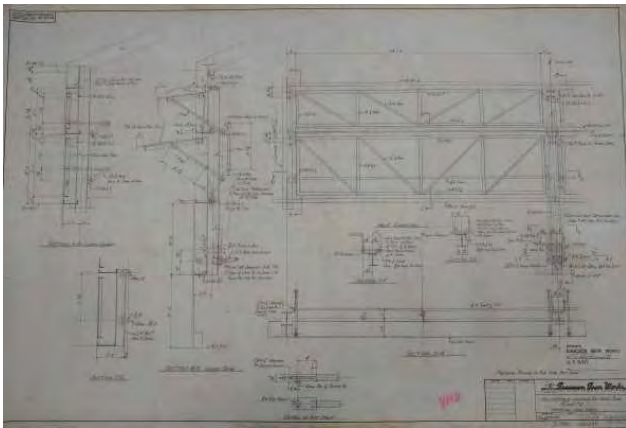


Isaacson Plant Number Two Machine Shop & Shipping Elevations & Sections - 1941.jpg

Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



Isaacson Plant Number Two Forge Shop Louvres - 1943.jpg



DSC_0271.JPG



DSC_0270.JPG



DSC_0269.JPG



DSC_0268.JPG



DSC_0267.JPG



Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



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DSC_0265.JPG



DSC_0264.JPG



DSC_0263.JPG



DSC_0262.JPG



DSC_0261.JPG



Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



DSC_0260.JPG



DSC_0259.JPG



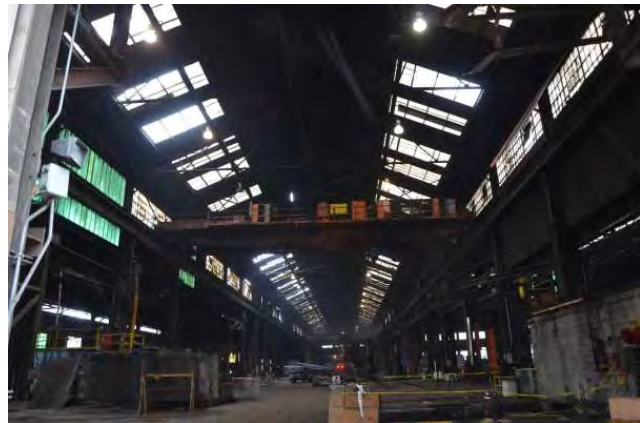
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DSC_0257.JPG



DSC_0256.JPG



DSC_0255.JPG



Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



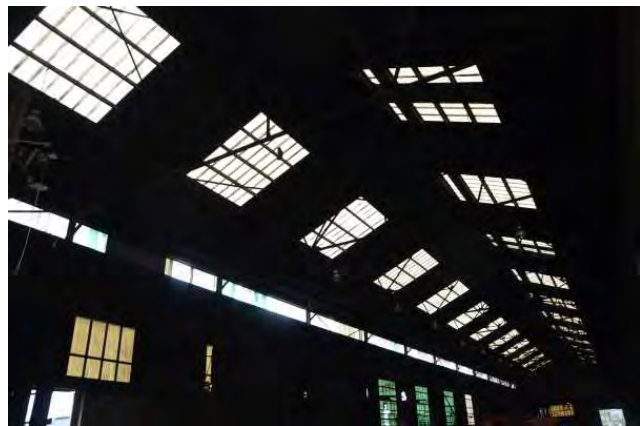
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DSC_0253.JPG



DSC_0252.JPG



DSC_0251.JPG



DSC_0250.JPG



DSC_0249.JPG

Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



DSC_0248.JPG



DSC_0247.JPG



DSC_0246.JPG



DSC_0245.JPG



DSC_0244.JPG



DSC_0243.JPG

Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



DSC_0242.JPG



DSC_0241.JPG



DSC_0240.JPG



DSC_0239.JPG



DSC_0238.JPG



DSC_0237.JPG

Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



DSC_0236.JPG



DSC_0235.JPG



DSC_0234.JPG



DSC_0281.JPG



DSC_0280.JPG



DSC_0279.JPG

Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



DSC_0278.JPG



DSC_0277.JPG



DSC_0276.JPG



DSC_0275.JPG



DSC_0274.JPG



DSC_0273.JPG

Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



DSC_0272.JPG



DSC_0230.JPG



DSC_0229.JPG



DSC_0228.JPG



DSC_0227.JPG



DSC_0226.JPG

Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two Property ID: 720357



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DSC_0224.JPG



DSC_0223.JPG



DSC_0222.JPG



DSC_0221.JPG



DSC_0220.JPG

Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



DSC_0219.JPG



DSC_0218.JPG



DSC_0217.JPG



DSC_0216.JPG



DSC_0215.JPG



DSC_0214.JPG



Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



DSC_0213.JPG



DSC_0212.JPG



DSC_0211.JPG



DSC_0210.JPG



DSC_0209.JPG



DSC_0208.JPG

Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



DSC_0207.JPG



DSC_0206.JPG



DSC_0205.JPG



DSC_0204.JPG



DSC_0203.JPG



DSC_0202.JPG



Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



DSC_0201.JPG



DSC_0200.JPG



DSC_0199.JPG



DSC_0198.JPG



DSC_0197.JPG



DSC_0196.JPG



Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



DSC_0195.JPG



DSC_0194.JPG



DSC_0193.JPG



DSC_0192.JPG



DSC_0191.JPG



DSC_0190.JPG



Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



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DSC_0188.JPG



DSC_0187.JPG



DSC_0186.JPG



DSC_0233.JPG



DSC_0232.JPG



Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



DSC_0231.JPG



DSC_0145.JPG



DSC_0144.JPG



DSC_0143.JPG



DSC_0127.JPG



DSC_0126.JPG



Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



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DSC_0124.JPG



DSC_0123.JPG



DSC_0152.JPG



DSC_0151.JPG



DSC_0150.JPG

Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



DSC_0149.JPG



DSC_0148.JPG



DSC_0147.JPG



DSC_0146.JPG



South side of Plant Two following construction of Melt Shop in 1943 (scrap metal storage in foreground)
(Isaacson Iron Works 1943)



East side of the Machine Shop (Isaacson Iron Works 1943)

Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



East end of the shipping area with southern portion of plant in background, view to the southwest.



northwest corner of Melt Shop Warehouse, with Melt Shop in background, view to the southeast.



North end of Plant Number Two: (left to right) Erection Shop (Hollowbore), Machine Shop, Heat Treat, Melt Shop. View to the southeast.



West half of Plant Number Two: Melt Shop and Melt Shop Warehouse (far right).



West end of Erection Shop (Hollowbore)



PDF0917-01 - Isaacson Plant Number Two Machine Shop & Shipping - 1941.pdf

Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



PDF0916-01 - Isaacson Plant Number Two Melt Shop
West Floor Plan - 1943.pdf



PDF0914-01 - EMJ Plant Number Two Melt Shop Floor
Plan - 1966.pdf



PDF0913-01 - Isaacson Plant Number Two E&W
Elevations - 1942.pdf



PDF0912-01 - Isaacson Plant Number Two Machine Shop
Addn - 1942.pdf



PDF0911-01 - Isaacson Plant Number Two EMJ Div
Machine Shop - 1941.pdf



PDF0910-01 - Isaacson Womens Service Bldg - 1942.pdf

Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357



PDF0908-01 - Isaacson Plot Plan Oxygen Lines - 1956.pdf



PDF0907-01 - Isaacson Power House Floor - 1941.pdf



PDF0904-01 - Isaacson Power House Foundation -
1941.pdf



Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357

Inventory Details - 10/25/2019

Common name: Jorgensen Forge Corporation

Date recorded: 10/25/2019

Field Recorder: Eileen Heideman

Field Site number: IIW-19-01

SHPO Determination

Detail Information

Characteristics:

Category	Item
Foundation	Concrete - Poured
Form Type	Utilitarian
Roof Type	Varied Roof Lines
Roof Material	Metal - Corrugated
Cladding	Metal - Corrugated
Structural System	Metal - Steel
Plan	Irregular

Surveyor Opinion

Property appears to meet criteria for the National Register of Historic Places: Yes

Property is located in a potential historic district (National and/or local): Yes

Property potentially contributes to a historic district (National and/or local): Yes

Significance narrative: The bulk of the building was constructed in 1942, with the addition of the Melt Shop in 1943, and the later additions of the Melt Shop Warehouse (1962), Shipping (ca.1965), the Billet Yard (1967), and the Ladle and Furnace Roof Shop (1966) (King County Department of Assessments 1941-1974; Wayne Turk, personal communication, September 23, 2019). The core of the building, dating to the original construction period of 1942-1943, is easily recognizable among the later additions, and the interior spaces largely retained their original use throughout the active use of the plant. Removal of equipment from the plant occurred in 2019 (personal communication, Wayne Turk, September 23, 2019).

This building is associated closely with the massive buildup of industry associated with the Second World War, with Isaacson Iron Works employees forging much of the material used to build and operate the Liberty ships that provided material to the Allied Army throughout the war as well as the bulldozers used by the Seabees in construction of Pacific theater runways and bases. Although the construction of the Billet Yard, Melt Shop Warehouse and Shipping areas in the 1960s resulted in some loss of integrity of design, the core of the building is largely unaltered and is easily recognizable from the exterior as the World War Two-era building. This building is significant under Criterion A for its association with the wartime industry and is recommended eligible for the National Register of Historic Places.



Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357

Physical description:

As the primary building and center of industry on the property, Plant Number Two was largely identified by areas of use. These areas include the Melt Shop and Melt Shop Warehouse, Forge Shop, Heat Treating Shop (Heat Treat), Machine Shop, Erection Shop (now called Hollowbore), Shipping, Automotive Shop, Billet Yard, and maintenance, lunch and locker rooms. These areas are to a certain degree defined on the exterior of the building by different rooflines (i.e., the Machine Shop has a sawtooth roof to allow for increased natural light for machine tooling of products, while the Melt Shop, Heat Treat and the Forge Shop have high rooflines to accommodate the larger equipment and higher temperatures required in these areas. The interior of the building is connected and designed for a flow of raw materials to finished product.

The building has an irregular footprint that forms a rough L shape. A variety of materials were used in construction, but the majority of the building is constructed with steel, resting on a poured concrete foundation, with the exterior and most of the roof clad in corrugated metal. Some windows are steel multi-light fixed and awning windows, although some windows consist of fiberglass panels, particularly on the south and west sides of the building. A scale and scale house stand on the south side of the building.

Bibliography:

Earley, Amber and Eileen Heideman

2019 Cultural Resources Assessment of the Star Forge Development Project, King County, Washington. Report prepared for Star Forge, LLC. Perteet, Seattle, Washington and Cascade Heritage Consultants, Seattle, Washington.

King County Department of Assessments

1941-1974 Property cards, Parcel Number 000160-0023. On file at Puget Sound Regional Branch, Washington State Archives, Bellevue, Washington.

2019 Parcel Number 000160-0023

[https://blue.kingcounty.com/Assessor/eRealProperty/Dashboard.aspx?](https://blue.kingcounty.com/Assessor/eRealProperty/Dashboard.aspx?ParcelNbr=0001600023)

ParcelNbr=0001600023, accessed October 2019.

Sanborn Map Company

1957 Sanborn Fire Insurance Maps of Seattle, Volume 8, 1929 Updated to 1960, Sheet 1384. Sanborn Map Company, New York.

Forging Ahead (FA). Volumes 1-7. Isaacson Iron Works, Seattle, Washington.

1943c "The Victory Fleet is on the Way." Volume 3, Number 1, October 1943: 3-5.

1944a "The American Merchant Marine and its Part in the War Effort." Special Issue, May 22 :10-11.

1944c "Buldozer's[sic] Prominent in the War News." Volume 4, Number 2, June: 14-15.



Historic Property Report

Resource Name: Isaacson Iron Works Plant Number Two

Property ID: 720357

Inventory Details - 2/6/2020

Common name:

Date recorded: 2/6/2020

Field Recorder: Mindy Graddon

Field Site number:

SHPO Determination

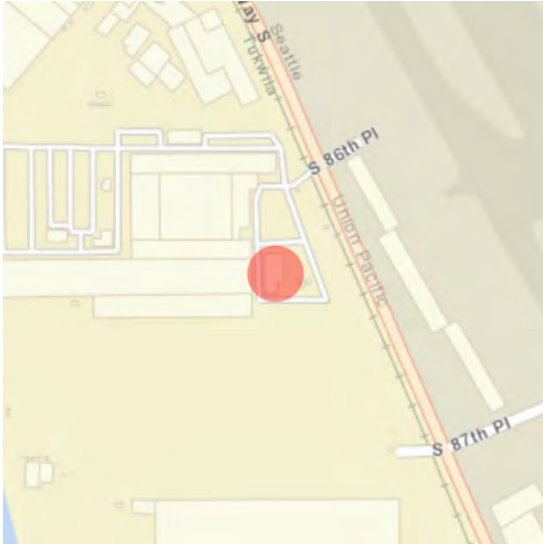


Historic Property Report

Resource Name: Isaacson Iron Works Power House

Property ID: 720359

Location



Address: 8531 E Marginal Way S, Seattle, WA, 98108, USA

Geographic Areas: King Certified Local Government, King County, T24R04E33, SEATTLE SOUTH Quadrangle

Information

Number of stories: N/A

Construction Dates:

Construction Type	Year	Circa
Built Date	1943	☐

Historic Use:

Category	Subcategory
Industry/Processing/Extraction	Industry/Processing/Extraction - Energy Facility
Industry/Processing/Extraction	Industry/Processing/Extraction - Energy Facility

Historic Context:

Category

Industry/Manufacturing

Architect/Engineer:

Category	Name or Company
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Historic Property Report

Resource Name: Isaacson Iron Works Power House

Property ID: 720359

Thematics:

Local Registers and Districts

Name	Date Listed	Notes
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Project History

Project Number, Organization, Project Name	Resource Inventory	SHPO Determination	SHPO Determined By, Determined Date
2019-10-08126, , Star Forge	10/25/2019	Determined Eligible	Holly Borth, 11/21/2019
2019-10-08126, , Star Forge	2/6/2020	Survey/Inventory	

Historic Property Report

Resource Name: Isaacson Iron Works Power House

Property ID: 720359

Photos



South end of building (Plant Number Two to left), view to the north.



DSC_0142.JPG



DSC_0141.JPG



DSC_0140.JPG



DSC_0139.JPG



DSC_0138.JPG



Historic Property Report

Resource Name: Isaacson Iron Works Power House

Property ID: 720359



DSC_0137.JPG



DSC_0136.JPG



DSC_0135.JPG



DSC_0134.JPG



DSC_0133.JPG



DSC_0132.JPG

Historic Property Report

Resource Name: Isaacson Iron Works Power House

Property ID: 720359



DSC_0131.JPG



DSC_0130.JPG



DSC_0129.JPG



DSC_0128.JPG



Power House in 1961, prior to conversion to Aluminum Heat Treat, view to the southwest (King County Department of Assessments 1941-1974).



Northwest corner of building, view to the southeast.

Historic Property Report

Resource Name: Isaacson Iron Works Power House

Property ID: 720359



Northeast corner of building, view to the southwest.



Power House with power lines and electrical equipment to right and Plant Number Two to left, view to the northwest.



Historic Property Report

Resource Name: Isaacson Iron Works Power House

Property ID: 720359

Inventory Details - 10/25/2019

Common name: Jorgensen Forge Corporation Aluminum Heat Treat Building
Date recorded: 10/25/2019
Field Recorder: Eileen Heideman
Field Site number: IIW-1903

SHPO Determination

Detail Information

Characteristics:

Category	Item
Foundation	Concrete - Poured
Form Type	Utilitarian
Roof Type	Gable
Roof Material	Metal - Corrugated
Cladding	Metal - Corrugated
Structural System	Metal - Steel
Plan	L-Shape

Surveyor Opinion

Property appears to meet criteria for the National Register of Historic Places: Yes

Property is located in a potential historic district (National and/or local): Yes

Property potentially contributes to a historic district (National and/or local): Yes

Significance narrative: This building was constructed in 1942 or 1943 and served as the Power House for Plant Number Two, which required a large amount of electricity to keep the plant in operation around the clock during its wartime production period. The building was later converted by the Jorgensen Forge Corporation into an Aluminum Heat Treat Building, but with the exception of the replacement of the garage doors and removal of some electrical equipment, the exterior of the building is largely unaltered. These changes resulted in some loss of integrity of association and design, but the exterior is still easily recognizable as the power plant. This building is closely associated with World War Two-era production at Isaacson Iron Works Plant Two, and, together with the main plant building, is recommended eligible for the National Register of Historic Places under Criterion A.



Historic Property Report

Resource Name: Isaacson Iron Works Power House

Property ID: 720359

Physical description:

This building is a tall (two-story), gable-roofed building with a north/south-oriented ridge and a shorter, single-story shed ell on the northern two-thirds of the building's east side. The building is clad with corrugated steel siding, and the roof is also covered with corrugated metal. The building is lit with steel multi-light fixed, awning and pivot windows. Some of these windows have been painted over or otherwise covered, but are largely intact. Large industrial ventilators line the ridge. The building is accessed by large garage openings on the north end of the building's west side, and at the south end of the building. Power line poles and electrical equipment stand near the southeast corner of the building.

Bibliography:

Earley, Amber and Eileen Heideman
2019 Cultural Resources Assessment of the Star Forge Development Project, King County, Washington. Report prepared for Star Forge, LLC. Perteet, Seattle, Washington and Cascade Heritage Consultants, Seattle, Washington.
King County Department of Assessments
1941-1974 Property cards, Parcel Number 000160-0023. On file at Puget Sound Regional Branch, Washington State Archives, Bellevue, Washington.
2019 Parcel Number 000160-0023
<https://blue.kingcounty.com/Assessor/eRealProperty/Dashboard.aspx?ParcelNbr=0001600023>, accessed October 2019.
Sanborn Map Company
1957 Sanborn Fire Insurance Maps of Seattle, Volume 8, 1929 Updated to 1960, Sheet 1384. Sanborn Map Company, New York.



Historic Property Report

Resource Name: Isaacson Iron Works Power House

Property ID: 720359

Inventory Details - 2/6/2020

Common name:

Date recorded: 2/6/2020

Field Recorder: Mindy Graddon

Field Site number:

SHPO Determination



Historic Property Report

Resource Name: Isaacson Iron Works Office Headquarters

Property ID: 720360

Location



Address: 8531 E Marginal Way S, Seattle, WA, 98108, USA

Geographic Areas: King Certified Local Government, King County, T24R04E33, SEATTLE SOUTH Quadrangle

Information

Number of stories: N/A

Construction Dates:

Construction Type	Year	Circa
Built Date	1950	☐
Remodel	1970	☒

Historic Use:

Category	Subcategory
Industry/Processing/Extraction	
Industry/Processing/Extraction	

Historic Context:

Category
Industry/Manufacturing

Architect/Engineer:

Category	Name or Company
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Historic Property Report

Resource Name: Isaacson Iron Works Office
Headquarters

Property ID: 720360

Thematics:

Local Registers and Districts

Name	Date Listed	Notes
------	-------------	-------

Project History

Project Number, Organization, Project Name	Resource Inventory	SHPO Determination	SHPO Determined By, Determined Date
2019-10-08126, , Star Forge	10/25/2019	Determined Eligible	Holly Borth, 11/21/2019
2019-10-08126, , Star Forge	2/6/2020	Survey/Inventory	



Historic Property Report

Resource Name: Isaacson Iron Works Office
Headquarters

Property ID: 720360

Photos



Office headquarters, view to the northwest.



AdminBuildingInterior 09.jpg



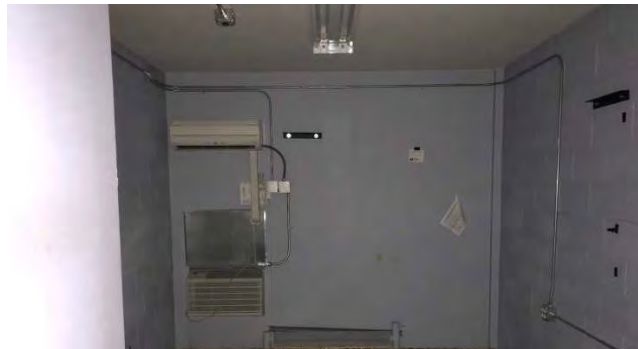
AdminBuildingInterior 08.jpg



AdminBuildingInterior 07.jpg



AdminBuildingInterior 06.jpg



AdminBuildingInterior 05.jpg



Historic Property Report

Resource Name: Isaacson Iron Works Office
Headquarters

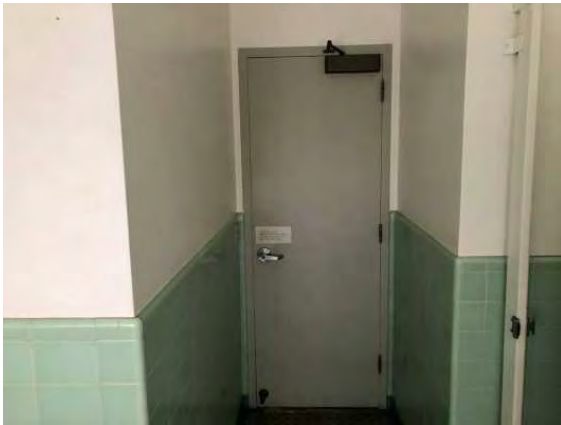
Property ID: 720360



AdminBuildingInterior 04.jpg



AdminBuildingInterior 03.jpg



AdminBuildingInterior 02.jpg



AdminBuildingInterior 01.jpg



AdminBuildingExterior 09.jpg



AdminBuildingExterior 08.jpg



Historic Property Report

Resource Name: Isaacson Iron Works Office
Headquarters

Property ID: 720360



AdminBuildingExterior 07.jpg



AdminBuildingExterior 06.jpg



AdminBuildingExterior 05.jpg



AdminBuildingExterior 04.jpg



AdminBuildingExterior 03.jpg



AdminBuildingExterior 02.jpg

Historic Property Report

Resource Name: Isaacson Iron Works Office
Headquarters

Property ID: 720360



AdminBuildingExterior 01.jpg



Office in 1951 shortly after construction, view to the west
(King County Department of Assessment 1941-1974)



Window opening on south side of building, showing
extent of infill, view to the north.



West end of building, view to the southeast.



Southwest corner of building, view to the northeast.



Northeast corner of building, view to the southwest.



Historic Property Report

Resource Name: Isaacson Iron Works Office
Headquarters

Property ID: 720360

Inventory Details - 10/25/2019

Common name: Jorgensen Forge Corporation Office Headquarters
Date recorded: 10/25/2019
Field Recorder: Eileen Heideman
Field Site number: IIW-19-04

SHPO Determination

Detail Information

Characteristics:

Category	Item
Foundation	Concrete - Poured
Form Type	Utilitarian
Roof Type	Flat with Eaves
Roof Material	Metal - Standing Seam
Cladding	Brick
Structural System	Masonry - Poured Concrete
Plan	Rectangle

Styles:

Period	Style Details
Modern Movement	Modern

Surveyor Opinion

Property appears to meet criteria for the National Register of Historic Places: No

Property is located in a potential historic district (National and/or local): No

Property potentially contributes to a historic district (National and/or local): No

Significance narrative: The office headquarters building was built in 1950 for the Isaacson Iron Works and was later altered by the Jorgensen Forge Corporation (King County Department of Assessments 1941-1974). Alterations include replacement and alteration of the roof form, removal and partial replacement of the windows, and redesign of the main entrance. These changes have caused loss of integrity of design, materials, and workmanship. This building was constructed after the main period of significance for Plant Number Two and lacks association with this period of the property history. This building is therefore recommended not eligible for the National Register of Historic Places.



Historic Property Report

Resource Name: Isaacson Iron Works Office
Headquarters

Property ID: 720360

Physical description: This brick-veneered building stands on the north end of the property, adjacent to the Hollowbore section of Plant Two. The building has a flat roof with overhanging, boxed-in eaves (a later alteration). The building is lit with metal-frame awning windows, a replacement of the original multi-light steel-frame windows, which were also partially filled in. The single-story main entrance is located on the east end of the building and is covered by a flat roof with boxed-in eaves. A rear entrance on the south side of the building is sheltered by a small porch with a south wall and a flat roof. The building has undergone extensive alterations since its construction and bears little resemblance to its original appearance.

Bibliography: Earley, Amber and Eileen Heideman
2019 Cultural Resources Assessment of the Star Forge Development Project, King County, Washington. Report prepared for Star Forge, LLC. Perteet, Seattle, Washington and Cascade Heritage Consultants, Seattle, Washington.
King County Department of Assessments
1941-1974 Property cards, Parcel Number 000160-0023. On file at Puget Sound Regional Branch, Washington State Archives, Bellevue, Washington.
2019 Parcel Number 000160-0023
<https://blue.kingcounty.com/Assessor/eRealProperty/Dashboard.aspx?ParcelNbr=0001600023>, accessed October 2019.
Sanborn Map Company
1957 Sanborn Fire Insurance Maps of Seattle, Volume 8, 1929 Updated to 1960, Sheet 1384. Sanborn Map Company, New York.



Historic Property Report

Resource Name: Isaacson Iron Works Office
Headquarters

Property ID: 720360

Inventory Details - 2/6/2020

Common name:

Date recorded: 2/6/2020

Field Recorder: Mindy Graddon

Field Site number:

SHPO Determination

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Appendix E

Data Quality Summary Reports

CONTENTS

- Data Quality Summary Report – November 2020 Remedial Investigation
- Data Quality Summary - 2021 Q1 through Q4 Site Investigation
- Laboratory Analytical Reports

March 2021

Project Name:	Jorgensen Forge Corporation Property – November 2020 Investigation
Client:	Earle M. Jorgensen
S&W Project Number:	21-1-12596-035
Subject:	Data Quality Summary for November 2020 Remedial Investigation

INTRODUCTION

This Quality Assurance/Quality Control (QA/QC) Summary has been prepared to assess the data quality and usability for samples collected during the Remedial Investigation (RI) activities completed at the Jorgensen Forge Corporation (JFC) facility, located at 8531 East Marginal Way South, Tukwila, Washington (Site). The RI activities were described in the RI Work Plan which was reviewed and approved by the Washington State Department of Ecology (Ecology) in September 2020. The Quality Assurance Project Plan (QAPP) was appended to the RI Work Plan and details the project organization and responsibilities, project-specific data-quality objectives (DQOs), sample-handling methods, analytical procedures, and data QC review and reporting requirements for the groundwater, soil, soil vapor, and light non-aqueous phase liquid (LNAPL) investigation. The RI was conducted to characterize the nature and extent of contamination at the Site and to collect further information about the physical characteristics of the Site.

The QAPP was prepared per the Ecology Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies (Ecology, 2016) and the U.S. Environmental Protection Agency (EPA) publication EPA Requirements for Quality Assurance Project Plans QA/R-5 (EPA, 2001). The QAPP described the process for qualifying analytical data based on a QA/QC review of Level II laboratory reports and electronic data deliverables (EDDs). The QAPP is used to provide guidance for conducting what the EPA refers to as a Stage 2a Validation (EPA, 2009). A more critical level of validation is beyond the scope of this project, but the QAPP does present guidance for determining whether additional review should be conducted, based on information received from the laboratory. The QAPP also assesses the quality of the analytical data using precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) parameters.

In general, most data-review guidelines presented in the QAPP are drawn from federal guidance documents. However, in some cases, federal guidance is not consistent, is outdated, or does not account for specific issues addressed in the QAPP; in these cases, the guidance

presented in the QAPP is based on standard industry practice or site-specific considerations, which are in turn based on Shannon & Wilson chemists' years of professional experience. Where non-federal guidance documents are used, they are cited within the text and in Section 6 of the QAPP. Most QAPPs specify DQOs for items such as laboratory control sample (LCS) recovery and target reporting limits. The Site QAPP does not present such limits, but instead defers to internal laboratory-control limits that are statistically derived, frequently updated, and within the requirements of the laboratory's national certification, and thus compliant with federal requirements.

BACKGROUND

The approximately 20-acre Site was a steel and aluminum forge and mill that produced custom steel and aluminum parts forged and machined to high precision specifications for various industrial clients. Operations remained relatively unchanged since the property was developed in the 1940s; however, melt operations were discontinued in 2015. Facility operations were discontinued in October 2018.

The Site is developed with an approximately 124,000-square-foot prefabricated steel building (main building), which is generally divided into the Hollowbore Area, the Machine Shop Area, the Heat Treat Area, the Forge Shop Area, and the Former Melt Shop Area.

Investigations began at the Site in 1990 and are described within the RI Work Plan. Investigations at the Site (prior to the RI) have included the completion of numerous borings and the installation of 52 groundwater monitoring wells, numbered MW-1 through MW-52. Several additional wells were installed in the northwest corner of the Site by consultants for The Boeing Company, numbered as PL2-JF01A, PL2-JF01AR, PL2-JF01B, PL2-JF01C, PL2-JF02A, PL2-JF03A, and PL2-JF04A. During the RI, 27 groundwater monitoring wells, numbered MW-10R, MW-13R, MW-22R, and MW-53 through MW-76, were installed. Several groundwater monitoring wells have been decommissioned over the years. The current groundwater monitoring network includes 71 monitoring wells.

LNAPL plumes are present in Site Areas 1 and 2. The potential contaminants of concern for the Site include benzene, toluene, ethylbenzene, and xylenes (BTEX), halogenated volatile organic compounds (HVOCs), limited semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH), polychlorinated biphenyls (PCBs), and metals.

ANALYTICAL QUALITY ASSURANCE AND QUALITY CONTROL

QA/QC procedures assist in producing data of acceptable quality and reliability. We reviewed the analytical results for laboratory QC samples and conducted our own QA assessment for this project. We reviewed the chain of custody (COC) records and laboratory receipt forms to check that custody was not breached, sample-holding times were met, and the samples were kept chilled (between 0 degrees Celsius [°C] and 6 °C) during shipping. Our QA-review procedures allowed us to document the accuracy and precision of the analytical data, as well as check that the analyses were sufficiently sensitive to meet project-specific DQOs.

Laboratory QC procedures included evaluating surrogate recovery, performing continuing calibration checks, and analyzing method blanks, LCS, and matrix spikes (MS) to assess accuracy and precision. LCS, LCS duplicate (LCSD), MS, MS duplicate (MSD), and surrogate recovery analyses were performed to evaluate the accuracy of the analytical process. Analytical precision was assessed by comparing the results of duplicate analyses performed on LCS/LCSD, MS/MSD, and duplicate-sample pairs.

QC procedures in the field included using single-use equipment to reduce the potential for sample cross-contamination. We used a new, clean pair of nitrile gloves when sampling at each boring location. Sample boring equipment was decontaminated between locations. Each laboratory report contains a case narrative and sample-receipt forms documenting sample conditions.

Details regarding the results of our QA review are presented below. The Analytical Resources, Incorporated (ARI) laboratory reports for work orders (WOs) 20K0101, 20K0117, 20K0152, 20L0098, 20L0100, 20L0286, 20L0346, and 20L0347, and corresponding laboratory data review checklists (LDRCs) are appended to this report. We refer the reader to these documents for additional information; a summary of our QA/QC assessment is presented below.

Exhibit 1: Laboratory Work Order List

Laboratory Report Number	Information contained
20K0101	Soil samples collected November 2-3, 2020 including: - Area 1 (A1) sample -02A; - Hand auger (HA-2020) samples -001, -002, -003, -004, -005, -006, -007, and -008; - Soil boring (SB-2020) samples -001, -028, -029, and -045; - TSA-2020 samples -001, -002, and -003; - TSA-Concrete samples -001 and -002; and - Trip blank sample TB-1.

Laboratory Report Number	Information contained
20K0117	Soil samples collected November 4-5, 2020 including: - Area 2 (A2) sample -07A; - Soil boring (SB-2020) samples -005, -007, -008, -014, -015, and -016; and - Trip blank samples TB-2 and TB-3.
20K0152	Soil samples collected November 5-6, 2020 including: - Area 2 (A2) sample -16A; - Soil boring (SB-2020) samples -004 and -013; - Equipment blank samples EB-1, EB-2, and EB-3; and - Trip blank sample TB-4.
20L0098	Soil boring samples SB-2020-007:20-21.4 and SB-2020-15:23 initially submitted with 20K0117 and placed on hold. These samples were taken off hold and requested for varying metals analysis on December 7, 2020.
20L0100	Several HA-2020 soil samples initially submitted with 20K0101 and placed on hold. These samples were taken off hold and requested for varying metals analysis on December 7, 2020 and PCB analysis on December 16, 2020.
20L0286	Three TSA-2020 soil samples initially submitted with 20K0101 and placed on hold. These samples were taken off hold and requested for PCB analysis on December 16, 2020.
20L0436	Soil boring samples SB-2020-005:20, SB-2020-007:20-21.4, SB-2020-007:23-24.6, SB-2020-008:20, SB-2020-014:18, and SB-2020-014:23 initially submitted with 20K0117 and placed on hold. These samples were taken off hold and requested for PAH and/or PCB analyses on December 29, 2020.
20L0437	Soil boring samples SB-2020-013:20.5 and SB-2020-013:23 initially submitted with 20K0152 and placed on hold. These samples were taken off hold and requested for PAH and PCB analyses on December 29, 2020.

Sample Handling

Soil samples collected by Shannon & Wilson, Inc. personnel were hand-delivered to the ARI in Tukwila, Washington. We completed COC forms, which were signed upon delivery to the ARI laboratory. Samples were submitted for the correct analyses listed in the QAPP with the following exceptions:

- WOs 20K0101, 20K0117, 20K0152, and 20L0098 – Section 3.2 of the QAPP mentions the samples for metals analysis will be performed by method 200.8. Attachment 2B of the QAPP provided the laboratory limits for method SW6010. The laboratory reported samples for metals analysis by method SW6020. The methods 200.8, SW6010, and SW6020 have the same method of separation (inductively coupled plasma [ICP]) but methods 200.8 and SW6020 use a mass spectrometry (MS) detector while method SW6010 uses atomic emission spectroscopy (AES). The laboratory reporting limits (RLs) are generally lower than those listed in Attachment 2B of the QAPP. Sample results are not affected by this deviation from the QAPP.

- WOs 20K0101, 20K0117, 20K0152, 20L0436, and 20L0437 – Section 3.2 of the QAPP mentions the samples for PAH analysis will be performed by method SW8270D. Attachment 2B of the QAPP provides the laboratory limits for some PAH analytes by method SW8270D and some PAH analytes by method SW8270E-Selective Ion Monitoring (SIM). The laboratory reported all PAH analytes by method SW8270D-SIM. The reported method is the most recent update to the EPA method SW8270 and the SIM detection method allows for lower RLs. Sample results are not affected by this deviation from the QAPP.

Sample-receipt forms provided by the ARI laboratory were reviewed and checked to verify that the samples were received in good condition and within the acceptable temperature range. Ecology considers samples received free of ice and received at temperatures between 0 and 6 degrees Celsius as acceptable. Samples were generally received in good condition, properly preserved, and within the acceptable temperature range upon arrival at the laboratory.

Samples were analyzed within the method recognized hold-times, with the exceptions listed below:

- WOs 20L0098 and 20L0100 – Samples associated with these WOs were initially submitted to the laboratory between November 3 and 5, 2020. Some of the samples were placed on hold; however they were kept in a freezer out of direct sunlight to extend the hold times. On December 7, 2020, Shannon & Wilson requested samples *SB-2020-007:20-21.4-11042020*, *HA-2020-001:0.5-11022020*, and *HA-2020-005:0.5-11022020* be analyzed for mercury by method 7470A. The samples were prepared past the method recognized hold time of 28-days for this analysis. The detected mercury results are considered estimated, biased low, and are flagged 'JL' in the data table.
- WOs 20L0436 and 20L0437 – Samples associated with these WOs were initially submitted to the laboratory between November 5 and 6, 2020. Some of the samples were placed on hold; however, they were kept in a freezer out of direct sunlight to extend the hold times. On December 29, 2020, Shannon & Wilson requested the samples *SB-2020-005:20-11042020*, *SB-2020-007:20-21.4-11042020*, *SB-2020-007:23-24.6-11042020*, *SB-2020-008:20-11052020*, *SB-2020-013:20.5-11052020*, *SB-2020-013:23-11052020*, *SB-2020-014:18-11052020*, and *SB-2020-014:23-11052020* be analyzed for PAH analysis by method SW8270E-SIM. The samples were prepared at least 55 to 71 days after collection, which is grossly past the method recognized hold time of 14-days. Based on recommendations from the laboratory, the analytical results do not require qualification for the hold time exceedances for these samples.

Additional sample handling discrepancies were noted by the laboratory; however, the minor discrepancies did not affect the data quality. Refer to the LDRCs for details.

Sensitivity

The laboratory's detection limit (DL) is the lowest analyte concentration that can be measured. The laboratory's reporting limit (RL) is the lowest analyte concentration that can be routinely measured with confidence in the sampled matrix, the point at which a concentration is considered quantitative. Sample matrix, instrument performance, sample dilutions, and other factors may affect the DL and RL. Analytes may be present in samples at concentrations below the DL. In cases where analytes were not detected at concentrations above their DL, the analytical results are presented in our data-summary tables with reference to their RLs. If the analyte is detected between the DL and the RL, its concentration is considered an estimate; in our tables this value is flagged with a 'J'. The flag is applied by the laboratory.

Prior to collecting the November 2020 samples, the current laboratory NELAP certifications were obtained and the RLs were compared to the project specified DQOs for the requested analytes. The laboratory RLs were sufficiently sensitive for reporting purposes with several exceptions, as reported in Attachment 2 of the QAPP. Analytes not detected in the samples that have RLs exceeding the DQOs are identified in bold in the results tables. Refer to the reporting tables for details.

Method Blanks

Laboratory method blanks (MBs) were analyzed in association with samples collected for this project to check for contributions to the analytical results possibly attributable to laboratory-based contamination. The project samples are only affected by the MB detections if the analyte is detected in the project sample at a concentration less than ten times the concentration detected in the MB. Sample results detected less than five times the MB detection are considered non-detect and are flagged 'UB' at the RL or detected value, whichever is greater. Samples results detected less than ten times but greater than five times the MB detection are considered estimated, biased high, and are flagged 'JH' on the data tables. The following analytes were detected in the MB samples:

- WO 20K0101 – The PAH analytes 1-methylnaphthalene, 2-methylnaphthalene, fluoranthene, fluorene, phenanthrene, and pyrene were detected at estimated concentrations in the MB associated with preparation batch BIK0517. The following samples are considered affected by the MB detections:

Analyte	Sample ID	Flag	Analyte	Sample ID	Flag
1-Methylnaphthalene	SB-2020-028:6.8-11032020	UB	Fluorene	SB-2020-001:6.8-11032020	JH
	SB-2020-029:7.5-11032020	UB		SB-2020-028:6.8-11032020	UB
	SB-2020-045:7.2-11032020	UB		SB-2020-029:7.5-11032020	UB
2-Methylnaphthalene	SB-2020-028:6.8-11032020	UB		SB-2020-045:2.8-11032020	JH
	SB-2020-029:7.5-11032020	UB	Phenanthrene	SB-2020-028:6.8-11032020	JH
	SB-2020-045:7.2-11032020	UB		SB-2020-029:7.5-11032020	JH
Fluoranthene	SB-2020-028:6.8-11032020	UB		SB-2020-045:7.2-11032020	JH
	SB-2020-029:7.5-11032020	UB	Pyrene	SB-2020-028:6.8-11032020	UB
	SB-2020-045:7.2-11032020	UB		SB-2020-029:7.5-11032020	UB
				SB-2020-045:7.2-11032020	UB

- WO 20K0117 – Pyrene was detected in the PAH MB associated with preparation batch BIK0557 at a concentration greater than the RL. In addition, the PAH analytes benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(j)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-c,d)pyrene, phenanthrene, and pyrene were detected at concentrations below the RL in the MBs associated with preparation batch BIK0557 and/or BIL0296. The following samples are considered affected by the MB detections:

Analyte	Sample ID	Flag	Analyte	Sample ID	Flag
Benz(a)anthracene	SB-2020-005:1-11042020	JH	Benzo(k)fluoranthene	SB-2020-005:1-11042020	UB
	SB-2020-005:12-11042020	UB		SB-2020-005:12-11042020	UB
	SB-2020-007:1.2-2.8-11042020	JH		SB-2020-007:1.2-2.8-11042020	UB
	SB-2020-015:7-11042020	UB		SB-2020-015:7-11042020	UB
	SB-2020-015:13-11042020	UB		SB-2020-016:2-11042020	UB
	SB-2020-016:2-11042020	UB		SB-2020-016:7-11042020	UB
	SB-2020-016:7-11042020	UB	Chrysene	SB-2020-005:1-11042020	JH
	SB-2020-016:12-11042020	UB		SB-2020-005:12-11042020	UB
Benzo(a)pyrene	SB-2020-005:1-11042020	UB		SB-2020-007:1.2-2.8-11042020	JH
	SB-2020-005:12-11042020	UB		SB-2020-015:7-11042020	UB
	SB-2020-007:1.2-2.8-11042020	UB		SB-2020-015:13-11042020	UB
	SB-2020-015:7-11042020	UB		SB-2020-016:2-11042020	UB
	SB-2020-015:13-11042020	UB		SB-2020-016:7-11042020	JH
	SB-2020-016:2-11042020	UB		SB-2020-016:12-11042020	UB
	SB-2020-016:7-11042020	JH	Fluoranthene	SB-2020-005:1-11042020	JH
	SB-2020-016:12-11042020	UB		SB-2020-005:12-11042020	UB
Benzo(b)fluoranthene	SB-2020-005:1-11042020	JH		SB-2020-007:1.2-2.8-11042020	JH

Analyte	Sample ID	Flag	Analyte	Sample ID	Flag
Benzo(b)fluoranthene	SB-2020-005:12-11042020	UB	Fluoranthene	SB-2020-015:7-11042020	UB
	SB-2020-007:1.2-2.8-11042020	JH		SB-2020-015:13-11042020	UB
	SB-2020-015:7-11042020	UB		SB-2020-016:2-11042020	UB
	SB-2020-015:13-11042020	UB		SB-2020-016:12-11042020	UB
	SB-2020-016:2-11042020	UB	Indeno(1,2,3-cd)pyrene	SB-2020-005:1-11042020	UB
	SB-2020-016:7-11042020	JH		SB-2020-005:12-11042020	UB
	SB-2020-016:12-11042020	UB		SB-2020-007:1.2-2.8-11042020	UB
Benzo(g,h,i)perylene	SB-2020-005:1-11042020	UB		SB-2020-015:7-11042020	UB
	SB-2020-005:12-11042020	UB		SB-2020-015:13-11042020	UB
	SB-2020-007:1.2-2.8-11042020	UB		SB-2020-016:2-11042020	UB
	SB-2020-014:11-11052020	JH		SB-2020-016:7-11042020	JH
	SB-2020-015:7-11042020	UB		SB-2020-016:12-11042020	UB
	SB-2020-015:13-11042020	UB	Phenanthrene	SB-2020-015:7-11042020	UB
	SB-2020-016:2-11042020	UB	Pyrene	SB-2020-005:1-11042020	JH
Benzo(j)fluoranthene	SB-2020-016:7-11042020	JH		SB-2020-005:12-11042020	UB
	SB-2020-016:12-11042020	JH		SB-2020-007:1.2-2.8-11042020	JH
	SB-2020-100:11-11052020	JH		SB-2020-015:7-11042020	UB
	SB-2020-005:1-11042020	UB		SB-2020-015:13-11042020	UB
	SB-2020-005:12-11042020	UB		SB-2020-016:2-11042020	UB
	SB-2020-007:1.2-2.8-11042020	UB		SB-2020-016:7-11042020	JH
	SB-2020-015:7-11042020	UB		SB-2020-016:12-11042020	UB
Benzo(j)fluoranthene	SB-2020-016:2-11042020	UB			
	SB-2020-016:7-11042020	UB			
	SB-2020-016:12-11042020	UB			

- WO 20K0152 – Several PAH analytes associated with preparation batches BIK0354, BIK0636, and BIK0296 were detected in the MB samples at estimated concentrations below the RLs. In addition, mercury was detected in the MB associated with preparation batch BIK0295 and chromium, iron, and magnesium were detected in the dissolved metals MB associated with preparation batch BIK0591. The following samples are considered affected by the MB detections:

Analyte	Sample ID	Flag	Analyte	Sample ID	Flag
Acenaphthene	MS/MSD-SB-2020-004:13-11062020	JH	Iron	EB-1-11052020	UB
	SB-2020-004:13-11062020	UB		EB-3-11062020	UB
Anthracene	MS/MSD-SB-2020-004:13-11062020	UB	Magnesium - dissolved	EB-2-11062020	UB
	SB-2020-004:17-11062020	JH		EB-3-11062020	UB
Chromium - dissolved	EB-1-11052020	UB	Mercury	EB-3-11062020	UB

- WO 20L0436 – The PAH analytes 1-methylnaphthalene, 2-methylnaphthalene, chrysene, fluoranthene, phenanthrene, and pyrene were detected at concentrations below the RL in the MBs associated with preparation batch BIL0797. The following samples are considered affected by the MB detections:

Analyte	Sample ID	Flag	Analyte	Sample ID	Flag
1-Methylnaphthalene	SB-2020-014:18-11052020	JH	Fluoranthene	SB-2020-014:18-11052020	JH
	SB-2020-014:23-11052020	UB		SB-2020-014:23-11052020	JH
2-Methylnaphthalene	SB-2020-014:18-11052020	UB	Phenanthrene	SB-2020-014:18-11052020	JH
	SB-2020-014:23-11052020	UB		SB-2020-014:23-11052020	UB
Chrysene	SB-2020-014:18-11052020	JH	Pyrene	SB-2020-014:18-11052020	JH
				SB-2020-014:23-11052020	JH

Additional analytes may have been detected in the associated method blanks, but the sample results are not affected. Refer to the LDRCs for further details.

Trip Blanks

To evaluate the potential for cross-contamination between samples or introduction of contamination from an outside source, laboratory-supplied trip blanks were carried with the samples in their cooler during sampling and shipping. A trip blank was analyzed as part of this sampling event for VOCs and gasoline analyses. The following trip blank samples had detections that affected the data quality.

- WOs 20K0101 and 20K0117 – The trip blanks associated with these WOs had estimated detections for toluene. The following samples are affected by the trip blank detections:

Analyte	Sample ID	Flag	Analyte	Sample ID	Flag
Toluene	SB-2020-005:1-11042020	UB	Toluene	SB-2020-015:13-11042020	UB
	SB-2020-005:6-11042020	UB		SB-2020-016:7-11042020	UB
	SB-2020-005:12-11042020	UB		SB-2020-016:12-11042020	UB
	SB-2020-008:2-11052020	UB		SB-2020-045:2.8-11032020	JH
	SB-2020-008:5.5-11052020	UB		SB-2020-045:7.2-11032020	JH

The remaining trip blank samples did not have detections for the target analytes.

Equipment Blanks

The equipment blank sample *EB-1-11052020* was collected from the decontamination water used by the drilling contractors to clean the drilling equipment, and not collected from the sampling equipment used for soil borings. The equipment blank sample *EB-2-11062020* was collected from the soil boring sampling equipment after decontamination and an initial rinse. The equipment blank *EB-3-11062020* was collected from soil boring sampling equipment after decontamination, an initial rinse, and a final rinse.

- The equipment blank sample *EB-1-11052020* had detections for several metals (total and dissolved) and naphthalene. However, two of the metal detections were attributable to laboratory contamination due to detections in the method blank samples.
- The equipment blank sample *EB-2-11062020* had detections for manganese, zinc, dissolved manganese, dissolved zinc, and toluene.
- The equipment blank sample *EB-3-11062020* had detections for iron, mercury, zinc, dissolved manganese, and dissolved zinc. However, iron, mercury, and dissolved manganese were attributable to laboratory contamination due to detections in the method blank samples.

The equipment blank samples were provided to assess the effectiveness of the initial and subsequent decontamination procedures. The possibility of cross contamination based on the equipment blank concentrations and the associated concentrations observed in the soil samples is negligible. Sample results are not affected by the equipment blank detections.

Accuracy

Accuracy refers to determining the correct analyte concentration and is a comparison between the measured value and a known or expected value. Laboratory analytical accuracy may be assessed through the analyte recoveries from LCS/LCSD and MS/MSD analyses, and the recovery of analyte surrogates (for organic analytes) added to project samples.

LCS, LCSD, MS, and MSD Samples

LCS samples are prepared by the laboratory for each preparatory batch, at a minimum of one LCS per 20 samples, where required. In some cases, analytical protocol requires the laboratory also analyze an LCSD. LCSs and LCSDs are blank samples that are spiked with a known amount of analyte(s) and prepared using the same method that is applied to field samples to extract/analyze the analyte(s). The laboratory reports a percent recovery (%R) of the spiked

amount for each analyte added to the blank sample. Project samples in the same preparation batch are considered affected by LCS/LCSD recovery failures.

For certain methods, the laboratory analyzes an MS and/or an MSD in addition to the LCS. MS/MSDs are prepared and analyzed on a preparatory-batch basis and are analyzed with every 20 samples, when required. MS/MSD samples are field (native) samples that are spiked with a known concentration of analyte(s) and prepared using the same method that is applied to project samples to extract/analyze the analyte(s). The MS and MSD are used to determine the presence of matrix interferences and evaluate the analytical accuracy for a given method and matrix, expressed as a percent recovery of the spiked amount added to the field sample. The parent sample used to prepare the MS/MSD samples are considered affected by MS/MSD recovery failures.

High recoveries in the LCS, LCSD, MS, and MSD samples indicate a high analytical bias and affected samples are considered estimated, biased high, and are flagged “JH” in the data tables. Conversely, low recoveries in these samples indicate a low analytical bias and affected samples are considered estimated, biased low. Detected results are flagged “JL” and non-detect results are flagged “UJ” in the data tables.

The following samples are affected by the recoveries reported for the LCS, LCSD, MS, and MSD samples:

- WO 20K0101 – The MS sample associated with preparation batch BIK0197 had a low recovery for selenium. The parent sample *HA-2020-007:0.25-11022020* did not have a detection for this analyte and the analytical results are flagged “UJ” in the data table.
- WO 20K0101 – The LCS and LCSD samples associated with preparation batch BIK0187 had low recoveries for cis-1,2-dichloroethene. The project samples *SB-2020-045:2.8-11032020* and *SB-2020-045:7.2-11032020* are associated with this preparation batch and did not have detections for this analyte. The sample results are flagged “UJ” in the data table.
- WOs 20K0117 and 20K0152 – The LCS and LCSD samples associated with preparation batch BIK0249 had low recoveries for cis-1,2-dichloroethene. The project samples *SB-2020-004:8-11062020*, *SB-2020-004:13-11062020*, *SB-2020-005:1-11042020*, *SB-2020-005:6-11042020*, *SB-2020-005:12-11042020*, *SB-2020-008:2-11052020*, *SB-2020-008:5.5-11052020*, *SB-2020-008:11.5-11052020*, *SB-2020-014:1.5-11052020*, *SB-2020-014:7-11052020*, *SB-2020-014:11-11052020*, *SB-2020-015:1-11042020*, *SB-2020-015:7-11042020*, *SB-2020-015:13-11042020*, *SB-2020-016:2-11042020*, *SB-2020-016:7-11042020*, *SB-2020-016:12-11042020*, and *MS/MSD-SB-2020-004:13-11062020* are associated with this preparation batch. Detected results are flagged “JL” and non-detect results are flagged “UJ” in the data table.

- WO 20K0117 – The LCSD sample associated with preparation batch BIK0249 had a high recovery for tetrachloroethene. The project samples *SB-2020-008:5.5-11052020*, *SB-2020-014:7-11052020*, *SB-2020-015:1-11042020*, and *SB-2020-015:7-11042020* are associated with the preparation batch and had detections for this analyte. The detected results are flagged “JH” in the data table.
- WO 20L0100 – The MS and MSD samples associated with preparation batch BIL0367 had low recoveries for selenium. The parent sample *HA-2020-007:0-11022020* is considered affected by the low selenium recovery and the result is flagged “JL” in the data table.

Additional QC failures were observed that did not affect the data. Refer to the LDRCs for further details.

Surrogates

Surrogates are organic compounds that are similar to the analytes being evaluated for a given analytical method (often a deuterated version of the one of the analytes). They are used to identify matrix interferences and inefficiencies in sample extraction process for organic analyses. The surrogates are introduced into a field or laboratory-QC sample prior to sample preparation and analysis. Accuracy is expressed as a percent recovery of the spiked amount. Some methods require analysis using an isotope dilution method, which uses isotope dilution analytes (IDAs) instead of a surrogate, and corrects the raw data of the associated analyte concentration based on the recovery of the IDA.

As with LCS, LCSD, MS, and MSD samples, high surrogate recoveries indicate a high analytical bias and affected samples are considered estimated, biased high, and are flagged “JH” in the data tables. Conversely, low surrogate recoveries in these samples indicate a low analytical bias and affected samples are considered estimated, biased low. Detected results are flagged “JL” in the data tables and non-detect results are flagged “UJ” in the data tables. IDA recoveries do not impart a bias to the data since these analytes are self-correcting.

There were no surrogate or IDA recovery failures that affected the analytical results. There was an instance in WO 20L0437 where the laboratory noted they were unable to quantify the surrogate decachlorobiphenyl for PCB sample *SB-2020-013:20.5-11052020* in the primary column. However, the confirmation column was run with the surrogate within limits, so the results were reported without qualification. Refer to the LDRCs for further details.

Calibration Verification Samples

The laboratory also assesses analytical batch accuracy using recovery information from initial calibration verification (ICV) and continuing calibration verification (CCV) samples. Assessment of ICV/CCV recoveries is beyond the scope of a Level II data review. However, the

laboratory reported ICV/CCV recovery discrepancies for several WOs in the case narratives and identified a bias to the analytical results. The following samples were affected by ICV/CCV failures:

- WO 20K0152 – The ICV associated with the analytical batch reported for this WO had a low recovery failure for cis-1,2-dichloroethene. Project samples *SB-2020-004:2.5-11062020*, *SB-2020-004:8-11062020*, *SB-2020-004:13-11062020*, *SB-2020-004:17-11062020*, *SB-2020-004:21-11062020*, *SB-2020-004:27-11062020*, *SB-2020-101:17-11062020*, and *MS/MSD-SB-2020-004:13-11062020* are affected by the low recovery failures. These samples did not have detections for this analyte and the results are flagged “UJ” in the data table.
- WOs 20L0436 and 20L0437 – The ICV and/or CCV associated with the analytical batch reported for this WO had high recovery failures for benzo(g,h,i)perylene and dibenzofuran. Project samples *SB-2020-005:20-11042020*, *SB-2020-007:20-21.4-11042020*, *SB-2020-007:23-24.6-11042020*, *SB-2020-008:20-11052020*, *SB-2020-013:20.5-11052020*, *SB-2020-013:23-11052020*, *SB-2020-014:18-11052020*, and/or *SB-2020-014:23-11052020* are affected by the high ICV/CCV failures. Detected results are flagged “JH” in the data table.

Additional ICV/CCV failures may have been observed but did not affect the data. Refer to the LDRCs for further details.

Precision

Laboratory analytical precision can be assessed by comparing the results of duplicate analyses performed on LCS/LCSD, MS/MSD, and laboratory-duplicate samples, and evaluating the associated relative percent differences (RPDs; difference between the sample and its duplicate divided by the mean of the two). The data quality objective for RPDs is 20 percent for the laboratory QC samples. In addition, we collected field-duplicate samples at the required frequency for the project to evaluate the precision of the analytical measurements and reproducibility of our sampling technique. The data quality objective is 50 percent for soil field-duplicate samples and 30 percent for water field-duplicate samples.

LCS/LCSD, MS/MSD, and Laboratory Duplicate RPDs

The laboratory LCS/LCSD, MS/MSD, and laboratory duplicate samples were evaluated to assess laboratory precision. Samples associated with preparation batches with LCS/LCSD RPD failures are considered affected by the precision failures. The parent samples associated with the MS/MSD or laboratory duplicate samples are considered affected by the precision failures. Affected samples with detections are flagged “J” and non-detect results are flagged “UJ” in the data tables. The following samples had RPDs that did not meet the project data quality objectives:

- WO 20K0101 – The laboratory duplicate associated with preparation batch BIK0197 had an RPD failure for zinc. The parent sample *HA-2020-007:0.25-11022020* result is considered affected and the result is flagged “J” in the data table.
- WO 20K0152 – The laboratory duplicate associated with preparation batch BIK0569 had RPD failures for arsenic, barium, chromium, and selenium. The parent sample *SB-2020-013:1.5-11052020* results are considered affected and the results are flagged “J” in the data table.
- WO 20L0100 – The laboratory duplicate associated with preparation batch BIK0569 had RPD failures for arsenic, chromium, cobalt, lead, and nickel. The parent sample *SB-2020-007:0-11022020* results are considered affected and the results are flagged “J” in the data table.

Additional LCS/LCSD, MS/MSD, and laboratory duplicate RPD failures may have been observed but did not affect the data. Refer to the LDRCs for further details.

Field Duplicate RPDs

The field-duplicate samples were evaluated to assess laboratory precision and the reproducibility of our sampling technique. Analytes in both the primary and field-duplicate samples would need to be detected in order to calculate an RPD. Affected samples are flagged “J” in the associated data tables. The following samples had field-duplicate precision failures that did not meet the project data quality objectives:

- WO 20K0101 – Sample *A1-100:5-11032020* is a field duplicate of sample *A1-02A:5-11032020*. The RPDs for diesel range organics (DRO) and residual range organics (RRO; reported as “motor oil range organics” in the laboratory report) were greater than the project data quality objectives. The results are flagged “J” in the data table.
- WO 20K0101 – Sample *HA-2020-100:02-11022020* is a field duplicate of sample *HA-2020-003:02-11022020*. The RPD for nickel was greater than the project data quality objective. The results are flagged “J” in the data table.
- WO 20K0117 – Sample *SB-2020-100:11-11052020* is a field duplicate of sample *SB-2020-014:11-11052020*. The RPDs for gasoline range organics (GRO), aroclor-1254, aroclor-1260, toluene, ethylbenzene, m&p-xylenes, o-xylene, total xylenes, acenaphthene, and anthracene were greater than the project data quality objectives. The results are flagged “J” in the data table. In addition, DRO and RRO were detected in the field-duplicate sample above the RL but not detected in the primary sample. Due to the difference in these results, the detected results are flagged “J” and non-detect results are flagged “UJ” to identify a possible precision error for these analytes.
- WO 20K0152 – Sample *SB-2020-101:17-11062020* is a field duplicate of sample *SB-2020-004:17-11062020*. The RPDs for 1-methylnaphthalene, 2-methylnaphthalene, acenaphthene,

acenaphthylene, anthracene, benzo(a)anthracene, benzo(g,h,i)perylene, chrysene, dibenzofuran, fluoranthene, fluorene, phenanthrene, pyrene, and total organic carbon were greater than the project data quality objectives. The results are flagged “J” in the data table.

Additional Precision Failures

In addition to the assessments of precision listed above, the analysis of PCBs was conducted using a primary and confirmation column. Per the method, the RPD data quality objective is 40 percent for the results obtained for the two columns. The laboratory noted the following confirmation column RPD failure:

- WO 20L0286 – The aroclor-1260 result for sample *TSA-2020-001:1.9-11032020* had a confirmation column RPD failure. The sample result is considered estimated and is flagged “J” in the data table.

Representativeness

Sample log sheets were reviewed to ensure the samples were collected according to the SAP, and the results, therefore, represent the location and depth sampled. In addition, where possible, the analytical result for each sample will be compared to the historical results to check that the result is consistent with the broader data set for that location.

Comparability

Our reviewers qualitatively assess the comparability between historical and current data sets and use caution in combining data sets if the quality of the data is uncertain. For example, current analytical methods used to analyze for BTEX may not be comparable to historical BTEX methods where the MRL was elevated.

Completeness

The overall data set from this sampling event was evaluated to determine if the completeness goal of 90 percent useable data was achieved. Completeness is calculated by comparing the amount of useable data to the overall number of samples. Since there were no data rejected in this data set, the completeness goal of 90 percent was met.

DATA QUALITY SUMMARY

Based on the methods outlined in the site-specific QAPP, the samples detailed in the ARI laboratory reports for WOs 20K0101, 20K0117, 20K0152, 20L0098, 20L0100, 20L0286, 20L0346, and 20L0347 are considered to be representative of site conditions at the locations and times they were obtained. Results affected by QC anomalies are qualified with the appropriate data

flags and are considered usable with the applied qualifiers. A summary of the applied qualifiers is presented in Table E-1. The quality of the analytical data for this sample batch does not appear to have been compromised by analytical irregularities.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON, INC.

Michael Jaramillo
Senior Chemist

Enc: Table 1 – November 2020 Result Flags
Laboratory Data Review Checklists

Table 1 - November 2020 Result Flags

Work Order Number	SampleName	Method	Analyte	CAS	Result	QC Flag	Display	Bias	QCNote
20K0101	A1-02A:5-11032020	NWTPH-DX	Diesel Range Organics	DRO	2260	J	2260 J*	None	Field-duplicate RPD failure
20K0101	A1-02A:5-11032020	NWTPH-DX	Residual Range Organics	RRO	7650	J	7650 J*	None	Field-duplicate RPD failure
20K0101	A1-100:5-11032020	NWTPH-DX	Diesel Range Organics	DRO	387	J	387 J*	None	Field-duplicate RPD failure
20K0101	A1-100:5-11032020	NWTPH-DX	Residual Range Organics	RRO	1730	J	1730 J*	None	Field-duplicate RPD failure
20K0101	HA-2020-003:0.2-11022020	SW6020A	Nickel	7440-02-0	673	J	673 J*	None	Field-duplicate RPD failure
20K0101	HA-2020-007:0.25-11022020	SW6020A	Selenium	7782-49-2	1.97	UJ	<1.97 J*	Low	MS recovery failure
20K0101	HA-2020-007:0.25-11022020	SW6020A	Zinc	7440-66-6	98.6	J	98.6 J*	None	Laboratory duplicate RPD failure
20K0101	HA-2020-100:0.2-11022020	SW6020A	Nickel	7440-02-0	1180	J	1180 J*	None	Field-duplicate RPD failure
20K0101	SB-2020-001:6.8-11032020	SW8270ESIM	Fluorene	86-73-7	0.00038	JH	0.000380 JH*	High	Method blank detection
20K0101	SB-2020-028:6.8-11032020	SW8270ESIM	1-Methylnaphthalene	90-12-0	0.00063	UB	<0.000630 B*	High	Method blank detection
20K0101	SB-2020-028:6.8-11032020	SW8270ESIM	2-Methylnaphthalene	91-57-6	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0101	SB-2020-028:6.8-11032020	SW8270ESIM	Fluoranthene	206-44-0	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0101	SB-2020-028:6.8-11032020	SW8270ESIM	Fluorene	86-73-7	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0101	SB-2020-028:6.8-11032020	SW8270ESIM	Phenanthrene	85-01-8	0.00153	JH	0.00153 JH*	High	Method blank detection
20K0101	SB-2020-028:6.8-11032020	SW8270ESIM	Pyrene	129-00-0	0.00064	UB	<0.000640 B*	High	Method blank detection
20K0101	SB-2020-029:7.5-11032020	SW8270ESIM	1-Methylnaphthalene	90-12-0	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0101	SB-2020-029:7.5-11032020	SW8270ESIM	2-Methylnaphthalene	91-57-6	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0101	SB-2020-029:7.5-11032020	SW8270ESIM	Fluoranthene	206-44-0	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0101	SB-2020-029:7.5-11032020	SW8270ESIM	Fluorene	86-73-7	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0101	SB-2020-029:7.5-11032020	SW8270ESIM	Phenanthrene	85-01-8	0.00162	JH	0.00162 JH*	High	Method blank detection
20K0101	SB-2020-029:7.5-11032020	SW8270ESIM	Pyrene	129-00-0	0.00059	UB	<0.000590 B*	High	Method blank detection
20K0101	SB-2020-045:2.8-11032020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00143	UJ	<0.00143 J*	Low	LCS recovery failure
20K0101	SB-2020-045:2.8-11032020	SW8270ESIM	Fluorene	86-73-7	0.00061	JH	0.000610 JH*	High	Method blank detection
20K0101	SB-2020-045:2.8-11032020	SW8260D	Toluene	108-88-3	0.00035	JH	0.000350 JH*	High	Trip blank detection
20K0101	SB-2020-045:7.2-11032020	SW8270ESIM	1-Methylnaphthalene	90-12-0	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0101	SB-2020-045:7.2-11032020	SW8270ESIM	2-Methylnaphthalene	91-57-6	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0101	SB-2020-045:7.2-11032020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00116	UJ	<0.00116 J*	Low	LCS recovery failure
20K0101	SB-2020-045:7.2-11032020	SW8270ESIM	Fluoranthene	206-44-0	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0101	SB-2020-045:7.2-11032020	SW8270ESIM	Phenanthrene	85-01-8	0.00138	JH	0.00138 JH*	High	Method blank detection
20K0101	SB-2020-045:7.2-11032020	SW8270ESIM	Pyrene	129-00-0	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0101	SB-2020-045:7.2-11032020	SW8260D	Toluene	108-88-3	0.00026	JH	0.000260 JH*	High	Trip blank detection

Table 1 - November 2020 Result Flags

Work Order Number	SampleName	Method	Analyte	CAS	Result	QC Flag	Display	Bias	QCNote
20K0117	SB-2020-005:1-11042020	SW8270ESIM	Benz[a]anthracene	56-55-3	0.00203	JH	0.00203 JH*	High	Method blank detection
20K0117	SB-2020-005:1-11042020	SW8270ESIM	Benzo(a)pyrene	50-32-8	0.00102	UB	<0.00102 B*	High	Method blank detection
20K0117	SB-2020-005:1-11042020	SW8270ESIM	Benzo(b)fluoranthene	205-99-2	0.00167	JH	0.00167 JH*	High	Method blank detection
20K0117	SB-2020-005:1-11042020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.00131	UB	<0.00131 B*	High	Method blank detection
20K0117	SB-2020-005:1-11042020	SW8270ESIM	Benzo(j)fluoranthene	205-82-3	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0117	SB-2020-005:1-11042020	SW8270ESIM	Benzo(k)fluoranthene	207-08-9	0.00051	UB	<0.000510 B*	High	Method blank detection
20K0117	SB-2020-005:1-11042020	SW8270ESIM	Chrysene	218-01-9	0.00339	JH	0.00339 JH*	High	Method blank detection
20K0117	SB-2020-005:1-11042020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00155	UJ	<0.00155 J*	Low	LCS recovery failure
20K0117	SB-2020-005:1-11042020	SW8270ESIM	Fluoranthene	206-44-0	0.00272	JH	0.00272 JH*	High	Method blank detection
20K0117	SB-2020-005:1-11042020	SW8270ESIM	Indeno(1,2,3-cd)pyrene	193-39-5	0.00064	UB	<0.000640 B*	High	Method blank detection
20K0117	SB-2020-005:1-11042020	SW8270ESIM	Pyrene	129-00-0	0.00414	JH	0.00414 JH*	High	Method blank detection
20K0117	SB-2020-005:1-11042020	SW8260D	Toluene	108-88-3	0.00155	UB	<0.00155 B*	High	Trip blank detection
20K0117	SB-2020-005:12-11042020	SW8270ESIM	Benz[a]anthracene	56-55-3	0.0007	UB	<0.000700 B*	High	Method blank detection
20K0117	SB-2020-005:12-11042020	SW8270ESIM	Benzo(a)pyrene	50-32-8	0.00075	UB	<0.000750 B*	High	Method blank detection
20K0117	SB-2020-005:12-11042020	SW8270ESIM	Benzo(b)fluoranthene	205-99-2	0.00095	UB	<0.000950 B*	High	Method blank detection
20K0117	SB-2020-005:12-11042020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.00091	UB	<0.000910 B*	High	Method blank detection
20K0117	SB-2020-005:12-11042020	SW8270ESIM	Benzo(j)fluoranthene	205-82-3	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0117	SB-2020-005:12-11042020	SW8270ESIM	Benzo(k)fluoranthene	207-08-9	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0117	SB-2020-005:12-11042020	SW8270ESIM	Chrysene	218-01-9	0.00127	UB	<0.00127 B*	High	Method blank detection
20K0117	SB-2020-005:12-11042020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00145	UJ	<0.00145 J*	Low	LCS recovery failure
20K0117	SB-2020-005:12-11042020	SW8270ESIM	Fluoranthene	206-44-0	0.00139	UB	<0.00139 B*	High	Method blank detection
20K0117	SB-2020-005:12-11042020	SW8270ESIM	Indeno(1,2,3-cd)pyrene	193-39-5	0.00055	UB	<0.000550 B*	High	Method blank detection
20K0117	SB-2020-005:12-11042020	SW8270ESIM	Pyrene	129-00-0	0.00157	UB	<0.00157 B*	High	Method blank detection
20K0117	SB-2020-005:12-11042020	SW8260D	Toluene	108-88-3	0.00145	UB	<0.00145 B*	High	Trip blank detection
20K0117	SB-2020-005:6-11042020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00171	UJ	<0.00171 J*	Low	LCS recovery failure
20K0117	SB-2020-005:6-11042020	SW8260D	Toluene	108-88-3	0.00171	UB	<0.00171 B*	High	Trip blank detection
20K0117	SB-2020-007:1.2-2.8-11042020	SW8270ESIM	Benz[a]anthracene	56-55-3	0.00252	JH	0.00252 JH*	High	Method blank detection
20K0117	SB-2020-007:1.2-2.8-11042020	SW8270ESIM	Benzo(a)pyrene	50-32-8	0.00117	UB	<0.00117 B*	High	Method blank detection
20K0117	SB-2020-007:1.2-2.8-11042020	SW8270ESIM	Benzo(b)fluoranthene	205-99-2	0.00185	JH	0.00185 JH*	High	Method blank detection
20K0117	SB-2020-007:1.2-2.8-11042020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.00096	UB	<0.000960 B*	High	Method blank detection
20K0117	SB-2020-007:1.2-2.8-11042020	SW8270ESIM	Benzo(j)fluoranthene	205-82-3	0.00064	UB	<0.000640 B*	High	Method blank detection

Table 1 - November 2020 Result Flags

Work Order Number	SampleName	Method	Analyte	CAS	Result	QC Flag	Display	Bias	QCNote
20K0117	SB-2020-007:1.2-2.8-11042020	SW8270ESIM	Benzo(k)fluoranthene	207-08-9	0.00061	UB	<0.000610 B*	High	Method blank detection
20K0117	SB-2020-007:1.2-2.8-11042020	SW8270ESIM	Chrysene	218-01-9	0.00427	JH	0.00427 JH*	High	Method blank detection
20K0117	SB-2020-007:1.2-2.8-11042020	SW8270ESIM	Fluoranthene	206-44-0	0.00347	JH	0.00347 JH*	High	Method blank detection
20K0117	SB-2020-007:1.2-2.8-11042020	SW8270ESIM	Indeno(1,2,3-cd)pyrene	193-39-5	0.00061	UB	<0.000610 B*	High	Method blank detection
20K0117	SB-2020-007:1.2-2.8-11042020	SW8270ESIM	Pyrene	129-00-0	0.00472	JH	0.00472 JH*	High	Method blank detection
20K0117	SB-2020-008:11.5-11052020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.0013	UJ	<0.00130 J*	Low	LCS recovery failure
20K0117	SB-2020-008:2-11052020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00103	UJ	<0.00103 J*	Low	LCS recovery failure
20K0117	SB-2020-008:2-11052020	SW8260D	Toluene	108-88-3	0.00103	UB	<0.00103 B*	High	Trip blank detection
20K0117	SB-2020-008:5.5-11052020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00106	UJ	<0.00106 J*	Low	LCS recovery failure
20K0117	SB-2020-008:5.5-11052020	SW8260D	Tetrachloroethene	127-18-4	0.00028	JH	0.000280 JH*	High	LCS recovery failure
20K0117	SB-2020-008:5.5-11052020	SW8260D	Toluene	108-88-3	0.00106	UB	<0.00106 B*	High	Trip blank detection
20K0117	SB-2020-014:1.5-11052020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00389	JL	0.00389 JL*	Low	LCS recovery failure
20K0117	SB-2020-014:11-11052020	SW8270ESIM	Acenaphthene	83-32-9	0.00112	J	0.00112 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-014:11-11052020	SW8270ESIM	Anthracene	120-12-7	0.00026	J	0.000260 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-014:11-11052020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.00082	JH	0.000820 JH*	High	Method blank detection
20K0117	SB-2020-014:11-11052020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00499	JL	0.00499 JL*	Low	LCS recovery failure
20K0117	SB-2020-014:11-11052020	NWTPH-DX	Diesel Range Organics	DRO	74.3	UJ	<74.3 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-014:11-11052020	SW8260D	Ethylbenzene	100-41-4	0.00386	J	0.00386 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-014:11-11052020	NWTPH-GX	Gasoline Range Organics	GRO	118	J	118 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-014:11-11052020	SW8260D	m, p-Xylene	179601-23-1	0.0203	J	0.0203 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-014:11-11052020	SW8260D	o-Xylene	95-47-6	0.00165	J	0.00165 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-014:11-11052020	SW8082A	PCB-aroclor 1254	11097-69-1	0.0175	J	0.0175 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-014:11-11052020	SW8082A	PCB-aroclor 1260	11096-82-5	0.0097	J	0.00970 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-014:11-11052020	NWTPH-DX	Residual Range Organics	RRO	149	UJ	<149 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-014:11-11052020	SW8260D	Toluene	108-88-3	0.0033	J	0.00330 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-014:11-11052020	SW8260D	Total Xylenes	1330-20-7	0.0219	J	0.0219 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-014:7-11052020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.0027	JL	0.00270 JL*	Low	LCS recovery failure
20K0117	SB-2020-014:7-11052020	SW8260D	Tetrachloroethene	127-18-4	0.00299	JH	0.00299 JH*	High	LCS recovery failure
20K0117	SB-2020-015:1-11042020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00134	UJ	<0.00134 J*	Low	LCS recovery failure
20K0117	SB-2020-015:1-11042020	SW8260D	Tetrachloroethene	127-18-4	0.00056	JH	0.000560 JH*	High	LCS recovery failure
20K0117	SB-2020-015:13-11042020	SW8270ESIM	Benz[a]anthracene	56-55-3	0.00049	UB	<0.000490 B*	High	Method blank detection

Table 1 - November 2020 Result Flags

Work Order Number	SampleName	Method	Analyte	CAS	Result	QC Flag	Display	Bias	QCNote
20K0117	SB-2020-015:13-11042020	SW8270ESIM	Benzo(a)pyrene	50-32-8	0.00049	UB	<0.000490 B*	High	Method blank detection
20K0117	SB-2020-015:13-11042020	SW8270ESIM	Benzo(b)fluoranthene	205-99-2	0.00049	UB	<0.000490 B*	High	Method blank detection
20K0117	SB-2020-015:13-11042020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.00049	UB	<0.000490 B*	High	Method blank detection
20K0117	SB-2020-015:13-11042020	SW8270ESIM	Chrysene	218-01-9	0.00069	UB	<0.000690 B*	High	Method blank detection
20K0117	SB-2020-015:13-11042020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00125	JL	0.00125 JL*	Low	LCS recovery failure
20K0117	SB-2020-015:13-11042020	SW8270ESIM	Fluoranthene	206-44-0	0.00049	UB	<0.000490 B*	High	Method blank detection
20K0117	SB-2020-015:13-11042020	SW8270ESIM	Indeno(1,2,3-cd)pyrene	193-39-5	0.00049	UB	<0.000490 B*	High	Method blank detection
20K0117	SB-2020-015:13-11042020	SW8270ESIM	Pyrene	129-00-0	0.00076	UB	<0.000760 B*	High	Method blank detection
20K0117	SB-2020-015:13-11042020	SW8260D	Toluene	108-88-3	0.00146	UB	<0.00146 B*	High	Trip blank detection
20K0117	SB-2020-015:7-11042020	SW8270ESIM	Benz[a]anthracene	56-55-3	0.00049	UB	<0.000490 B*	High	Method blank detection
20K0117	SB-2020-015:7-11042020	SW8270ESIM	Benzo(a)pyrene	50-32-8	0.00049	UB	<0.000490 B*	High	Method blank detection
20K0117	SB-2020-015:7-11042020	SW8270ESIM	Benzo(b)fluoranthene	205-99-2	0.00049	UB	<0.000490 B*	High	Method blank detection
20K0117	SB-2020-015:7-11042020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.00049	UB	<0.000490 B*	High	Method blank detection
20K0117	SB-2020-015:7-11042020	SW8270ESIM	Benzo(j)fluoranthene	205-82-3	0.00049	UB	<0.000490 B*	High	Method blank detection
20K0117	SB-2020-015:7-11042020	SW8270ESIM	Benzo(k)fluoranthene	207-08-9	0.00049	UB	<0.000490 B*	High	Method blank detection
20K0117	SB-2020-015:7-11042020	SW8270ESIM	Chrysene	218-01-9	0.00049	UB	<0.000490 B*	High	Method blank detection
20K0117	SB-2020-015:7-11042020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00126	UJ	<0.00126 J*	Low	LCS recovery failure
20K0117	SB-2020-015:7-11042020	SW8270ESIM	Fluoranthene	206-44-0	0.00049	UB	<0.000490 B*	High	Method blank detection
20K0117	SB-2020-015:7-11042020	SW8270ESIM	Indeno(1,2,3-cd)pyrene	193-39-5	0.00049	UB	<0.000490 B*	High	Method blank detection
20K0117	SB-2020-015:7-11042020	SW8270ESIM	Phenanthrene	85-01-8	0.00051	UB	<0.000510 B*	High	Method blank detection
20K0117	SB-2020-015:7-11042020	SW8270ESIM	Pyrene	129-00-0	0.00049	UB	<0.000490 B*	High	Method blank detection
20K0117	SB-2020-015:7-11042020	SW8260D	Tetrachloroethene	127-18-4	0.00043	JH	0.000430 JH*	High	LCS recovery failure
20K0117	SB-2020-016:12-11042020	SW8270ESIM	Benz[a]anthracene	56-55-3	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0117	SB-2020-016:12-11042020	SW8270ESIM	Benzo(a)pyrene	50-32-8	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0117	SB-2020-016:12-11042020	SW8270ESIM	Benzo(b)fluoranthene	205-99-2	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0117	SB-2020-016:12-11042020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.00248	JH	0.00248 JH*	High	Method blank detection
20K0117	SB-2020-016:12-11042020	SW8270ESIM	Benzo(j)fluoranthene	205-82-3	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0117	SB-2020-016:12-11042020	SW8270ESIM	Chrysene	218-01-9	0.00075	UB	<0.000750 B*	High	Method blank detection
20K0117	SB-2020-016:12-11042020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00061	JL	0.000610 JL*	Low	LCS recovery failure
20K0117	SB-2020-016:12-11042020	SW8270ESIM	Fluoranthene	206-44-0	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0117	SB-2020-016:12-11042020	SW8270ESIM	Indeno(1,2,3-cd)pyrene	193-39-5	0.0005	UB	<0.000500 B*	High	Method blank detection

Table 1 - November 2020 Result Flags

Work Order Number	SampleName	Method	Analyte	CAS	Result	QC Flag	Display	Bias	QCNote
20K0117	SB-2020-016:12-11042020	SW8270ESIM	Pyrene	129-00-0	0.00061	UB	<0.000610 B*	High	Method blank detection
20K0117	SB-2020-016:12-11042020	SW8260D	Toluene	108-88-3	0.0017	UB	<0.00170 B*	High	Trip blank detection
20K0117	SB-2020-016:2-11042020	SW8270ESIM	Benz[a]anthracene	56-55-3	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0117	SB-2020-016:2-11042020	SW8270ESIM	Benzo(a)pyrene	50-32-8	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0117	SB-2020-016:2-11042020	SW8270ESIM	Benzo(b)fluoranthene	205-99-2	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0117	SB-2020-016:2-11042020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0117	SB-2020-016:2-11042020	SW8270ESIM	Benzo(j)fluoranthene	205-82-3	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0117	SB-2020-016:2-11042020	SW8270ESIM	Benzo(k)fluoranthene	207-08-9	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0117	SB-2020-016:2-11042020	SW8270ESIM	Chrysene	218-01-9	0.00079	UB	<0.000790 B*	High	Method blank detection
20K0117	SB-2020-016:2-11042020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00121	UJ	<0.00121 J*	Low	LCS recovery failure
20K0117	SB-2020-016:2-11042020	SW8270ESIM	Fluoranthene	206-44-0	0.00073	UB	<0.000730 B*	High	Method blank detection
20K0117	SB-2020-016:2-11042020	SW8270ESIM	Indeno(1,2,3-cd)pyrene	193-39-5	0.0005	UB	<0.000500 B*	High	Method blank detection
20K0117	SB-2020-016:2-11042020	SW8270ESIM	Pyrene	129-00-0	0.00096	UB	<0.000960 B*	High	Method blank detection
20K0117	SB-2020-016:7-11042020	SW8270ESIM	Benz[a]anthracene	56-55-3	0.00154	UB	<0.00154 B*	High	Method blank detection
20K0117	SB-2020-016:7-11042020	SW8270ESIM	Benzo(a)pyrene	50-32-8	0.00159	JH	0.00159 JH*	High	Method blank detection
20K0117	SB-2020-016:7-11042020	SW8270ESIM	Benzo(b)fluoranthene	205-99-2	0.00223	JH	0.00223 JH*	High	Method blank detection
20K0117	SB-2020-016:7-11042020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.0022	JH	0.00220 JH*	High	Method blank detection
20K0117	SB-2020-016:7-11042020	SW8270ESIM	Benzo(j)fluoranthene	205-82-3	0.00093	UB	<0.000930 B*	High	Method blank detection
20K0117	SB-2020-016:7-11042020	SW8270ESIM	Benzo(k)fluoranthene	207-08-9	0.00088	UB	<0.000880 B*	High	Method blank detection
20K0117	SB-2020-016:7-11042020	SW8270ESIM	Chrysene	218-01-9	0.00251	JH	0.00251 JH*	High	Method blank detection
20K0117	SB-2020-016:7-11042020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00037	JL	0.000370 JL*	Low	LCS recovery failure
20K0117	SB-2020-016:7-11042020	SW8270ESIM	Indeno(1,2,3-cd)pyrene	193-39-5	0.00171	JH	0.00171 JH*	High	Method blank detection
20K0117	SB-2020-016:7-11042020	SW8270ESIM	Pyrene	129-00-0	0.00463	JH	0.00463 JH*	High	Method blank detection
20K0117	SB-2020-016:7-11042020	SW8260D	Toluene	108-88-3	0.00129	UB	<0.00129 B*	High	Trip blank detection
20K0117	SB-2020-100:11-11052020	SW8270ESIM	Acenaphthene	83-32-9	0.00129	J	0.00129 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-100:11-11052020	SW8270ESIM	Anthracene	120-12-7	0.0008	J	0.000800 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-100:11-11052020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.00083	JH	0.000830 JH*	High	Method blank detection
20K0117	SB-2020-100:11-11052020	NWTPH-DX	Diesel Range Organics	DRO	190	J	190 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-100:11-11052020	SW8260D	Ethylbenzene	100-41-4	0.0014	J	0.00140 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-100:11-11052020	NWTPH-GX	Gasoline Range Organics	GRO	713	J	713 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-100:11-11052020	SW8260D	m, p-Xylene	179601-23-1	0.00892	J	0.00892 J*	None	Field-duplicate RPD failure

Table 1 - November 2020 Result Flags

Work Order Number	SampleName	Method	Analyte	CAS	Result	QC Flag	Display	Bias	QCNote
20K0117	SB-2020-100:11-11052020	SW8260D	o-Xylene	95-47-6	0.00067	J	0.000670 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-100:11-11052020	SW8082A	PCB-aroclor 1254	11097-69-1	0.0445	J	0.0445 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-100:11-11052020	SW8082A	PCB-aroclor 1260	11096-82-5	0.0243	J	0.0243 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-100:11-11052020	NWTPH-DX	Residual Range Organics	RRO	600	J	600 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-100:11-11052020	SW8260D	Toluene	108-88-3	0.00194	J	0.00194 J*	None	Field-duplicate RPD failure
20K0117	SB-2020-100:11-11052020	SW8260D	Total Xylenes	1330-20-7	0.00958	J	0.00958 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	EB-1-11052020	SW6020A	Chromium - Dissolved	7440-47-3	0.00055	UB	<0.000550 B*	High	Method blank detection
20K0152 Revision 1	EB-1-11052020	SW6020A	Iron	7439-89-6	0.02	UB	<0.0200 B*	High	Method blank detection
20K0152 Revision 1	EB-2-11062020	sw6020a	Magnesium - Dissolved	7439-95-4	0.02	UB	<0.0200 B*	High	Method blank detection
20K0152 Revision 1	EB-3-11062020	SW6020A	Iron	7439-89-6	0.02	UB	<0.0200 B*	High	Method blank detection
20K0152 Revision 1	EB-3-11062020	sw6020a	Magnesium - Dissolved	7439-95-4	0.02	UB	<0.0200 B*	High	Method blank detection
20K0152 Revision 1	EB-3-11062020	SW7470A	Mercury	7439-97-6	0.0001	UB	<0.000100 B*	High	Method blank detection
20K0152 Revision 1	MS/MSD-SB-2020-004:13-11062020	SW8270ESIM	Acenaphthene	83-32-9	0.00105	JH	0.00105 JH*	High	Method blank detection
20K0152 Revision 1	MS/MSD-SB-2020-004:13-11062020	SW8270ESIM	Anthracene	120-12-7	0.00048	UB	<0.000480 B*	High	Method blank detection
20K0152 Revision 1	MS/MSD-SB-2020-004:13-11062020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.0017	UJ	<0.00170 J*	Low	LCS and ICV recovery failures
20K0152 Revision 1	SB-2020-004:13-11062020	SW8270ESIM	Acenaphthene	83-32-9	0.00048	UB	<0.000480 B*	High	Method blank detection
20K0152 Revision 1	SB-2020-004:13-11062020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00157	UJ	<0.00157 J*	Low	LCS and ICV recovery failures
20K0152 Revision 1	SB-2020-004:17-11062020	SW8270ESIM	1-Methylnaphthalene	90-12-0	0.00036	J	0.000360 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-004:17-11062020	SW8270ESIM	2-Methylnaphthalene	91-57-6	0.0003	J	0.000300 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-004:17-11062020	SW8270ESIM	Acenaphthene	83-32-9	0.0124	J	0.0124 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-004:17-11062020	SW8270ESIM	Acenaphthylene	208-96-8	0.00006	J	0.0000600 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-004:17-11062020	SW8270ESIM	Anthracene	120-12-7	0.0008	JH	0.000800 JH*	High	Method blank detection and field-duplicate RPD failure
20K0152 Revision 1	SB-2020-004:17-11062020	SW8270ESIM	Benz[a]anthracene	56-55-3	0.00011	J	0.000110 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-004:17-11062020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.00011	J	0.000110 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-004:17-11062020	SW8270ESIM	Chrysene	218-01-9	0.00023	J	0.000230 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-004:17-11062020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00122	UJ	<0.00122 J*	Low	ICV recovery failure
20K0152 Revision 1	SB-2020-004:17-11062020	SW8270ESIM	Dibenzofuran	132-64-9	0.00028	J	0.000280 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-004:17-11062020	SW8270ESIM	Fluoranthene	206-44-0	0.00039	J	0.000390 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-004:17-11062020	SW8270ESIM	Fluorene	86-73-7	0.0014	J	0.00140 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-004:17-11062020	SW8270ESIM	Phenanthrene	85-01-8	0.0113	J	0.0113 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-004:17-11062020	SW8270ESIM	Pyrene	129-00-0	0.00043	J	0.000430 J*	None	Field-duplicate RPD failure

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Work Order Number	SampleName	Method	Analyte	CAS	Result	QC Flag	Display	Bias	QCNote
20K0152 Revision 1	SB-2020-004:17-11062020	SW9060M	Total Organic Carbon	TOC	0.04	J	0.0400 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-004:2.5-11062020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.0016	UJ	<0.00160 J*	Low	LCS and ICV recovery failures
20K0152 Revision 1	SB-2020-004:21-11062020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00189	UJ	<0.00189 J*	Low	ICV recovery failure
20K0152 Revision 1	SB-2020-004:27-11062020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.0015	UJ	<0.00150 J*	Low	ICV recovery failure
20K0152 Revision 1	SB-2020-004:8-11062020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00158	UJ	<0.00158 J*	Low	ICV recovery failure and LCS recovery failure
20K0152 Revision 1	SB-2020-013:1.5-11052020	SW6020A	Arsenic	7440-38-2	7.26	J	7.26 J*	None	Laboratory duplicate RPD failure
20K0152 Revision 1	SB-2020-013:1.5-11052020	SW6020A	Barium	7440-39-3	63.4	J	63.4 J*	None	Laboratory duplicate RPD failure
20K0152 Revision 1	SB-2020-013:1.5-11052020	SW6020A	Chromium	7440-47-3	30.8	J	30.8 J*	None	Laboratory duplicate RPD failure
20K0152 Revision 1	SB-2020-013:1.5-11052020	SW6020A	Selenium	7782-49-2	1.87	J	1.87 J*	None	Laboratory duplicate RPD failure
20K0152 Revision 1	SB-2020-101:17-11062020	SW8270ESIM	1-Methylnaphthalene	90-12-0	0.00088	J	0.000880 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-101:17-11062020	SW8270ESIM	2-Methylnaphthalene	91-57-6	0.00057	J	0.000570 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-101:17-11062020	SW8270ESIM	Acenaphthene	83-32-9	0.0319	J	0.0319 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-101:17-11062020	SW8270ESIM	Acenaphthylene	208-96-8	0.0001	J	0.000100 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-101:17-11062020	SW8270ESIM	Anthracene	120-12-7	0.00284	J	0.00284 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-101:17-11062020	SW8270ESIM	Benz[a]anthracene	56-55-3	0.00026	J	0.000260 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-101:17-11062020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.00022	J	0.000220 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-101:17-11062020	SW8270ESIM	Chrysene	218-01-9	0.00052	J	0.000520 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-101:17-11062020	SW8260D	Cis-1,2-Dichloroethene	156-59-2	0.00124	UJ	<0.00124 J*	Low	ICV recovery failure
20K0152 Revision 1	SB-2020-101:17-11062020	SW8270ESIM	Dibenzofuran	132-64-9	0.00096	J	0.000960 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-101:17-11062020	SW8270ESIM	Fluoranthene	206-44-0	0.00255	J	0.00255 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-101:17-11062020	SW8270ESIM	Fluorene	86-73-7	0.00484	J	0.00484 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-101:17-11062020	SW8270ESIM	Phenanthrene	85-01-8	0.025	J	0.0250 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-101:17-11062020	SW8270ESIM	Pyrene	129-00-0	0.00179	J	0.00179 J*	None	Field-duplicate RPD failure
20K0152 Revision 1	SB-2020-101:17-11062020	SW9060M	Total Organic Carbon	TOC	0.33	J	0.330 J*	None	Field-duplicate RPD failure
20L0098	SB-2020-007:20-21.4-11042020	SW7471B	Mercury	7439-97-6	0.028	JL	0.0280 JL*	Low	Hold time exceedance
20L0100 Revision 1	HA-2020-001:0.5-11022020	SW7471B	Mercury	7439-97-6	0.112	JL	0.112 JL*	Low	Hold time exceedance
20L0100 Revision 1	HA-2020-005:0.5-11022020	SW7471B	Mercury	7439-97-6	0.102	JL	0.102 JL*	Low	Hold time exceedance
20L0100 Revision 1	HA-2020-007:0-11022020	SW6020A	Arsenic	7440-38-2	39.2	J	39.2 J*	None	Laboratory duplicate RPD failure
20L0100 Revision 1	HA-2020-007:0-11022020	SW6020A	Chromium	7440-47-3	673	J	673 J*	None	Laboratory duplicate RPD failure
20L0100 Revision 1	HA-2020-007:0-11022020	SW6020A	Cobalt	7440-48-4	37.3	J	37.3 J*	None	Laboratory duplicate RPD failure
20L0100 Revision 1	HA-2020-007:0-11022020	SW6020A	Lead	7439-92-1	585	J	585 J*	None	Laboratory duplicate RPD failure

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Work Order Number	SampleName	Method	Analyte	CAS	Result	QC Flag	Display	Bias	QCNote
20L0100 Revision 1	HA-2020-007:0-11022020	SW6020A	Nickel	7440-02-0	4230	J	4230 J*	None	Laboratory duplicate RPD failure
20L0100 Revision 1	HA-2020-007:0-11022020	SW6020A	Selenium	7782-49-2	0.94	JL	0.940 JL*	Low	MS/MSD recovery failures
20L0286	TSA-2020-001:1.9-11032020	SW8082A	PCB-aroclor 1260	11096-82-5	0.0445	J	0.0445 J*	None	Primary/confirmation column RPD failure
20L0436	SB-2020-005:20-11042020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.0201	JH	0.0201 JH*	High	High ICV/CCV recovery failure
20L0436	SB-2020-005:20-11042020	SW8270ESIM	Dibenzofuran	132-64-9	0.00332	JH	0.00332 JH*	High	High ICV/CCV recovery failure
20L0436	SB-2020-007:20-21.4-11042020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.00603	JH	0.00603 JH*	High	High ICV/CCV recovery failure
20L0436	SB-2020-007:20-21.4-11042020	SW8270ESIM	Dibenzofuran	132-64-9	0.00723	JH	0.00723 JH*	High	High ICV/CCV recovery failure
20L0436	SB-2020-007:23-24.6-11042020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.00752	JH	0.00752 JH*	High	High ICV/CCV recovery failure
20L0436	SB-2020-007:23-24.6-11042020	SW8270ESIM	Dibenzofuran	132-64-9	0.00567	JH	0.00567 JH*	High	High ICV/CCV recovery failure
20L0436	SB-2020-008:20-11052020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.00379	JH	0.00379 JH*	High	High ICV/CCV recovery failure
20L0436	SB-2020-008:20-11052020	SW8270ESIM	Dibenzofuran	132-64-9	0.006	JH	0.00600 JH*	High	High ICV/CCV recovery failure
20L0436	SB-2020-014:18-11052020	SW8270ESIM	1-Methylnaphthalene	90-12-0	0.0006	JH	0.000600 JH*	High	Method blank detection
20L0436	SB-2020-014:18-11052020	SW8270ESIM	2-Methylnaphthalene	91-57-6	0.00064	UB	<0.000640 B*	High	Method blank detection
20L0436	SB-2020-014:18-11052020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.00027	JH	0.000270 JH*	High	High ICV recovery failure
20L0436	SB-2020-014:18-11052020	SW8270ESIM	Chrysene	218-01-9	0.00064	JH	0.000640 JH*	High	Method blank detection
20L0436	SB-2020-014:18-11052020	SW8270ESIM	Dibenzofuran	132-64-9	0.00024	JH	0.000240 JH*	High	High ICV recovery failure
20L0436	SB-2020-014:18-11052020	SW8270ESIM	Fluoranthene	206-44-0	0.0009	JH	0.000900 JH*	High	Method blank detection
20L0436	SB-2020-014:18-11052020	SW8270ESIM	Phenanthrene	85-01-8	0.00147	JH	0.00147 JH*	High	Method blank detection
20L0436	SB-2020-014:18-11052020	SW8270ESIM	Pyrene	129-00-0	0.00112	JH	0.00112 JH*	High	Method blank detection
20L0436	SB-2020-014:23-11052020	SW8270ESIM	1-Methylnaphthalene	90-12-0	0.0005	UB	<0.000500 B*	High	Method blank detection
20L0436	SB-2020-014:23-11052020	SW8270ESIM	2-Methylnaphthalene	91-57-6	0.0005	UB	<0.000500 B*	High	Method blank detection
20L0436	SB-2020-014:23-11052020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.00334	JH	0.00334 JH*	High	High ICV recovery failure
20L0436	SB-2020-014:23-11052020	SW8270ESIM	Fluoranthene	206-44-0	0.00094	JH	0.000940 JH*	High	Method blank detection
20L0436	SB-2020-014:23-11052020	SW8270ESIM	Phenanthrene	85-01-8	0.0005	UB	<0.000500 B*	High	Method blank detection
20L0436	SB-2020-014:23-11052020	SW8270ESIM	Pyrene	129-00-0	0.00106	JH	0.00106 JH*	High	Method blank detection
20L0437	SB-2020-013:20.5-11052020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.017	JH	0.0170 JH*	High	High ICV/CCV recovery failure
20L0437	SB-2020-013:20.5-11052020	SW8270ESIM	Dibenzofuran	132-64-9	0.00995	JH	0.00995 JH*	High	High ICV/CCV recovery failure
20L0437	SB-2020-013:23-11052020	SW8270ESIM	Benzo(ghi)perylene	191-24-2	0.00338	JH	0.00338 JH*	High	High ICV/CCV recovery failure
20L0437	SB-2020-013:23-11052020	SW8270ESIM	Dibenzofuran	132-64-9	0.00683	JH	0.00683 JH*	High	High ICV/CCV recovery failure

NOTES:
J* Estimated concentration due to quality control failures. Flag applied by Shannon & Wilson, Inc.
JL* Estimated concentration, biased low due to quality control failures. Flag applied by Shannon & Wilson, Inc.

Table 1 - November 2020 Result Flags

Work Order Number	SampleName	Method	Analyte	CAS	Result	QC Flag	Display	Bias	QCNote
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JH* Estimated concentration, biased high due to quality control failures. Flag applied by Shannon & Wilson, Inc.

B* Result is considered not detected due to quality control failures; see checklist for details. Flag applied by Shannon & Wilson, Inc.

CCV = continuing calibration verification sample; ICV = initial calibration verification sample; LCS = laboratory control sample; MS = matrix spike sample; MSD = matrix spike duplicate sample; RPD = relative percent difference.

LABORATORY DATA REVIEW CHECKLISTS

Laboratory Data Review Checklist

Completed By:

Reviewed by: Michael Jaramillo/ Validated by: Ashley Jaramillo

Title:

Environmental Chemist/ Senior Chemist

Date:

January 6, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

20K0101

Laboratory Report Date:

January 4, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

20K0101

Laboratory Report Date:

January 4, 2021

Report Name:

Lower Duwamish

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Correct analyses requested?

Yes ☐ No ☒ N/A ☐

Comments:

Specific methods were not clearly identified on the COC. The samples were analyzed for the correct analysis listed in the project Quality Assurance Project Plan (QAPP) with the following exceptions:

- Section 3.2 of the QAPP mentions the samples for metals analysis will be performed by method 200.8. Attachment 2B of the QAPP provide the laboratory limits for method SW6010. The laboratory reported samples for metals analysis by method SW6020. The methods 200.8, SW6010, and SW6020 have the same method of separation (inductively coupled plasma; ICP) but methods 200.8 and SW6020 use a mass spectrometry (MS) detector while method SW6010 uses atomic emission spectroscopy (AES). The laboratory reporting limits (RLs) are generally lower (but comparable) to than those listed in Attachment 2B of the QAPP. Sample results are not affected by this deviation from the QAPP.
- The QAPP identifies the analysis of polycyclic aromatic hydrocarbons (PAHs) were to be reported by EPA method SW8270D, with a few exceptions which were to be analyzed by EPA method SW8270D – selective ion monitoring (SIM). All analytes were reported by method SW8270E – SIM. The reported method is the most recent update to method SW8270 and the SIM detection method allows for lower RLs. The results are not considered affected by this deviation from the QAPP.

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐

Comments:

b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐

Comments:

c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐

Comments:

Samples were received in good condition.

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- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The number of sample containers received by the laboratory did not match the COC.

- One container was received for sample *HA-2020-005:0-11022020* while the COC listed two sample containers for this sample.
- Nine containers were received for sample *SB-2020-45:2.8-11032020* and *SB-2020-45:7.2-11032020* while the COC listed ten sample containers for this sample.

Sufficient sample was provided to perform the requested analyses. Sample results are not affected by this discrepancy.

- e. Data quality or usability affected?

Comments:

The data quality and usability were not affected.

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4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

Sample *SB-2020-029:6.8-11032020* was re-analyzed for polynuclear aromatic hydrocarbon (PAH) analysis by method SW8270E – SIM at a dilution due to “E” flagged compounds concentrations exceeding the upper calibration limits. The re-analyzed results were extracted within the method recognized holding time and are used for reporting purposes.

Initial and continuing calibrations for PAH analysis by method SW8270E-SIM were within method requirements, with the exception of SIH0304-SCV1 which is outside of control limits low for dibenzo(a,h)anthracene. In addition, the initial calibration verifications (ICVs) are outside control limits low for all laboratory control sample (LCS) compounds flagged with a “Q” qualifier. Associated detected results have also been flagged with a “Q” qualifier. No further corrective action was taken.

A matrix spike (MS) and matrix spike duplicate (MSD) for PAH analysis by method SW8270E-SIM were prepared in conjunction with project sample *SB -2020-001:6.8-11032020*. The MS and MSD have low spike recoveries for several flagged compounds. The results are advisory. Refer to section 6.c for further assessment.

Initial and continuing calibrations for volatile organic compound (VOC) analysis by method SW8260D were within method requirements, with the exception of the ICV which is outside of control limits low for cis-1,2-dichloroethene. Associated detected results and QC have been flagged with "Q" qualifiers. No further corrective action was taken.

The LCS and laboratory control sample duplicate (LCSD) for VOC analysis by method SW8260D had recoveries and relative percent difference (RPD) within control limits, with the exception of cis-1,2-dichloroethene which is outside of control limits low. This is likely a calibration bias. No corrective action was taken. Refer to section 6.b for further assessment.

Initial and continuing calibrations for polychlorinated biphenyls (PCBs) by method SW8082A were within method requirements, with the exception of flagged surrogates and Aroclors. All data was reported from passing columns. No corrective action was taken.

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

A MS, MSD, and laboratory duplicate samples were prepared in conjunction with sample HA-2020-007:0.25- 11022020 for total metals Universal Cell Technology™ (UCT) – Kinetic Energy Discrimination (KED) analysis by method SW6020A. The duplicate and MSD have high RPD for zinc. The MS and MSD have high spike recoveries, as well as natural concentrations of copper and nickel that are so much greater than the concentrations spiked that accurate determination of spike recovery is not possible, as post digest spike was prepared within QC limits. The MS/MSD have been flagged with "HC" qualifiers. The results are advisory. Refer to section 6.c for further assessment.

A MS, MSD, and laboratory duplicate samples were prepared in conjunction with sample HA-2020-007:0.25- 11022020 for total metals analysis by method SW6020A. The MS has high spike recoveries for barium and lead and low recovery for selenium, the MSD has high spike recovery for lead and low recovery for selenium, while both have natural concentrations of cadmium that are so much greater than the concentrations spiked that accurate determination of spike recovery is not possible. A post digest spike was prepared within QC limits. The MS/MSD has been flagged with "HC" qualifiers. The results are advisory. Refer to section 6.c for further assessment.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

Sample results that exceeded the laboratory calibration limits were re-analyzed at a dilution.

The laboratory applied "Q" flags to samples and QC samples affected by low ICV/CCV failures.

Additional corrective actions were not required.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

Except for the "Q" flagged results due to low ICV/CCV failures, the laboratory does not identify any effect on the data quality and usability. Refer to the subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

However, refer to Section 2.b for information regarding deviations from the QAPP.

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b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☒ No ☐ N/A ☐ Comments:

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

The analytes benzene, trichloroethene, vinyl chloride, dibenzo(a,h)anthracene, the Aroclors, and selenium had RLs greater than the WA Ecology preliminary cleanup level (PCUL) for at least one sample. We note that the method detection limits (MDLs) for benzene, trichloroethene, and selenium were below the PCUL and estimated detections between the RL and MDL (J-flagged detections) would allow for the comparison of these analytes to the PCUL.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

No analytes were detected in method blank samples above the RL; however, six analytes were detected in method blank samples below the RL, as described below.

The PAH analytes 1-methylnaphthalene, 2-methylnaphthalene, fluoranthene, fluorene, phenanthrene, and pyrene were detected in the method blank associated with preparation batch BIK0517.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples are considered affected if the samples are reported in the same preparation batch and have detections for the analytes at concentrations less than ten times the detection in the method blank sample. The following samples are considered affected by the method blank detections.

- Samples *SB-2020-028:6.8-11032020*, *SB-2020-029:7.5-11032020*, and *SB-2020-045:7.2-11032020* had detections for 1-methylnaphthalene, 2-methylnaphthalene, fluoranthene, and pyrene at concentrations less than five times the method blank detections. The sample results are considered non-detect and are flagged “UB” in the analytical database at the detected result or the RL, whichever value is greater.
- Samples *SB-2020-028:6.8-11032020* and *SB-2020-029:7.5-11032020* had detections for fluorene at concentrations less than five times the method blank detections. The sample results are considered non-detect and are flagged “UB” in the analytical database at the detected result or the RL, whichever value is greater.
- Samples *SB-2020-001:6.8-11032020* and *SB-2020-045:2.8-11032020* had detections for fluorene at concentrations less than ten times but greater than five times the method blank detection. The sample results are considered estimated, biased high, and are flagged “JH” in the analytical database.
- Samples *SB-2020-028:6.8-11032020*, *SB-2020-029:7.5-11032020*, and *SB-2020-045:7.2-11032020* had detections for phenanthrene at concentrations less than ten times but greater than five times the method blank detection. The sample results are considered estimated, biased high, and are flagged “JH” in the analytical database.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Refer to section 6.a.iii for applied qualifiers.

v. Data quality or usability affected?

Comments:

Yes; see above.

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b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS samples were reported for PAH, DRO, and PCB analysis. Refer to section 6.c for assessment of laboratory precision.

LCS/LCSD samples were reported for VOC and GRO analyses.

The method NWTPH-Dx does not require LCS/LCSD, MS/MSD, or laboratory duplicate QC information to be reported for RRO analysis. Refer to DRO analysis for assessment of laboratory precision and accuracy requirements for method NWTPH-Dx.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

An LCS and laboratory duplicate samples were reported for metals and mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The LCS and LCSD samples associated with preparation batch BIK0187 had low recoveries for cis-1,2-dichloroethene.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The laboratory duplicate sample associated with preparation batch BIK1097 had an RPD failure for zinc.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The project samples *SB-2020-045:2.8-11032020* and *SB-2020-045:7.2-11032020* are associated with the low LCS and LCSD recovery failures for cis-1,2-dichloroethene. The analyte was not detected in the project samples and the RL may not represent the true RL due to the low LCS/LCSD recoveries. The RLs are considered estimated and are flagged “UJ” in the analytical database to identify the QC failure.

The parent sample associated with the laboratory duplicate RPD failure for zinc is considered affected by the precision failure. The parent sample utilized for the laboratory duplicate sample was *HA-2020-007:0.25-11022020*. The sample results is considered estimated and is flagged “J” in the analytical database.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Refer to section 6.b.v for applied qualifiers.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

Yes; see above.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for PAH, DRO, and PCB analyses.

Refer to section 6.b for assessment of laboratory precision and accuracy for the remaining analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for metals and mercury analyses.

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- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The MS and MSD samples associated with preparation batch BIK0517 had low recoveries for fluoranthene, phenanthrene, and/or pyrene.

The MS and MSD samples associated with preparation batch BIK0197 had recovery failures for barium, chromium, copper, lead, nickel, selenium, and/or zinc.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The parent sample associated with the MS and MSD failures for fluoranthene, phenanthrene, and pyrene is considered affected by the precision failure. The parent sample utilized for the MS and MSD samples was *SB-2020-001:6.8-11032020*. The native concentration of these analytes are greater than one-half the spiking concentration. This may contribute a significant uncertainty to the recovery calculations and the MS recoveries may not be representative of method performance. The sample results are considered unaffected.

The parent sample associated with the MS and MSD failures for barium, chromium, copper, lead, nickel, selenium, and zinc is considered affected by the precision failure. The parent sample utilized for the MS and MSD samples was *HA-2020-007:0.25-11022020*. The native concentration of barium, chromium, copper, lead, nickel, and zinc are greater than one-half the spiking concentration. This may contribute a significant uncertainty to the recovery calculations and the MS recoveries may not be representative of method performance. However, the low MS and MSD recovery failures for selenium affect the sample results. The analyte was not detected; the non-detect result is considered estimated and is flagged “UJ” in the analytical database.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Refer to section 6.c.v for applied qualifiers.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

Yes; see above.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The PCB surrogate tetrachloro-m-xylene was not reported for sample *HA-2020-002:0-11022020* due to chromatographic interference. However, the remaining surrogates were reported within acceptance criteria. The sample results are not affected by the surrogate recovery failure.

The DRO/RRO surrogate o-terphenyl was not reported for sample *A1-02A:18-11032020* due to sample dilution. Sample results are not affected by surrogate recovery failures attributed to sample dilution.

The PCB surrogate 2C-tetrachloro-m-xylene had a low recovery failure for sample *TSA-2020-003:1.5-11032020*. The sample was re-analyzed at a dilution due to sample concentrations exceeding the instrument upper calibration range. The re-analyzed sample results are used for reporting purposes.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☒ N/A ☐

Comments:

Sample results are not affected; refer to section 6.d.ii for assessment.

iv. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

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e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☒ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

No analytes were detected in trip blank sample above the RL; however, toluene was detected in trip blank sample below the RL.

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

Samples are considered affected if the samples have detections for toluene at concentrations less than ten times the detection in the trip blank sample. The samples *SB-2020-045:2.8-11032020* and *SB-2020-045:7.2-11032020* had detections for toluene at concentrations less than ten times but greater than five times the trip blank detection. The sample results are considered estimated, biased high, and are flagged "JH" in the analytical database.

- v. Data quality or usability affected?

Comments:

Yes; see above.

f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

Sample *HA-2020-100:0.2-11022020* is a field duplicate of sample *HA-2020-003:0.2-11022020*.
Sample *A1-100:5-11032020* is a field duplicate of sample *A1-02A:5-11032020*.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☒ N/A ☐ Comments:

The field duplicate RPDs were within the project specified DQO of 50%, with the following exceptions:

- *A1-02A:5-11032020/A1-100:5-11032020* – The field duplicate RPDs for DRO and RRO are outside the project-specified DQO. The sample results are considered estimated and are flagged “J” in the analytical database.
- *HA-2020-003:0.2-11022020/HA-2020-100:0.2-11022020* – The field duplicate RPD for nickel is outside the project-specified DQO. The sample results are considered estimated and are flagged “J” in the analytical database.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

Yes; see above.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not collected with reusable equipment. An equipment blank was not required for this work order.

- i. All results less than RL and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank was not required for this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not required for this work order.

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iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory flagged the PCB analyte Aroclor-1254 results "P1" for samples *HA-2020-002:0-11022020*, *HA-2020-003:0.2-11022020*, and *HA-2020-100-0.2-11022020* due to a precision failure between the primary and confirmation column results. The flags were converted to "J" in the analytical database to identify the imprecision.

The laboratory flagged the PCB analyte Aroclor-1260 results "P1" for samples *HA-2020-002:0-11022020*, *HA-2020-100:0.2-11022020*, and *TSA-2020-003:1.5-11032020* due to a precision failure between the primary and confirmation column results. The flags were converted to "J" in the analytical database to identify the imprecision.

The laboratory flagged the PCB analytes benzo(j)fluoranthene and dibenzo(a,h)anthracene and the surrogate dibenzo(a,h)anthracene-d14 results "Q" for several project samples and the LCS, MS, and MSD for preparation batch BIK0517 due to low ICV failures. However, the precision and accuracy for these analytes and surrogate were demonstrated within laboratory acceptance criteria in the LCS, MS, and MSD samples. The laboratory qualifier was removed from the samples in the analytical database.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Michael Jaramillo/ Validated by: Ashley Jaramillo

Title:

Environmental Chemist/ Senior Chemist

Date:

January 12, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

20K0117

Laboratory Report Date:

January 4, 2021

Report Name:

Lower Duwamish

Project Number

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20K0117

Laboratory Report Date:

January 4, 2021

Report Name:

Lower Duwamish

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Correct analyses requested?

Yes ☐ No ☒ N/A ☐

Comments:

Specific methods were not clearly identified on the COC. The samples were analyzed for the correct analysis listed in the project Quality Assurance Project Plan (QAPP) with the following exceptions:

- Section 3.2 of the QAPP mentions the samples for metals analysis will be performed by method 200.8. Attachment 2B of the QAPP provide the laboratory limits for method SW6010. The laboratory reported samples for metals analysis by method SW6020. The methods 200.8, SW6010, and SW6020 have the same method of separation (inductively coupled plasma; ICP) but methods 200.8 and SW6020 use a mass spectrometry (MS) detector while method SW6010 uses atomic emission spectroscopy (AES). The laboratory reporting limits (RLs) are generally lower (but comparable) to than those listed in Attachment 2B of the QAPP. Sample results are not affected by this deviation from the QAPP.
- The QAPP identifies the analysis of polycyclic aromatic hydrocarbons (PAHs) were to be reported by EPA method SW8270D, with a few exceptions which were to be analyzed by EPA method SW8270D – selective ion monitoring (SIM). All analytes were reported by method SW8270E – SIM. The reported method is the most recent update to method SW8270 and the SIM detection method allows for lower RLs. The results are not considered affected by this deviation from the QAPP.

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐

Comments:

b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐

Comments:

c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐

Comments:

Samples were received in good condition.

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- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The number of sample containers received by the laboratory did not match the COC.

- Sample A2-07A:18-11052020 had smeared labels on vials. The sample was identified by the laboratory by process of elimination.
- Sample SB-2020-008:11.5-11052020 was determined to be labeled incorrectly on the sample containers. The correct sample name was logged based on the number of containers, sample times, and dates listed on the COC.

Sufficient sample was provided to perform the requested analyses. Sample results are not affected by this discrepancy.

- e. Data quality or usability affected?

Comments:

The data quality and usability were not affected.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

Initial and continuing calibrations for volatile organic compounds (VOCs) by method SW8260D were within method requirements, with the exception of the ICV which is outside of control limits low for cis-1,2-Dichloroethene. Associated detected results and QC have been flagged with "Q" qualifiers. No further corrective action was taken.

The laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) for VOC analysis by method SW8260D have low spike recoveries for cis-1,2-dichloroethene which is likely due to calibration bias. The LCSD also has high percent recovery for tetrachloroethene. No corrective action was taken. Refer to section 6.b for further assessment.

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

Several samples were reanalyzed at dilutions for polynuclear aromatic hydrocarbon (PAH) analysis by method SW8270E-selective ion monitoring (SIM) due to "E" flagged compound concentrations exceeding the upper calibration limits. No further corrective action was taken. The re-analyzed results were extracted within the method recognized holding time and are used for reporting purposes.

Initial and continuing calibrations for PAH analysis by method SW8270E-SIM were within method requirements, with the exception of SIH0304-SCV1 which is outside of control limits low for dibenzo(a,h)anthracene. In addition, the initial calibration verifications (ICVs) are outside control limits low. Associated detected results have also been flagged with a "Q" qualifier. No further corrective action was taken.

The method blank BIK0557-BLK1 for PAH analysis by method SW8270E-SIM has a detection for pyrene above the reporting limit. Associated detected results with concentrations 10x the contamination have been flagged with "B" qualifiers, samples with less than 10x the contamination were reanalyzed on a new batch. No further corrective action was taken. Refer to section 6.a for further assessment.

The matrix spike (MS) and matrix spike duplicate (MSD) for diesel range organics (DRO) by method NWTPHDx were prepared in conjunction with sample *SB -2020-016:2-11042020*. The matrix spike duplicate has low spike recovery DRO. The results are advisory. No corrective action taken. Refer to section 6.c for further assessment.

Initial and continuing calibrations for polychlorinated biphenyls (PCBs) by method SW8082A were within method requirements, with exception of SIL0088-SCV1/SCV3/SVC5 which are outside of control limits high for the second column surrogate Decachlorobiphenyl. Data was reported from passing columns. No corrective action was taken.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

Sample results that exceeded the laboratory calibration limits were re-analyzed at a dilution.

The laboratory applied "Q" flags to samples and QC samples affected by low ICV/CCV failures.

Sample results with detections for pyrene less than ten times the method blank detection were reanalyzed under a different preparation batch.

Additional corrective actions were not required.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

Except for the "Q" flagged results due to low ICV/CCV failures, the laboratory does not identify any effect on the data quality and usability. Refer to the subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

However, refer to Section 2.b for information regarding deviations from the QAPP.

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☒ No ☐ N/A ☐ Comments:

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

The analytes benzene, tetrachloroethene, trichloroethene, vinyl chloride, dibenzo(a,h)anthracene, the Aroclors, and selenium had RLs greater than the WA Ecology preliminary cleanup level (PCUL) for at least one sample. We note that the method detection limits (MDLs) for benzene, trichloroethene, and selenium were below the PCUL and estimated detections between the RL and MDL (J-flagged detections) would allow for the comparison of these analytes to the PCUL.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, with the exception of tetrachloroethene, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Pyrene was detected in the PAH method blank associated with preparation batch BIK0557 at a concentration greater than the RL. In addition, the following analytes were detected in method blank samples below the RL.

The PAH analytes benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(j)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, indeno(1,2,3-c,d)pyrene, and phenanthrene were detected in the method blank associated with preparation batch BIK0557.

The PAH analytes benzo(g,h,i)perylene, fluoranthene, phenanthrene, and pyrene were detected in the method blank associated with preparation batch BIL0296.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples are considered affected if the samples are reported in the same preparation batch and have detections for the analytes at concentrations less than ten times the detection in the method blank sample.

- Affected samples with concentrations less than five times the method blank detections are considered non-detect results are flagged “UB” in the analytical database at the detected result or the RL, whichever value is greater.
- Affected samples with concentrations less than ten times but greater than five times the method blank detections are considered estimated, biased high, and are flagged “JH” in the analytical database.
- Refer to the following table for affected samples and applied qualifiers.

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Analyte	Sample ID	Flag	Analyte	Sample ID	Flag
Benz(a)anthracene	SB-2020-005:1-11042020	JH	Benzo(k)fluoranthene	SB-2020-005:1-11042020	UB
	SB-2020-005:12-11042020	UB		SB-2020-005:12-11042020	UB
	SB-2020-007:1.2-2.8-11042020	JH		SB-2020-007:1.2-2.8-11042020	UB
	SB-2020-015:13-11042020	UB		SB-2020-015:7-11042020	UB
	SB-2020-015:7-11042020	UB		SB-2020-016:2-11042020	UB
	SB-2020-016:12-11042020	UB		SB-2020-016:7-11042020	UB
	SB-2020-016:2-11042020	UB		SB-2020-005:1-11042020	JH
	SB-2020-016:7-11042020	UB		SB-2020-005:12-11042020	UB
Benzo(a)pyrene	SB-2020-005:1-11042020	UB	Chrysene	SB-2020-007:1.2-2.8-11042020	JH
	SB-2020-005:12-11042020	UB		SB-2020-015:13-11042020	UB
	SB-2020-007:1.2-2.8-11042020	UB		SB-2020-015:7-11042020	UB
	SB-2020-015:13-11042020	UB		SB-2020-016:12-11042020	UB
	SB-2020-015:7-11042020	UB		SB-2020-016:2-11042020	UB
	SB-2020-016:12-11042020	UB		SB-2020-016:7-11042020	JH
	SB-2020-016:2-11042020	UB		SB-2020-005:1-11042020	JH
	SB-2020-016:7-11042020	JH		SB-2020-005:12-11042020	UB
Benzo(b)fluoranthene	SB-2020-005:1-11042020	JH	Fluoranthene	SB-2020-007:1.2-2.8-11042020	JH
	SB-2020-005:12-11042020	UB		SB-2020-015:13-11042020	UB
	SB-2020-007:1.2-2.8-11042020	JH		SB-2020-015:7-11042020	UB
	SB-2020-015:13-11042020	UB		SB-2020-016:12-11042020	UB
	SB-2020-015:7-11042020	UB		SB-2020-016:2-11042020	UB
	SB-2020-016:12-11042020	UB		SB-2020-005:1-11042020	UB
	SB-2020-016:2-11042020	UB		SB-2020-005:12-11042020	UB
	SB-2020-016:7-11042020	JH		SB-2020-007:1.2-2.8-11042020	UB
Benzo(g,h,i)perylene	SB-2020-005:1-11042020	UB	Indeno(1,2,3-cd)pyrene	SB-2020-015:13-11042020	UB
	SB-2020-005:12-11042020	UB		SB-2020-015:7-11042020	UB
	SB-2020-007:1.2-2.8-11042020	UB		SB-2020-016:12-11042020	UB
	SB-2020-014:11-11052020	JH		SB-2020-016:2-11042020	UB
	SB-2020-015:13-11042020	UB		SB-2020-016:7-11042020	JH
	SB-2020-015:7-11042020	UB	Phenanthrene	SB-2020-015:7-11042020	UB
	SB-2020-016:12-11042020	JH		SB-2020-005:1-11042020	JH
	SB-2020-016:2-11042020	UB		SB-2020-005:12-11042020	UB
	SB-2020-016:7-11042020	JH		SB-2020-007:1.2-2.8-11042020	JH
	SB-2020-100:11-11052020	JH		SB-2020-015:13-11042020	UB
Benzo(j)fluoranthene	SB-2020-005:1-11042020	UB	Pyrene	SB-2020-015:7-11042020	UB
	SB-2020-005:12-11042020	UB		SB-2020-016:12-11042020	UB
	SB-2020-007:1.2-2.8-11042020	UB		SB-2020-016:2-11042020	UB
	SB-2020-015:7-11042020	UB		SB-2020-016:7-11042020	JH
	SB-2020-016:12-11042020	UB			
	SB-2020-016:2-11042020	UB			
	SB-2020-016:7-11042020	UB			

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Refer to section 6.a.iii for applied qualifiers.

v. Data quality or usability affected?

Comments:

Yes; see above.

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b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS samples were reported for PAH, DRO, and PCB analysis. Refer to section 6.c for assessment of laboratory precision.

LCS/LCSD samples were reported for VOC and GRO analyses.

The method NWTPH-Dx does not require LCS/LCSD, MS/MSD, or laboratory duplicate QC information to be reported for RRO analysis. Refer to DRO analysis for assessment of laboratory precision and accuracy requirements for method NWTPH-Dx.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

An LCS and laboratory duplicate samples were reported for metals and mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The LCS and LCSD samples associated with preparation batch BIK0249 had low recoveries for cis-1,2-dichloroethene. In addition, the LCSD had a high recovery for tetrachloroethene.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The project samples SB-2020-005:1-11042020, SB-2020-005:6-11042020, SB-2020-005:12-11042020, SB-2020-008:2-11052020, SB-2020-008:5.5-11052020, SB-2020-008:11.5-11052020, SB-2020-014:1.5-11052020, SB-2020-014:7-11052020, SB-2020-014:11-11052020, SB-2020-015:1-11042020, SB-2020-015:7-11042020, SB-2020-015:13-11042020, SB-2020-016:2-11042020, SB-2020-016:7-11042020, and SB-2020-016:12-11042020 are associated with the low LCS and LCSD recovery failures for cis-1,2-dichloroethene. The results are considered estimated, biased low, and detected results are flagged “JL” and non-detect results are flagged “UJ” in the analytical database to identify the QC failure.

The project samples SB-2020-005:1-11042020, SB-2020-005:6-11042020, SB-2020-005:12-11042020, SB-2020-008:2-11052020, SB-2020-008:5.5-11052020, SB-2020-008:11.5-11052020, SB-2020-014:1.5-11052020, SB-2020-014:7-11052020, SB-2020-014:11-11052020, SB-2020-015:1-11042020, SB-2020-015:7-11042020, SB-2020-015:13-11042020, SB-2020-016:2-11042020, SB-2020-016:7-11042020, and SB-2020-016:12-11042020 are associated with the high LCSD recovery failure for tetrachloroethene. However, only the samples SB-2020-008:5.5-11052020, SB-2020-014:7-11052020, SB-2020-015:1-11042020, and SB-2020-015:7-11042020 had detections for the analyte and are affected by the high LCSD recovery failure for this analyte. The sample results are considered estimated, biased high, and flagged “JH” in the analytical database to identify the QC failure.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Refer to section 6.b.v for applied qualifiers.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

Yes; see above.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for PAH, DRO, and PCB analyses.

Refer to section 6.b for assessment of laboratory precision and accuracy for the remaining analyses.

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ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for metals and mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The MS recovery for DRO prepared from parent sample A2-07A:12-11052020 was recovered low. However, the native sample result is much larger than the spiked amount, therefore data quality and/or usability not affected.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

See above.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

Data quality and usability were not affected; see above.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

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- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

- iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Surrogates were within laboratory acceptance criteria.

- iv. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☒ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

No analytes were detected in trip blank sample above the RL; however, toluene was detected in trip blank sample below the RL.

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iv. If above RL or project specified objectives, what samples are affected?

Comments:

Samples are considered affected if the samples have detections for the analytes at concentrations less than ten times the detection in the method blank sample.

- Samples *SB-2020-005:1-11042020*, *SB-2020-005:6-11042020*, *SB-2020-005:12-11042020*, *SB-2020-008:2-11052020*, *SB-2020-008:5.5-11052020*, *SB-2020-015:13-11042020*, *SB-2020-016:7-11042020*, and *SB-2020-016:12-11042020* have detections for toluene at concentrations less than five times the trip blank detection. The results are considered non-detect and are flagged “UB” in the analytical database at the detected result or the RL, whichever value is greater.

v. Data quality or usability affected?

Comments:

Yes; see above.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐

Comments:

Sample *SB-2020-100:11-11052020* is a field duplicate of sample *SB-2020-014:11-11052020*.iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☒ N/A ☐

Comments:

The field duplicate RPDs were within the project specified DQO of 50%, with the following exceptions. GRO, DRO, RRO, Aroclor-1254, Aroclor-1260, ethylbenzene, m&p-xylene, o-xylene, toluene, total xylenes, acenaphthene, and anthracene had field duplicate RPDs outside QC criteria. The sample results are considered estimated and are flagged “J” in the analytical database.

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iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

Yes; see above.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not collected with reusable equipment. An equipment blank was not required for this work order.

i. All results less than RL and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank was not required for this work order.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not required for this work order.

iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory flagged the VOC analyte cis-1,2-dichloroethene results "Q" for samples *SB-2020-014:1.5-11052020*, *SB-2020-014:7-11052020*, and *SB-2020-014:11-11052020*. However, the analyte was previously qualified due to LCS and LCSD recovery failures. Refer to section 6.b for applied qualifiers.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Michael Jaramillo / Validated by: Kristen Freiburger

Title:

Senior Chemist / Associate

Date:

February 23, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

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February 23, 2021

Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples for grain size analysis were transferred to Materials Testing & Consulting, Inc.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Correct analyses requested?

Yes ☐ No ☒ N/A ☐

Comments:

Specific methods were not clearly identified on the COC. The samples were analyzed for the correct analysis listed in the project Quality Assurance Project Plan (QAPP) with the following exceptions:

- Section 3.2 of the QAPP mentions the samples for metals analysis will be performed by method 200.8. Attachment 2B of the QAPP provide the laboratory limits for method SW6010. The laboratory reported samples for metals analysis by method SW6020. The methods 200.8, SW6010, and SW6020 have the same method of separation (inductively coupled plasma; ICP) but methods 200.8 and SW6020 use a mass spectrometry (MS) detector while method SW6010 uses atomic emission spectroscopy (AES). The laboratory reporting limits (RLs) are generally lower (but comparable) to than those listed in Attachment 2B of the QAPP. Sample results are not considered affected.
- The QAPP identifies the analysis of polycyclic aromatic hydrocarbons (PAHs) were to be reported by EPA method SW8270D, with a few exceptions which were to be analyzed by EPA method SW8270D – selective ion monitoring (SIM). All analytes were reported by method SW8270E – SIM. The reported method is the most recent update to method SW8270 and the SIM detection method allows for lower RLs. The results are not considered affected by this deviation from the QAPP.

The report was revised to include analytes/analyses not initially reported.

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐

Comments:

b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐

Comments:

c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐

Comments:

Samples were received in good condition.

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- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☒ N/A ☐ Comments:

There were no discrepancies reported by the laboratory.

- e. Data quality or usability affected?

Comments:

The data quality and usability were not affected.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

Initial and continuing calibrations for volatile organic compounds (VOCs) by method SW8260D were within method requirements, with the exception of the ICV which is outside of control limits (low) for cis-1,2-dichloroethene. Associated detected results and QC have been flagged with "Q" qualifiers. No further corrective action was taken.

The laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) for VOC analysis by method SW8260D have low spike recoveries for cis-1,2-dichloroethene which is likely due to calibration bias. The LCSD also has high percent recovery for tetrachloroethene. No corrective action was taken. Refer to section 6.b for further assessment.

Sample *SB-2020-004:21-110620020* was reanalyzed for polynuclear aromatic hydrocarbon (PAH) analysis by method SW8270E-selective ion monitoring (SIM) at a dilution due to "E" flagged compound concentrations exceeding the upper calibration limits. No further corrective action was taken. The re-analyzed results were extracted within the method recognized holding time and are used for reporting purposes.

Matrix spike (MS) and matrix spike duplicate (MSD) samples for PAH analysis by method SW8270E-SIM were prepared in conjuncture with sample *EB-1-11052020*. The MSD has a high recovery for benzo(b)fluoranthene and total benzofluoranthenes. Results are advisor. No corrective action was taken. Refer to section 6.c for further assessment.

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

In addition to the discrepancies reported above, the case narrative also notes the following.

MS and MSD samples for diesel range organics (DRO) analysis by method NWTPH-Dx were prepared in conjunction with samples *SB-2020-013:11.5-11052020* and *SB-2020-004:2.5-11062020*. The MSD has low spike recovery. The results are advisory. No corrective action was taken. Refer to section 6.c for further assessment.

Initial and continuing calibrations were within method requirements for polychlorinated biphenyl (PCB) analysis by method SW8082A, with exception of SIL0088-SCV1/SCV3/SVC5 which are outside of control limits (high) for the surrogate decachlorobiphenyl. The calibrations were reanalyzed until there was a passing column. Data was reported from passing columns. No corrective action was taken.

MS, MSD, and laboratory duplicates were prepared in conjunction with sample *SB-2020-013:1.5-11052020* for metals analysis by EPA method 6020A. The duplicate has high relative percent difference (RPD) for chromium, barium and selenium and a concentration of silver less than or equal to five times the reporting limits and the replicate control limit defaults to +/- the reporting limit instead of 20% of the RPD. The duplicate has been flagged with an "L" qualifier. The MS has high spike recovery for chromium and barium, and the MSD has high spike recovery for lead and barium. Post digest spikes were prepared within QC limits. The results are advisory. No further corrective action was taken. Refer to Section 6.c for further assessment.

MS, MSD, and laboratory duplicates were prepared in conjunction with samples *SB-2020-013:1.5-11052020* and *EB-1-11052020* for metals analysis by EPA method 6020A. The duplicate has a high RPD for arsenic. The MS and MSD have high spike recoveries and RPD for nickel. A post spike digest was prepared within QC limits. The results are advisory. No further corrective action was taken. Refer to section 6.c for further assessment.

Samples *SB-2020-004:8-11062020*, *SB-2020-004:17-11062020*, and *SB-2020-101:17-11062020* did not have sufficient fines for the pipette portion of the size grain analysis. The samples could not be split to reach the required amount of fines while staying within the capacity of the balance. The samples have been qualified on the QA summary.

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c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

Sample results that exceeded the laboratory calibration limits were re-analyzed at a dilution.

The laboratory applied “Q” flags to samples and QC samples affected by low ICV/CCV failures. While ICV and CCV failures are beyond the scope of a Level II data validation, the low recovery failures were qualified uniformly. Project samples with detections for cis-1,2-dichloroethene are qualified with a “JL” in the analytical database to identify the potential low bias.

Additional corrective actions were not required.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

Except for the “Q” flagged and “L” flagged results noted above, the laboratory does not identify any effect on the data quality and usability. Refer to the subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☐ No ☒ N/A ☐ Comments:

Refer to Section 2.b for information regarding deviations from the QAPP.

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☒ No ☐ N/A ☐ Comments:

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

The analytes benzene, tetrachloroethene, trichloroethene, vinyl chloride, dibenzo(a,h)anthracene, and the Aroclors had RLs greater than the WA Ecology preliminary cleanup level (PCUL) for at least one sample. We note that the method detection limits (MDLs) for benzene and trichloroethene were below the PCUL and estimated detections between the RL and MDL (J-flagged detections) would allow for the comparison of these analytes to the PCUL.

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e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, with the exception of tetrachloroethene, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

No analytes were detected in the method blank sample above the RL; however, the following analytes were detected in the referenced method blank sample below the RL.

- Fluorene was detected in the PAH water method blank associated with preparation batch BIK0354.
- Acenaphthene and anthracene were detected in the PAH soil method blank associated with preparation batch BIK0636.
- Benzo(g,h,i)perylene, fluoranthene, phenanthrene, and pyrene were detected in the PAH soil method blank associated with preparation batch BIL0296.
- Mercury was detected in the water (total mercury) method blank associated with preparation batch BIK0295.
- Chromium, iron, and magnesium were detected in the dissolved metals water method blank associated with preparation batch BIK0591.
- Iron was detected in the total metals water method blank associated with preparation BJB0514.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples are considered affected if the samples are reported in the same preparation batch and have detections for the analytes at concentrations less than ten times the detection in the method blank sample. The following samples are affected by the method blank detections:

- Sample *SB-2020-004:13-11062020* had a detection for acenaphthene at a concentration less than five times the method blank detection. The sample result is considered non-detect and is flagged “UB” in the analytical database at the RL.
- Sample *MS/MSD-SB-2020-004:13-11062020* had a detection for acenaphthene at a concentration less than ten times but greater than five times the method blank detection. The result is considered estimated, biased high, and is flagged “JH” in the analytical database.
- Sample *MS/MSD-SB-2020-004:13-11062020* had a detection for anthracene at a concentration less than five times the method blank detection. The sample result is considered non-detect and is flagged “UB” in the analytical database at the RL.
- Sample *SB-2020-004:17-11062020* had a detection for anthracene at a concentration less than ten times but greater than five times the method blank detection. The result is considered estimated, biased high, and is flagged “JH” in the analytical database.
- Sample *EB-3-11062020* had a detection for mercury at a concentration less than five times the method blank detection. The sample result is considered non-detect and is flagged “UB” in the analytical database at the RL.
- Sample *EB-1-11052020* had a detection for dissolved chromium at a concentration less than five times the method blank detection. The sample result is considered non-detect and is flagged “UB” in the analytical database at the detected result.
- Samples *EB-2-11062020* and *EB-3-11062020* had detections for dissolved magnesium at a concentrations less than five times the method blank detection. The sample results are considered non-detect and are flagged “UB” at the detected RL.
- Samples *EB-1-11052020* and *EB-3-11062020* had detections for total iron at a concentration less than five times the method blank detection. The sample results are considered non-detect and are flagged “UB” in the analytical database at the detected result or the RL, whichever value is greater.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Refer to section 6.a.iii for applied qualifiers.

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v. Data quality or usability affected?

Comments:

Yes; see above.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS samples were reported for PAH, DRO (BIK0587), and PCB analysis. Refer to section 6.c for assessment of laboratory precision. We have no measure of laboratory precision for PCB analysis associated with preparation batch BIK0588. Refer to the MS/MSD section below for precision assessment for the other analytes.

LCS/LCSD samples were reported for VOC, GRO, and DRO (BIK0629) analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

An LCS and laboratory duplicate samples were reported for metals and mercury analyses, excluding preparation batch BIK0509 for metals analysis. Only an LCS was provided for preparation batch BIK0509; we have no measure of laboratory precision for metals analysis for this preparation batch.

Triplicate samples were reported for size grain analysis for the purposes of assessing precision.

An LCS was reported for total organic carbon (TOC). We have no measure of laboratory precision for TOC analysis.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The LCS and/or LCSD samples associated with preparation batch BIK0249 had low recoveries for cis-1,2-dichloroethene. In addition, the LCSD had a high recovery for tetrachloroethene; the analyte was not detected in the project samples and the data is unaffected by the high recovery.

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The metals laboratory duplicate sample associated with preparation batch BIK0569 had RPD failures for arsenic, barium, chromium, selenium, and silver.

The metals laboratory duplicate sample associated with preparation batch BJB0514 had an RPD failure for iron.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The project samples *SB-2020-004:2.5-11062020*, *SB-2020-004:8-11062020*, *SB-2020-004:13-11062020*, and *MS/MSD-SB-2020-004:13-11062020* are associated with the low LCS and LCSD recovery failures for cis-1,2-dichloroethene. The results are considered estimated, biased low, and detected results are flagged “JL” and non-detect results are flagged “UJ” in the analytical database to identify the QC failure. However, sample *SB-2020-004:8-11062020* was re-extracted due to a surrogate recovery failure. The re-extraction result for this analyte was used for reporting purposes and is not affected by the low LCS and LCSD recovery failures.

The parent sample *SB-2020-013:1.5-11052020* is associated with the laboratory duplicate sample RPD failures. The analytes arsenic, barium, chromium, and selenium results are considered estimated and flagged “J” in the analytical database to identify the QC failures. The analyte silver is not considered affected due to the application of the “L” flag by the laboratory indicating “analyte concentration is ≤ 5 times the reporting limit and the replicate control limit defaults to $\pm$ RL instead of 20% RPD.”

The parent sample *EB-1-11052020* is not affected by the iron laboratory duplicate RPD failure due to the application of the “L” flag by the laboratory. See above for description.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Refer to section 6.b.v for applied qualifiers.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

Yes; see above.

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c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for PAH, DRO, and PCB analyses, except for PCB analysis associated with preparation batch BIK0588. We have no measure of laboratory precision for PCB analysis associated with preparation batch BIK0588.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for metals and mercury analyses, except for metals analysis associated with preparation batch BIK0509. We have no measure of laboratory precision for metals analysis associated with preparation batch BIK0509.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The MSD for PAH analysis associated with preparation batch BIK0354 had high recovery failures for benzo(b)fluoranthene and total benzofluoranthenes.

The MS for PAH analysis associated with preparation batch BIK0636 had high recovery failures for 1-methylnaphthalene, 2-methylnaphthalene, acenaphthene, naphthalene, and phenanthrene. The MSD had high recovery failures for 1-methylnaphthalene and naphthalene and low recovery failures for fluoranthene, phenanthrene, and pyrene.

The MS for PCB analysis associated with preparation batch BIK0633 had low recovery failures for Aroclor-1016 and Aroclor-1260.

The MS for metals analysis associated with preparation batch BIK0569 had a low recovery failure for barium and a high recovery failure for chromium. The MSD had a low recovery failure for barium and high recovery failures for lead and nickel.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The MS/MSD for PAH analysis associated with preparation batch BIK0636 had an RPD failure for acenaphthene.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The parent sample *EB-1-11052020* was utilized to prepare the MS and MSD for PAH analysis associated with preparation batch BIK0354. The sample did not have detections for benzo(b)fluoranthene and total benzo(b)fluoranthenes. The sample result is not affected by the high MSD recovery failures for these analytes.

The parent sample *SB-2020-004:8-11062020* was utilized to prepare the MS and MSD for PAH analysis associated with preparation batch BIK0636. The native concentration of analytes with MS and MSD recovery failures are greater than one-half the spiking concentration. This may contribute a significant uncertainty to the recovery calculations and the MS recoveries and RPDs may not be representative of method performance. The sample results are considered unaffected.

The parent sample *SB-2020-004:8-11062020* was utilized to prepare the MS and MSD for PCB analysis associated with preparation batch BIK0633. The parent sample and MS/MSD samples were reported at a dilution due to high concentrations of target analytes. This may contribute a significant uncertainty to the recovery calculations and the MS/MSD recovery failures may not be representative of method performance. The sample results are considered unaffected.

The parent sample *SB-2020-004:8-11062020* was utilized to prepare the MS and MSD for metals analysis associated with preparation batch BK0569. The native concentration of analytes with MS and MSD recovery failures are greater than one-half the spiking concentration. This may contribute a significant uncertainty to the recovery calculations and the MS recoveries may not be representative of method performance. The sample results are considered unaffected.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☒ N/A ☐ Comments:

See above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

No; see above.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

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- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

Sample SB-2020-004:8-11062020 had a low surrogate recovery failure for the VOC surrogate 4-bromofluorobenzene. The sample was re-extracted within hold time and reanalyzed with surrogate recovery failures within QC criteria. The re-extraction results are used for reporting purposes and the reported results are not affected by the low surrogate recovery failure.

- iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Surrogates were within laboratory acceptance criteria for reported results.

- iv. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☒ N/A ☐ Comments:

- iii. All results less than RLs and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

No analytes were detected in trip blank sample.

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; target analytes were not detected in the trip blank.

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v. Data quality or usability affected?

Comments:

Data quality and usability are not affected; see above.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐

Comments:

Sample SB-2020-101:17-11062020 is a field duplicate of sample SB-2020-004:17-11062020.

iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☒ N/A ☐

Comments:

The field duplicate RPDs were within the project specified soil DQO of 50%, with the following exceptions. The analytes 1-methylnaphthalene, 2-methylnaphthalene, acenaphthene, acenaphthylene, anthracene, benzo(a)anthracene, benzo(g,h,i)perylene, chrysene, dibenzofuran, fluoranthene, fluorene, phenanthrene, pyrene, and TOC had field duplicate RPDs outside QC criteria. The sample results are considered estimated and are flagged “J” in the analytical database for the duplicate pair.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

Yes; see above.

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- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

Equipment blank samples *EB-1-11052020* (sample collected from the water used by drillers to decon drilling equipment, not the sampling equipment used for soil borings), *EB-2-11062020* (collected from soil boring sampling equipment after decon and rinse 1), and *EB-3-11062020* (collected from soil boring sampling equipment after decon, rinse 1, and final rinse) were collected for this project.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

The following analytes were detected in the equipment blank samples at concentrations greater than the MDL (concentrations below the RL are estimated): naphthalene, arsenic, barium, chromium, copper, manganese, nickel, vanadium, zinc, dissolved antimony, dissolved arsenic, dissolved barium, dissolved copper, dissolved magnesium, dissolved manganese, dissolved nickel, dissolved vanadium, and dissolved zinc were detected in the equipment blank sample *EB-1-11052020*. However, iron and dissolved chromium were considered non-detect due to a method blank detection. Detections for dissolved chromium and iron for equipment blank sample *EB-1-11052020* are the result of laboratory contamination, as is noted in the method blank detections.

The analytes toluene, manganese, zinc, dissolved manganese, and dissolved zinc were detected in the equipment blank sample *EB-2-11062020* at estimated concentrations below the RL.

The analytes iron, mercury, zinc, and dissolved magnesium were detected in the equipment blank sample *EB-3-11062020* at estimated concentrations below the RL. However, we note that iron, mercury, and dissolved magnesium are considered non-detect due to a method blank detection.

Project samples are not affected by the equipment blank detections observed in these samples.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

Based on conversations with the PM, the equipment blank samples were provided to assess effectiveness of the initial and subsequent decontamination procedures (see descriptions above). The possibility of cross contamination based on the equipment blank concentrations and the associated concentrations observed in the soil samples is negligible. Sample results are not affected by the equipment blank detections.

- iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒ Comments:

Additional data flags and qualifiers were not required.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Michael Jaramillo/ Validated by: Kristen Freiburger

Title:

Senior Chemist / Associate

Date:

January 14, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

20L0098

Laboratory Report Date:

January 4, 2021

Report Name:

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Project Number

21-1-12596-035

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Note: Any N/A or No box checked must have an explanation in the comments box.1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

The samples reported in this work order were initially submitted to the laboratory in November 5, 2020 and placed on hold. On December 7, 2020, Shannon & Wilson requested that sample SB-2020-007:20-21.4-11042020 be analyzed for the metal analytes arsenic and mercury and sample SB-2020-15:23-11042020 be analyzed for the metal analytes copper and nickel.

- b. Correct analyses requested?

Yes ☐ No ☐ N/A ☒ Comments:

Specific methods were not clearly identified on the COC. The samples were analyzed for the correct analysis listed in the project Quality Assurance Project Plan (QAPP) with the following exceptions:

- Section 3.2 of the QAPP mentions the samples for metals analysis will be performed by method 200.8. Attachment 2B of the QAPP provides the laboratory limits for method SW6010. The laboratory reported samples for metals analysis by method SW6020. The methods 200.8, SW6010, and SW6020 have the same method of separation (inductively coupled plasma; ICP) but methods 200.8 and SW6020 use a mass spectrometry (MS) detector while method SW6010 uses atomic emission spectroscopy (AES). The laboratory reporting limits (RLs) are generally lower (but comparable) to than those listed in Attachment 2B of the QAPP. Sample results are not affected by this deviation from the QAPP.

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3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☒ N/A ☐ Comments:

There were no discrepancies reported by the laboratory.

e. Data quality or usability affected?

Comments:

The data quality and usability were not affected.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☐ No ☒ N/A ☐ Comments:

There were no discrepancies, errors, or QC failures identified in the case narrative.

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c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

Corrective actions were not required.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory did not specify an effect on the data quality and usability.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☐ No ☒ N/A ☐ Comments:

The samples reported in this work order were initially submitted to the laboratory on November 5, 2020 and placed on hold. On December 7, 2020, Shannon & Wilson requested that sample SB-2020-007:20-21.4-11042020 be analyzed for the metal analytes arsenic and mercury and sample SB-2020-15:23-11042020 be analyzed for the metal analytes copper and nickel.

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The hold time of 28-days for mercury analysis was exceeded for sample SB-2020-007:20-21.4-11042020. The detected sample result is considered estimated, biased low, and is flagged "JL" in the analytical database.

c. All soils reported on a dry weight basis?

Yes ☒ No ☐ N/A ☐ Comments:

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☐ N/A ☒ Comments:

N/A; each of the reported analytes were detected in the project samples.

e. Data quality or usability affected?

Data quality and usability were not affected; see above.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

No analytes were detected in the method blank samples above the RL.

- iii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; project analytes were not detected in the method blank samples.

- iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Project analytes were not detected in the method blank samples.

- v. Data quality or usability affected?

Comments:

Data quality and usability were not affected; see above.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

- i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Organic analyses were not requested for this work order.

- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

An LCS sample was reported for metals and mercury analyses. We have no measure of laboratory precision for these analyses.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

LCSD and laboratory duplicate samples were not reported for this work order. We have no measure of laboratory precision for these methods.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; the percent recoveries were within laboratory acceptance criteria.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The percent recoveries were within laboratory acceptance criteria.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

Data quality and usability were not affected; see above.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Organic analyses were not requested for this work order.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for this work order.

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- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for this work order.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for this work order.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; MS/MSD samples were not reported for this work order.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for this work order.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

Data quality and usability were not affected; see above.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☐ No ☐ N/A ☒ Comments:

Organic analyses were not requested for this work order.

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☐ N/A ☒ Comments:

Organic analyses were not requested for this work order.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Organic analyses were not requested for this work order.

iv. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☐ No ☐ N/A ☒ Comments:

Volatile analyses were not requested for this work order. A trip blank was not required for this work order.

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☐ N/A ☒ Comments:

Volatile analyses were not requested for this work order. A trip blank was not required for this work order.

iii. All results less than RL and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Volatile analyses were not requested for this work order. A trip blank was not required for this work order.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; volatile analyses were not requested for this work order. A trip blank was not required for this work order.

v. Data quality or usability affected?

Comments:

Data quality and usability are not affected; see above.

Laboratory Report Date:

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

A field-duplicate was not reported for the samples reported in this work order. However, a field duplicate was submitted at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field-duplicate was not submitted for this work order.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☐ N/A ☒ Comments:

A field-duplicate was not submitted for this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

Data quality and usability were not affected; see above.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

20L0098

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒

Comments:

Additional data flags and qualifiers were not required.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Michael Jaramillo/ Validated by: Kristen Freiburger

Title:

Senior Chemist / Associate

Date:

February 10, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

20L0100_Revision 1

Laboratory Report Date:

January 28, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

Laboratory Report Date:

January 28, 2021

Report Name:

Lower Duwamish

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

The samples reported in this work order were initially submitted to the laboratory on November 3, 2020 and placed on hold. On December 6, 2020, Shannon & Wilson requested samples HA-2020-001:0.5-11022020, HA-2020-002:0.5-11022020, HA-2020-003:0-11022020, HA-2020-003:0.7-11022020, HA-2020-004:0-11022020, HA-2020-004:0.7-11022020, HA-2020-005:0.5-11022020, HA-2020-006:0-11022020, HA-2020-006:0.8-11022020, HA-2020-007:0-11022020, HA-2020-007:0.8-11022020, and HA-2020-008:0.5-11022020 for specific metals and samples HA-2020-001:0.5-11022020, HA-2020-002:0.5-11022020, HA-2020-003:0-11022020, and HA-2020-003:0.7-11022020 for PCB analysis.

The laboratory report was revised to include analytes/analyses not reported in the initial report.

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b. Correct analyses requested?

Yes ☐ No ☒ N/A ☐ Comments:

Specific methods were not clearly identified on the COC. The samples were analyzed for the correct analysis listed in the project Quality Assurance Project Plan (QAPP) with the following exceptions:

- Section 3.2 of the QAPP mentions samples for metals analysis will be performed by method 200.8. Attachment 2B of the QAPP provide the laboratory limits for method SW6010. The laboratory reported samples for metals analysis by method SW6020. The methods 200.8, SW6010, and SW6020 have the same method of separation (inductively coupled plasma; ICP) but methods 200.8 and SW6020 use a mass spectrometry (MS) detector while method SW6010 uses atomic emission spectroscopy (AES). The laboratory reporting limits (RLs) are generally lower (but comparable) to than those listed in Attachment 2B of the QAPP. Sample results are not affected by this deviation from the QAPP.

3. Laboratory Sample Receipt Documentation

a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☒ N/A ☐ Comments:

There were no discrepancies reported by the laboratory.

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e. Data quality or usability affected?

Comments:

The data quality and usability were not affected.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐

Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐

Comments:

The matrix spike (MS) and matrix spike duplicate (MSD) for metals analysis had several low spike recoveries, noting the natural concentrations of chromium, lead, copper and nickel are so much greater than the concentrations spiked. These elements have been flagged with "HC" qualifiers on the MS/MSD. The laboratory duplicate has a selenium concentration ≤ 5 times the reporting limit and the replicate control limit defaults to $\pm$ the reporting limits instead of 20% of the RPD. The duplicate has been flagged with an "L" qualifier. The results are advisory. No further corrective action was taken.

The samples were analyzed for mercury analysis outside of the 28 day recommended holding time and have been flagged with "H" qualifiers.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒

Comments:

Corrective actions were not required.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory did not specify an effect on the data quality and usability. Please see the following sections for our assessment of the data quality due to the discrepancies noted above.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☐ No ☒ N/A ☐ Comments:

The samples reported in this work order were initially submitted to the laboratory on November 3, 2020 and placed on hold. On December 6, 2020, Shannon & Wilson requested that sample HA-2020-001:0.5-11022020, HA-2020-002:0.5-11022020, HA-2020-003:0-11022020, HA-2020-003:0.7-11022020, HA-2020-004:0-11022020, HA-2020-004:0.7-11022020, HA-2020-005:0.5-11022020, HA-2020-006:0-11022020, HA-2020-006:0.8-11022020, HA-2020-007:0-11022020, HA-2020-007:0.8-11022020, and HA-2020-008:0.5-11022020 for specific metals and samples HA-2020-001:0.5-11022020, HA-2020-002:0.5-11022020, HA-2020-003:0-11022020, and HA-2020-003:0.7-11022020 for PCB analysis.

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The hold time of 28-days for mercury analysis was exceeded for samples HA-2020-001:0.5-11022020 and HA-2020-005:0.5-11022020. The sample results are considered estimated, biased low, and are flagged "JL" in the analytical database.

We also note the holding time listed in the QAPP for PCB analysis (14 days) was exceeded. However, in our professional opinion the hold time is not representative of the stability of these compounds and we do not consider the results affected. The EPA method does not list a required hold time for these analytes, noting "PCBs are very stable in a variety of matrices, and holding times under the conditions listed above may be as long as a year." The conditions they are referring to are storing the samples under refrigeration and out of direct light. These samples were stored in a freezer out of direct sunlight, therefore we do not consider analysis 56 days past collection to affect the results.

c. All soils reported on a dry weight basis?

Yes ☒ No ☐ N/A ☐ Comments:

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☒ No ☐ N/A ☐ Comments:

The Aroclor analytes had RLs greater than the WA Ecology preliminary cleanup level (PCUL) for at least one sample.

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e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

No analytes were detected in the method blank sample above the RL. However, the metals method blank associated with preparation batch BIL0367 had estimated detections for zinc of 3.8 and 3.4 mg/kg (laboratory analyzed for zinc twice).

iii. If above RL or project specified objectives, what samples are affected?

Comments:

Project samples are considered affected if they are in the same preparation batch and have detections for zinc at a concentration less than ten times the method blank detection. Each of the project sample results are greater than 10 times the highest method blank detection. The results are not affected.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

N/A; see above.

v. Data quality or usability affected?

Comments:

Data quality and usability was not affected; see above.

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b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS samples were reported for PCB analysis. Refer to Section 6.c. for assessment of laboratory precision.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for metals and mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The metals laboratory duplicate associated with preparation batch BIL0367 had RPD failures for arsenic, cadmium, chromium, cobalt, lead, and nickel. The parent sample *HA-2020-007:0-11022020* results for these analytes are considered estimated and are flagged “J” in the analytical database due to the imprecision.

We note the RPD for selenium had a calculated value greater than 20% but the laboratory flagged the sample with an “L” flag. This flag is defined as “analyte concentration is ≤ 5 times the reporting limit and the replicate control limit defaults to $\pm$ RL instead of 20% RPD.” We do not consider the associated Selenium results to be affected.

We also note that cadmium was not a requested analyte for sample *HA-2020-007:0-11022020* so the result is unaffected.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

See above.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

Data quality and usability were affected; see above.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for PCB analysis.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for metals and mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The metals MS and/or MSD samples associated with preparation batch BIL0367 had recovery failures for arsenic, chromium, cobalt, copper, lead, nickel, selenium, and vanadium. The parent sample HA-2020-007:0-11022020 had initial results greater than the spiking concentrations for these analytes, with the exception of selenium. The recovery failures for these analytes, excluding selenium, may not be representative of method performance. The results are not affected, with the exception of selenium (see below).

The PCB MS and/or MSD had low recoveries for Aroclor 1016 and Aroclor 1260. However, the parent sample and the MS/MSD samples were analyzed at a dilution due to the nature of the sample matrix and high concentrations for target analytes. Sample results are not affected by these recovery failures.

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The metals MS and MSD samples associated with preparation batch BIL0367 had RPD failures for arsenic, cobalt, copper, and lead. However, the parent sample *HA-2020-007:0-11022020*, had initial results greater than the spiking concentrations for these analytes. The RPD failures for these analytes may not be representative of method performance.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The selenium results for sample *HA-2020-007:0-11022020* are considered estimated, biased low, and flagged “JL” due to the MS/MSD recovery failures.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

Data quality and usability were affected; see above.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Surrogate recoveries were within laboratory acceptance criteria.

iv. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☐ No ☐ N/A ☒ Comments:

Volatile analyses were not requested for this work order. A trip blank was not required for this work order.

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☐ N/A ☒ Comments:

Volatile analyses were not requested for this work order. A trip blank was not required for this work order.

iii. All results less than RL and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Volatile analyses were not requested for this work order. A trip blank was not required for this work order.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; volatile analyses were not requested for this work order. A trip blank was not required for this work order.

v. Data quality or usability affected?

Comments:

Data quality and usability are not affected; see above.

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

A field-duplicate was not submitted for this work order. However, a field duplicate was submitted at the required frequency of the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field-duplicate was not submitted for this work order.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field-duplicate was not submitted for this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

Data quality and usability were not affected; see above.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒ Comments:

Additional data flags and qualifiers were not required.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Michael Jaramillo / Validated by: Kristen Freiburger

Title:

Senior Chemist / Associate

Date:

January 14, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

20L0286

Laboratory Report Date:

January 4, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

Laboratory Report Date:

January 4, 2021

Report Name:

Lower Duwamish

Note: Any N/A or No box checked must have an explanation in the comments box.1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

The samples reported in this work order were initially submitted to the laboratory on November 3, 2020 and placed on hold. On December 6, 2020, Shannon & Wilson requested that samples TSA-2020-001:1.9-11032020, TSA-2020-002:2-11032020, and TSA-2020-003:2-11032020 be analyzed for polychlorinated biphenyls (PCBs).

- b. Correct analyses requested?

Yes ☐ No ☒ N/A ☐ Comments:

Specific methods were not clearly identified on the COC. The samples were analyzed for the correct analysis listed in the project Quality Assurance Project Plan (QAPP).

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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January 4, 2021

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☒ N/A ☐ Comments:

There were no discrepancies reported by the laboratory.

- e. Data quality or usability affected?

Comments:

The data quality and usability were not affected.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☐ No ☒ N/A ☐ Comments:

There were no discrepancies, errors, or QC failures identified in the case narrative.

- c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

Corrective actions were not required.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory did not specify an effect on the data quality and usability.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☐ No ☒ N/A ☐

Comments:

The samples reported in this work order were initially submitted to the laboratory on November 3, 2020 and placed on hold. On December 6, 2020, Shannon & Wilson requested that samples TSA-2020-001:1.9-11032020, TSA-2020-002:2-11032020, and TSA-2020-003:2-11032020 be analyzed for PCBs.

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐

Comments:

We note the holding time listed in the QAPP for PCB analysis (14 days) was exceeded for the PCB samples reported in this work order. However, in our professional opinion the hold time is not representative of the stability of these compounds and we do not consider the results affected. The EPA method does not list a required hold time for these analytes, noting "PCBs are very stable in a variety of matrices, and holding times under the conditions listed above may be as long as a year." The conditions they are referring to are storing the samples under refrigeration and out of direct light. These samples were stored in a freezer out of direct sunlight, therefore we do not consider analysis 54 days past collection to affect the results.

c. All soils reported on a dry weight basis?

Yes ☒ No ☐ N/A ☐

Comments:

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐

Comments:

The Aroclor analytes had RLs greater than the WA Ecology preliminary cleanup level (PCUL) for at least one sample.

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e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

No analytes were detected in the method blank sample above the RL.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; project analytes were not detected in the method blank sample.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Project analytes were not detected in the method blank sample.

v. Data quality or usability affected?

Comments:

Data quality and usability were not affected; see above.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

An LCS sample was reported for PCB analysis. We have no measure of laboratory precision for this analysis.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals/Inorganics were not requested for this work order.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

LCSD and laboratory duplicate samples were not reported for this work order. We have no measure of laboratory precision for PCB analysis.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; the percent recoveries were within laboratory acceptance criteria.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The percent recoveries were within laboratory acceptance criteria.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

Data quality and usability were not affected; see above.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were not reported for this work order.

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ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals/inorganic analyses were not requested for this work order.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for this work order.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for this work order.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; MS/MSD samples were not reported for this work order.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for this work order.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

Data quality and usability were not affected; see above.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

Organic analyses were not requested for this work order.

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- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

- iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

N/A; surrogate recoveries were within the laboratory limits.

- iv. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☐ No ☐ N/A ☒ Comments:

Volatile analyses were not requested for this work order. A trip blank was not required for this work order.

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☐ N/A ☒ Comments:

Volatile analyses were not requested for this work order. A trip blank was not required for this work order.

- iii. All results less than RL and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Volatile analyses were not requested for this work order. A trip blank was not required for this work order.

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; volatile analyses were not requested for this work order. A trip blank was not required for this work order.

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v. Data quality or usability affected?

Comments:

Data quality and usability are not affected; see above.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐

Comments:

A field-duplicate was not submitted for this work order. However, a field duplicate was submitted at the required frequency of the overall project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒

Comments:

A field-duplicate was not submitted for this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☐ N/A ☒

Comments:

A field-duplicate was not submitted for this work order.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

Data quality and usability were not affected; see above.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒

Comments:

Equipment blank samples were not submitted with this work order.

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i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The PCB analyte Aroclor-1260 for project sample *TSA-2020-001:1.9-11032020* was flagged "P1" by the laboratory due to an RPD failure between the reported concentrations from the primary and confirmation columns. The sample results are considered estimated and is flagged "J" in the analytical database.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Michael Jaramillo / Validated by: Kristen Freiburger

Title:

Senior Chemist / Associate

Date:

February 10, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

20L0436

Laboratory Report Date:

January 20, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

Laboratory Report Date:

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Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

The samples reported in this work order were initially submitted to the laboratory on November 5, 2020 and placed on hold. On December 29, 2020, Shannon & Wilson requested that samples SB-2020-007:20-21.4-11042020, SB-2020-007:23-24.6-11042020, SB-2020-005:20-11042020, SB-2020-014:18-11052020, SB-2020-014:23-11052020, and SB-2020-008:20-11052020 be analyzed for polynuclear aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs), except samples SB-2020-005:20-11042020 and SB-2020-008:20-11052020 where only PAH analysis was requested.

- b. Correct analyses requested?

Yes ☐ No ☒ N/A ☐ Comments:

Specific methods were not clearly identified on the COC. The samples were analyzed for the correct analysis listed in the project Quality Assurance Project Plan (QAPP) with the following exceptions:

- The QAPP identifies the analysis of polycyclic aromatic hydrocarbons (PAHs) were to be reported by EPA method SW8270D, with a few exceptions which were to be analyzed by EPA method SW8270D – selective ion monitoring (SIM). All analytes were reported by method SW8270E – SIM. The reported method is the most recent update to method SW8270 and the SIM detection method allows for lower reporting limits (RLs). The results are not considered affected by this deviation from the QAPP.

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3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☒ N/A ☐ Comments:

There were no discrepancies reported by the laboratory.

- e. Data quality or usability affected?

Comments:

The data quality and usability were not affected.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The initial calibration verification (ICV) and continuing calibration verification (CCV) samples associated with method SW8270E-SIM had high recovery failures for dibenzofuran. No corrective action was taken.

The ICV associated with method SW8270E-SIM had a high recovery failure for benzo(g,h,i)perylene. The samples with detected results were qualified "Q" by the laboratory to identify the high bias.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The sample associated with the high ICV recovery for benzo(g,h,i)perylene with detections for this analyte were qualified "Q" by the laboratory.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

While ICV and CCV failures are beyond the scope of a Level II data validation, the high recovery failures were qualified uniformly. Project samples with detections for dibenzofuran and benzo(g,h,i)perylene are qualified "JH" in the analytical database to identify the potential high bias.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☐ No ☒ N/A ☐ Comments:

The samples reported in this work order were initially submitted to the laboratory in November 5, 2020 and placed on hold. On December 29, 2020, Shannon & Wilson requested that samples SB-2020-007:20-21.4-11042020, SB-2020-007:23-24.6-11042020, SB-2020-005:20-11042020, SB-2020-014:18-11052020, SB-2020-014:23-11052020, and SB-2020-008:20-11052020 be analyzed for PAHs and PCBs, with the exception of SB-2020-05:20-11042020 and SB-2020-008:20-11052020 where only PAH analysis was requested..

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b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The hold time for PAHs is 14-days from collection. The samples were submitted to the laboratory on November 5, 2020 and were kept in a freezer out of direct sunlight to extend the hold time for this analysis. Upon receipt of results for other project samples, Shannon & Wilson requested for the analysis of these samples 71 days past collection. Based on recommendations from the laboratory, the analytical results do not require qualification due to the hold time exceedances for these samples.

We also note the holding time listed in the QAPP for PCB analysis (14 days) was exceeded. However, in our professional opinion the hold time is not representative of the stability of these compounds and we do not consider the results affected. The EPA method does not list a required hold time for these analytes, noting "PCBs are very stable in a variety of matrices, and holding times under the conditions listed above may be as long as a year." The conditions they are referring to are storing the samples under refrigeration and out of direct light. These samples were stored in a freezer out of direct sunlight, therefore we do not consider analysis 68 days past collection to affect the results.

c. All soils reported on a dry weight basis?

Yes ☒ No ☐ N/A ☐ Comments:

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

The Aroclor analytes had RLs greater than the WA Ecology preliminary cleanup level (PCUL) for at least one sample.

e. Data quality or usability affected?

Sample results for PAH analysis which were reported past the holding time are qualified according to Section 5.b.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

However, the SW8270E-SIM method blank associated with preparation batch BIL0797 had estimated detections (less than the RL but greater than the MDL) for 1-methylnaphthalene, 2-methylnaphthalene, chrysene, fluoranthene, phenanthrene, and pyrene.

- iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples are considered affected by the method blank detection if they sample results are less than ten times the concentration observed in the method blank sample. The following samples are considered affected.

- Sample *SB-2020-014-:18-11052020* had a detection for 2-methylnaphthalene that was less than five times the method blank detection. The sample result is considered non-detect and flagged “UB” at the reported concentration (0.64 µg/kg) in the analytical database.
- Sample *SB-2020-014-:18-11052020* had detections for 1-methylnaphthalene, chrysene, fluoranthene, phenanthrene, and pyrene that were less than ten times but greater than five times the method blank detection. The sample results are considered estimated, biased high, and are flagged “JH.”
- Sample *SB-2020-014-:23-11052020* had detections for 1-methylnaphthalene, 2-methylnaphthalene, and phenanthrene that were less than five times the method blank detection. The sample results are considered non-detect and flagged “UB” at the reporting limit in the analytical database.
- Sample *SB-2020-014-:23-11052020* had detections for fluoranthene and pyrene that were less than ten times but greater than five times the method blank detection. The sample results are considered estimated, biased high and are flagged “JH.”

- iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above.

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v. Data quality or usability affected?

Comments:

Data quality and usability are affected; see above.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS samples were reported for PCB and PAH analyses. Refer to Section 6.c. for assessment of laboratory precision.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals/Inorganics were not requested for this work order.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

LCSD and laboratory duplicate samples were not reported for this work order. Refer to Section 6.c. for assessment of laboratory precision.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; the percent recoveries were within laboratory acceptance criteria.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The percent recoveries were within laboratory acceptance criteria.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

Data quality and usability were not affected; see above.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for PAH and PCB analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals/inorganic analyses were not requested for this work order.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; percent recoveries and RPDs were within laboratory acceptance criteria.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Percent recoveries and RPDs were with laboratory acceptance criteria.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

Data quality and usability were not affected; see above.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐

Comments:

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒

Comments:

Surrogate recoveries were within laboratory acceptance criteria.

iv. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☐ No ☐ N/A ☒

Comments:

Volatile analyses were not requested for this work order. A trip blank was not required for this work order.

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☐ N/A ☒

Comments:

Volatile analyses were not requested for this work order. A trip blank was not required for this work order.

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iii. All results less than RL and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Volatile analyses were not requested for this work order. A trip blank was not required for this work order.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; volatile analyses were not requested for this work order. A trip blank was not required for this work order.

v. Data quality or usability affected?

Comments:

Data quality and usability are not affected; see above.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

A field-duplicate was not submitted for this work order. However, a field duplicate was submitted at the required frequency of the overall project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field-duplicate was not submitted for this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☐ N/A ☒ Comments:

A field-duplicate was not submitted for this work order.

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iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

Data quality and usability were not affected; see above.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒

Comments:

Equipment blank samples were not submitted with this work order.

i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒

Comments:

Equipment blank samples were not submitted with this work order.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒

Comments:

Additional data flags and qualifiers were not required for this work order.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Michael Jaramillo/ Validated by: Kristen Freiburger

Title:

Senior Chemist / Associate

Date:

February 10, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

20L0437

Laboratory Report Date:

January 20, 2021

Report Name:

Lower Duwamish

Project Number

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Laboratory Report Date:

January 20, 2021

Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

The samples reported in this work order were initially submitted to the laboratory on November 6, 2020 and placed on hold. On December 29, 2020, Shannon & Wilson requested that samples SB-2020-013:20.5-11052020 and SB-2020-013:23-11052020 be analyzed for polynuclear aromatic hydrocarbons (PAHs) and polychlorinated biphenyls (PCBs).

- b. Correct analyses requested?

Yes ☐ No ☒ N/A ☐ Comments:

Specific methods were not clearly identified on the COC. The samples were analyzed for the correct analysis listed in the project Quality Assurance Project Plan (QAPP) with the following exceptions:

- The QAPP identifies the analysis of polycyclic aromatic hydrocarbons (PAHs) were to be reported by EPA method SW8270D, with a few exceptions which were to be analyzed by EPA method SW8270D – selective ion monitoring (SIM). However, the analytes were reported by method SW8270E – SIM. The reported method is the most recent update to method SW8270 and the SIM detection method allows for lower reporting limits (RLs). The results are not considered affected by this deviation from the QAPP.

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3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☒ N/A ☐ Comments:

There were no discrepancies reported by the laboratory.

- e. Data quality or usability affected?

Comments:

The data quality and usability were not affected.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

Sample *SB-2020-013:20.5-11052020* was reanalyzed at a dilution due to “E” flag being applied for concentrations exceeding the upper calibration limits. No further corrective action was taken.

The initial calibration verification (ICV) and continuing calibration verification (CCV) samples associated with method SW8270E-SIM had high recovery failures for dibenzofuran. No corrective action was taken.

The ICV associated with method SW8270E-SIM had a high recovery failure for benzo(g,h,i)perylene. The samples with detected results were qualified “Q” by the laboratory to identify the high bias.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The detected concentrations for samples associated with the high ICV recovery for benzo(g,h,i)perylene qualified with a “Q” flag by the laboratory.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

Sample *SB-2020-013:23-11052020* was reanalyzed for PAH analysis at a dilution due to fluoranthene, phenanthrene, and pyrene being detected outside the upper calibration range in the original analysis. The reanalysis results for these analytes are used for reporting purposes in sample *SB-2020-013:23-11052020*.

While ICV and CCV failures are beyond the scope of a Level II data validation, the high recovery failures were qualified uniformly. Project samples with detections for dibenzofuran and benzo(g,h,i)perylene are qualified “JH” in the analytical database to identify the potential high bias.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☐ No ☒ N/A ☐ Comments:

The samples reported in this work order were initially submitted to the laboratory on November 6, 2020 and placed on hold. On December 29, 2020, Shannon & Wilson requested that samples *SB-2020-013:20.5-11052020* and *SB-2020-013:23-11052020* be analyzed for PAHs and PCBs.

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b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The hold time for PAHs is 14-days from collection. The samples were submitted to the laboratory on November 6, 2020 and were kept frozen to extend the hold time for this analysis. Upon receipt of results for other project samples, Shannon & Wilson requested for the analysis of these samples 54 days past collection. Based on recommendations from the laboratory, the analytical results do not require qualification due to the hold time exceedances for these samples.

We also note the holding time listed in the QAPP for PCB analysis (14 days) was exceeded. However, in our professional opinion the hold time is not representative of the stability of these compounds and we do not consider the results affected. The EPA method does not list a required hold time for these analytes, noting "PCBs are very stable in a variety of matrices, and holding times under the conditions listed above may be as long as a year." The conditions they are referring to are storing the samples under refrigeration and out of direct light. These samples were stored in a freezer out of direct sunlight, therefore we do not consider analysis 54 days past collection to affect the results.

c. All soils reported on a dry weight basis?

Yes ☒ No ☐ N/A ☐ Comments:

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

The Aroclor analytes had RLs greater than the WA Ecology preliminary cleanup level (PCUL) for at least one sample.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

However, the SW8270E-SIM method blank associated with preparation batch BIL0797 had estimated detections (less than the RL but greater than the MDL) for 1-methylnaphthalene, 2-methylnaphthalene, chrysene, fluoranthene, phenanthrene, and pyrene.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples are considered affected by the method blank detection if the associated sample results are less than ten times the concentration observed in the method blank sample. The associated project samples had detections for these analytes at concentrations greater than ten times the method blank detections. Project samples are not affected by the PAH method blank detections.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☒ N/A ☐ Comments:

See above.

v. Data quality or usability affected?

Comments:

Data quality and usability are not affected; see above.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS samples were reported for PCB and PAH analyses. We have no measure of laboratory precision for these analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals/Inorganics were not requested for this work order.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

We have no measure of laboratory precision for these analyses.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; the percent recoveries were within laboratory acceptance criteria.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The percent recoveries were within laboratory acceptance criteria.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

Data quality and usability were not affected; see above.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not analyzed for this work order.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals/inorganic analyses were not requested for this work order.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not analyzed for this work order.

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

We have no measure of laboratory precision for these analyses.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; we have no measure of laboratory precision for these analyses.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

We have no measure of laboratory precision for these analyses.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

Data quality and usability were not affected; see above.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

We note the first column recovery of surrogate decachlorobiphenyl for PCB sample SB-2020-013:20.5-11052020 was unable to be quantified due to matrix interferences (flagged NRS by the laboratory). However, the second column run was reported and within limits. We do not consider the project sample results to be affected by the NRS flag.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Surrogate recoveries were within laboratory acceptance criteria.

iv. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☐ No ☐ N/A ☒ Comments:

Volatile analyses were not requested for this work order. A trip blank was not required for this work order.

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☐ N/A ☒ Comments:

Volatile analyses were not requested for this work order. A trip blank was not required for this work order.

iii. All results less than RL and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Volatile analyses were not requested for this work order. A trip blank was not required for this work order.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; volatile analyses were not requested for this work order. A trip blank was not required for this work order.

v. Data quality or usability affected?

Comments:

Data quality and usability are not affected; see above.

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

A field-duplicate was not submitted for this work order. However, a field duplicate was submitted at the required frequency of the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field-duplicate was not submitted for this work order.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field-duplicate was not submitted for this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

Data quality and usability were not affected; see above.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒

Comments:

Additional data flags and qualifiers were not required for this work order.

February 2022

Project Name:	Lower Duwamish
Client:	Earle M. Jorgensen
S&W Project Number:	21-1-12596-035
Subject:	Data Quality Summary for 2021 Q1 – Q4 Site Investigation

INTRODUCTION

This Quality Assurance/Quality Control (QA/QC) Summary has been prepared to assess the data quality and usability for samples collected during the Remedial Investigation (RI) activities completed at the Jorgensen Forge Corporation (JFC) facility, located at 8531 East Marginal Way South, Tukwila, Washington (Site). The RI activities were described in the RI Work Plan which was reviewed and approved by the Washington State Department of Ecology (Ecology) in September 2020. The Quality Assurance Project Plan (QAPP) was appended to the RI Work Plan and details the project organization and responsibilities, project-specific data-quality objectives (DQOs), sample-handling methods, analytical procedures, and data QC review and reporting requirements for the groundwater, soil, soil vapor, and light non-aqueous phase liquid (LNAPL) investigation. The RI was conducted to characterize the nature and extent of contamination at the Site and to collect further information about the physical characteristics of the Site.

The QAPP was prepared per the Ecology Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies (Ecology, 2016) and the U.S. Environmental Protection Agency (EPA) publication EPA Requirements for Quality Assurance Project Plans QA/R-5 (EPA, 2001). The QAPP described the process for qualifying analytical data based on a QA/QC review of Level II laboratory reports and electronic data deliverables (EDDs). The QAPP is used to provide guidance for conducting what the EPA refers to as a Stage 2a Validation (EPA, 2009). A more critical level of validation is beyond the scope of this project, but the QAPP does present guidance for determining whether additional review should be conducted, based on information received from the laboratory. The QAPP also assesses the quality of the analytical data using precision, accuracy, representativeness, comparability, completeness, and sensitivity (PARCCS) parameters.

In general, most data-review guidelines presented in the QAPP are drawn from federal guidance documents. However, in some cases, federal guidance is not consistent, is outdated, or does not account for specific issues addressed in the QAPP; in these cases, the guidance

presented in the QAPP is based on standard industry practice or site-specific considerations, which are in turn based on Shannon & Wilson chemists' years of professional experience. Where non-federal guidance documents are used, they are cited within the text and in Section 6 of the QAPP. Most QAPPs specify DQOs for items such as laboratory control sample (LCS) recovery and target reporting limits. The Site QAPP does not present such limits, but instead defers to internal laboratory-control limits that are statistically derived, frequently updated, and within the requirements of the laboratory's national certification, and thus compliant with federal requirements.

BACKGROUND

The approximately 20-acre Site was a steel and aluminum forge and mill that produced custom steel and aluminum parts forged and machined to high precision specifications for various industrial clients. Operations remained relatively unchanged since the property was developed in the 1940s; however, melt operations were discontinued in 2015. Facility operations were discontinued in October 2018.

The Site is developed with an approximately 124,000-square-foot prefabricated steel building (main building), which is generally divided into the Hollowbore Area, the Machine Shop Area, the Heat Treat Area, the Forge Shop Area, and the Former Melt Shop Area.

Investigations began at the Site in 1990 and are described within the RI Work Plan. Investigations at the Site (prior to the RI) have included the completion of numerous borings and the installation of 52 groundwater monitoring wells, numbered MW-1 through MW-52. Several additional wells were installed in the northwest corner of the Site by consultants for The Boeing Company, numbered as PL2-JF01A, PL2-JF01AR, PL2-JF01B, PL2-JF01C, PL2-JF02A, PL2-JF03A, and PL2-JF04A. During the RI, 27 groundwater monitoring wells, numbered MW-10R, MW-13R, MW-22R, and MW-53 through MW-76, were installed. Several groundwater monitoring wells have been decommissioned over the years. The current groundwater monitoring network includes 71 monitoring wells.

LNAPL plumes are present in Site Areas 1 and 2. The potential contaminants of concern for the Site include benzene, toluene, ethylbenzene, and xylenes (BTEX), halogenated volatile organic compounds (HVOCs), semi-volatile organic compounds (SVOCs), polycyclic aromatic hydrocarbons (PAHs), total petroleum hydrocarbons (TPH), polychlorinated biphenyls (PCBs), and metals.

ANALYTICAL QUALITY ASSURANCE AND QUALITY CONTROL

QA/QC procedures assist in producing data of acceptable quality and reliability. We reviewed the analytical results for laboratory QC samples and conducted our own QA assessment for this project. We reviewed the chain of custody (COC) records and laboratory receipt forms to check that custody was not breached, sample-holding times were met, and the samples were kept chilled (between 0 degrees Celsius [°C] and 6 °C) during transport and storage. Our QA-review procedures allowed us to document the accuracy and precision of the analytical data, as well as check that the analyses were sufficiently sensitive to meet project-specific DQOs.

Laboratory QC procedures included evaluating surrogate recovery, performing continuing calibration checks, and analyzing method blanks, LCS, and matrix spikes (MS) to assess accuracy and precision. LCS, LCS duplicate (LCSD), MS, MS duplicate (MSD), and surrogate recovery analyses were performed to evaluate the accuracy of the analytical process. Analytical precision was assessed by comparing the results of duplicate analyses performed on LCS/LCSD, MS/MSD, and duplicate-sample pairs.

QC procedures in the field included using single-use equipment to reduce the potential for sample cross-contamination. We used a new, clean pair of nitrile gloves when sampling at each monitoring well or soil boring location. Monitoring well and soil boring sampling equipment was decontaminated between locations. Each laboratory report contains a case narrative and sample-receipt forms documenting sample conditions.

Details regarding the results of our QA review are presented below. The Analytical Resources, Incorporated (ARI) and Eurofins TestAmerica, Inc. (TestAmerica) laboratory reports for work orders and corresponding laboratory data review checklists (LDRCs) are appended to this report. We refer the reader to these documents for additional information; a summary of our QA/QC assessment is presented below.

Exhibit 1: Laboratory Work Order List

Quarter	Laboratory Report Number	Information Contained
Q1	21A0352	Soil samples collected January 25, 2021, including 12 soil borings with 43 grab samples and 3 asphalt samples.
	21A0376	Soil samples collected January 26 - 27, 2021, including 19 soil borings with 96 grab samples, 1 asphalt sample, and 1 composite sample.
	21B0005	Soil samples collected January 26 - 29, 2021, including 12 soil borings with 50 grab samples, 1 asphalt sample, 3 surface soil samples, and 4 decontamination water samples.

Quarter	Laboratory Report Number	Information Contained
Q1	21B0081	Soil samples collected February 1 - 2, 2021, including 10 soil borings with 49 grab samples.
	21B0087	Soil samples collected February 3, 2021, including 6 soil borings with 27 grab samples.
	21B0101	Soil samples collected February 4, 2021, including 2 soil borings with 7 grab samples.
	21B0126	Soil samples collected February 5, 2021, including 1 soil boring with 6 grab samples and 2 additional soil samples.
	21B0160	Groundwater samples collected February 10, 2021, including samples from 4 monitoring wells, 1 duplicate sample, and 1 matrix spike/matrix spike duplicate sample.
	21B0174	Groundwater samples collected February 11, 2021, including samples from 6 monitoring wells and 1 equipment blank sample.
	21B0192	Groundwater samples collected February 12, 2021, including samples from 5 monitoring wells.
	21B0227	Groundwater samples collected February 16, 2021, including samples from 4 monitoring wells and 1 matrix spike/matrix spike duplicate sample.
	21B0239	Groundwater samples collected February 17, 2021, including samples from 4 monitoring wells and 1 duplicate sample.
	21B0255	Groundwater samples collected February 18, 2021, including samples from 7 monitoring wells.
	21B0272	Groundwater samples collected February 19, 2021, including samples from 6 monitoring wells.
	21B0296	Groundwater samples collected February 22, 2021, including samples from 7 monitoring wells and 1 duplicate sample.
	21B0309	Groundwater samples collected February 23, 2021, including samples from 6 monitoring wells and 1 duplicate sample.
	21B0322	Groundwater samples collected February 24, 2021, including samples from 5 monitoring wells.
	21B0344	Groundwater and soil samples collected February 2 - 25, 2021, including 4 soil samples and samples from 5 monitoring wells.
	21G0121	Soil samples collected January 26 - 27, 2021, including 14 soil borings with 71 primary samples, one asphalt sample, and one composite sample.
Q2	21D0061	Soil samples collected January 26 - 29, 2021, including 31 soil borings with 94 primary samples, 5 asphalt samples, 3 surface stain soil samples, 17 other soil samples, 1 composite sample, and 2 decontamination water samples.
	320-703131-1	Groundwater samples collected February 16 and 17, 2021, including samples from 8 monitoring wells, 1 duplicate sample, and 2 blank samples.
	21E0174	Groundwater samples collected May 13, 2021, including samples from 4 monitoring wells.
	21E0190	Groundwater samples collected May 14, 2021, including samples from 6 monitoring wells.

Quarter	Laboratory Report Number	Information Contained
Q2	21E0194	Groundwater samples collected May 17, 2021, including samples from 4 monitoring wells, 1 equipment blank sample, and 1 matrix spike/matrix spike duplicate sample.
	21E0206	Groundwater samples collected May 18, 2021, including samples from 7 monitoring wells.
	21E0213	Groundwater samples collected May 19, 2021, including samples from 4 monitoring wells and 1 duplicate sample.
	21E0244	Groundwater samples collected May 19 - 20, 2021, including samples from 7 monitoring wells and 1 duplicate sample.
	21E0260	Groundwater samples collected May 21, 2021, including samples from 6 monitoring wells.
	21E0290	Groundwater samples collected May 24, 2021, including samples from 7 monitoring wells and 1 duplicate sample.
	21E0302	Groundwater samples collected May 25, 2021, including samples from 3 monitoring wells and 1 equipment blank sample.
	21E0323	Groundwater samples collected May 27, 2021, including samples from 2 monitoring wells.
	21E0352	Groundwater samples collected May 26, 2021, including samples from 5 monitoring wells and 1 decontamination water sample.
	21E0361	Groundwater samples collected May 28, 2021, including samples from 2 monitoring wells.
Q3	21H0207	Groundwater samples collected August 17, 2021, including samples from 2 monitoring wells.
	21H0209	Groundwater samples collected August 17, 2021, including samples from 2 monitoring wells.
	21H0210	Groundwater samples collected August 17, 2021, including samples from 4 monitoring wells.
	21H0222	Groundwater samples collected August 17, 2021, including samples from 4 monitoring wells and 1 duplicate sample.
	21H0230	Groundwater samples collected August 19, 2021, including samples from 3 monitoring wells.
	21H0248	Groundwater samples collected August 20, 2021, including samples from 5 monitoring wells, 1 equipment blank sample, and 1 duplicate sample.
	21H0282	Groundwater samples collected August 23, 2021, including samples from 2 monitoring wells and 1 duplicate sample.
	21H0291	Groundwater samples collected August 24, 2021, including samples from 5 monitoring wells.
	21H0304	Groundwater samples collected August 25, 2021, including samples from 5 monitoring wells and 1 equipment blank sample.

Quarter	Laboratory Report Number	Information Contained
	21H0320	Groundwater samples collected August 26, 2021, including samples from 7 monitoring wells.
	21H0341	Groundwater samples collected August 27, 2021, including samples from 6 monitoring wells and 1 matrix spike/matrix spike duplicate sample.
	21H0367	Groundwater samples collected August 30, 2021, including samples from 4 monitoring wells.
Q3	21I0001	Groundwater samples collected August 31, 2021, including samples from 5 monitoring wells, 1 matrix spike/matrix spike duplicate sample, and 1 duplicate sample.
	21I0012	Groundwater samples collected September 1, 2021, including samples from 6 monitoring wells.
	21I0040	Groundwater samples collected September 2, 2021, including samples from 6 monitoring wells and 1 equipment blank sample.
Q4	21J0060	Soil samples collected October 4, 2021, including 5 soil borings with 22 grab samples.
	21K0165	Groundwater samples collected November 9, 2021, including samples from 4 monitoring wells and 1 duplicate sample.
	21K0213	Groundwater samples collected November 10, 2021, including samples from 3 monitoring wells, 1 matrix spike/matrix spike duplicate sample, and 1 equipment blank sample.
	21K0240	Groundwater samples collected November 11, 2021, including samples from 4 monitoring wells and 1 duplicate sample.
	21K0245	Groundwater samples collected November 12, 2021, including samples from 4 monitoring wells.
	21K0284	Groundwater samples collected November 16, 2021, including samples from 5 monitoring wells and 1 equipment blank sample.
	21K0303	Groundwater samples collected November 17, 2021, including samples from 4 monitoring wells.
	21K0322	Groundwater samples collected November 18, 2021, including samples from 4 monitoring wells.
	21K0343	Groundwater samples collected November 19, 2021, including samples from 4 monitoring wells.
	21K0367	Groundwater samples collected November 22, 2021, including samples from 2 monitoring wells and 1 equipment blank sample.
	21K0382	Groundwater samples collected November 23, 2021, including samples from 3 monitoring wells.
	21K0419	Groundwater samples collected November 24, 2021, including samples from 4 monitoring wells.
	21K0444	Groundwater samples collected November 30, 2021, including samples from 4 monitoring wells.

Quarter	Laboratory Report Number	Information Contained
Q4	21L0003	Groundwater samples collected November 29, 2021, including samples from 3 monitoring wells.
	21L0031	Groundwater samples collected December 1, 2021, including samples from 5 monitoring wells and 1 duplicate sample.
	21L0046	Groundwater samples collected December 2, 2021, including samples from 4 monitoring wells.
	21L0078	Groundwater samples collected December 3, 2021, including samples from 3 monitoring wells and 1 duplicate sample.
	J81991-1	Groundwater samples collected November 16 - 17, 2021, including samples from 8 monitoring wells, 1 equipment blank sample, and 1 field blank sample.
	J82516-1	Groundwater samples collected December 3, 2021, including samples from 3 monitoring wells, 1 equipment blank sample, and 1 field blank sample.
	J83346-1	Groundwater samples collected December 20, 2021, including samples from 6 drums.

Sample Handling

Soil and groundwater samples collected by Shannon & Wilson, Inc. personnel were hand-delivered to the ARI laboratory in Tukwila, Washington. We completed COC forms, which were signed upon delivery to the ARI laboratory. A small subset of groundwater samples were submitted to TestAmerica in Sacramento, California (shipped via FedEx) for per- and polyfluorinated alkyl substances (PFAS) analysis. Samples were submitted for the correct analyses listed in the QAPP with the following exceptions:

- All WOs with metals analysis – Section 3.2 of the QAPP mentions the samples for metals analysis will be performed by method 200.8. Attachment 2B of the QAPP provided the laboratory limits for method SW6010. The laboratory reported samples for metals analysis by method SW6020. The methods 200.8, SW6010, and SW6020 have the same method of separation (inductively coupled plasma [ICP]) but methods 200.8 and SW6020 use a mass spectrometry (MS) detector while method SW6010 uses atomic emission spectroscopy (AES). The laboratory reporting limits (RLs) are generally lower than those listed in Attachment 2B of the QAPP. Sample results are not affected by this deviation from the QAPP.
- All WOs with PAH analysis – Section 3.2 of the QAPP mentions the samples for PAH analysis will be performed by method SW8270D. Attachment 2B of the QAPP provides the laboratory limits for some PAH analytes by method SW8270D and some PAH analytes by method SW8270E-Selective Ion Monitoring (SIM). The laboratory reported all PAH analytes by method SW8270E-SIM. The reported method is the most recent update to the EPA method SW8270 and the SIM detection method allows for lower RLs. Sample results are not affected by this deviation from the QAPP.

Sample-receipt forms provided by the laboratory were reviewed and checked to verify that the samples were received in good condition and within the acceptable temperature range. Samples received free of ice and at temperatures between 0 and 6 degrees Celsius are within the acceptable temperature range. Samples were generally received in good condition, properly preserved, and within the acceptable temperature range upon arrival at the laboratory, with exceptions listed below:

- The sample containers submitted for dissolved metals analysis were submitted to the laboratory without filtration or preservative; consequently, the laboratory sample receipt form notes that these samples were inadequately preserved. The laboratory filtered and acidified the samples for dissolved metals analysis on the same day that they were collected. The data quality and usability were not affected.
- The cooler temperature exceeded the acceptable temperature range in WOs 21H0207, 21H0209, 21H0210, and 21H0304. Because the samples were packed in ice and received by the laboratory on the same day that they were collected, we consider the data quality and usability to be unaffected.
- In WOs 21E0190 and 21E0194, there was confusion regarding the sulfite analysis. The samples for sulfite analysis were delivered in unpreserved sulfide containers, and the incorrect sulfide analysis was requested on the COC. The sulfide analysis was cancelled, and the sulfite analysis was also cancelled because the analyte dissipates rapidly without preservative.
- In WO 21E0323, one of the sample vials was received with a hairline fracture that allowed some of the sample to leak out. The broken vial was not used for analysis.
- In WO 21H0320, 21K0303, and 21K0343 the sample volume for analysis of ferrous iron had excess headspace that may result in a low analytical bias. To be conservative, we qualified the results 'JL' in the summary table.
- In WO 21H0341, the vials used for VOC analysis had excess headspace and results were considered estimated with a low bias.

Samples were analyzed within the method recognized hold-times, with the exceptions listed below:

2021 Quarter 1

- WO 21B0081 – The soil sample *MW-70:4.3-02022021* was missed during the initial extraction for PAH analysis and its subsequent analysis was outside of the method-required holding time. In addition, the soil sample *MW-73:11-02022021* GRO analysis had to be re-run because the initial extract was overdiluted, and the re-analysis occurred outside of the method-required holding time. These results are considered biased low and are qualified 'JL' in the summary table.

- WO 21B0101 – The soil sample MW-71:20.5-02042021 was re-extracted for VOCs outside of the required holding time due to low surrogate recovery in the initial run. Results were reported for the within-hold data except for cis-1,2-dichloroethene and vinyl chloride, which reported higher concentrations in the re-analysis.
- WO 21B0126 – The soil samples MW-10R:9-02052021 and MW-104:9-02052021 were re-extracted for VOCs outside of the method-required holding time due to elevated surrogate recovery in the initial run. However, the re-extracted batch was affected by serious laboratory errors and was not used; the within-hold results from the initial run are reported.
- WOs 21B0160, 21B0192, 21B0239, 21B0255, 21B0272, 21B0296 - The samples submitted for sulfite analysis exceeded the method holding time, which is 15 minutes. Meeting this holding time is not practical for most field sites. The samples were analyzed within 24 hours of collection but the sulfite results are assumed to have a low analytical bias.
- WO 21D00061 – The samples in this work order were kept frozen by the laboratory to extend the hold time for analysis, if the results of other samples would require their analysis. Shannon & Wilson requested the analysis of these samples 70 days past collection and hold time was exceeded for PAHs and PCBs. Based on recommendations from the laboratory, the PAH analytical results do not require qualification for the hold time exceedance. It is our professional opinion that the PCB results are also not affected because of the relative stability of these compounds.
- WO 21G0121 – The samples analyzed in this work order represent analyses that were missed in prior work orders. The samples had been kept frozen in storage. Though the analyses were conducted outside of their method-required holding times, they were not qualified for gross hold time exceedances because the samples had been kept frozen.

See Table 1 for the complete list of flagged samples from Quarter 1.

2021 Quarter 2

- WO 21E0194 – nitrate and nitrite were analyzed outside of the method-required holding time because the instrument stopped analyzing samples midway through a sequence. The nitrate and nitrite sample results are considered to have a low analytical bias due to the holding time exceedance and are qualified 'J' in the summary table.
- WO 21E0213 – nitrate and nitrite were prepared outside the method holding time in sample MW-30-20211905. The affected result is qualified 'J' in the summary table. In addition, sulfite exceeded the method holding time and has a low analytical bias.
- WO 21E0290, 21E0302, 21E0323, and 21E0352 – total and dissolved mercury were analyzed outside of the method-required holding time due to an instrument failure at the laboratory which necessitated subcontracting the dissolved mercury analysis to Fremont Analytical. The delay caused the samples to break hold and the results have a low analytical bias.

See Table 2 for the complete list of flagged samples from Quarter 2.

2021 Quarter 3

- WO 21H0222, 21H0248, 21H0304, 21H0320, 21H0367, 21I0012 – The samples submitted for sulfite analysis exceeded the method holding time, which is 15 minutes. Meeting this holding time is not practical for most field sites. The samples were analyzed within 24 hours of collection but the sulfite results are assumed to have a low analytical bias.
- WO 21H0304 – chloride was analyzed outside of the method-required holding time because the sample had to be reanalyzed multiple times to bring the concentration within the instrument's calibration range. The chloride results of samples MW-23-20212508 and MW-58-20212508 are considered estimated with a low bias and are flagged 'JL' in the summary table.

See Table 3 for the complete list of flagged samples from Quarter 3.

2021 Quarter 4

- WO 21K0245, 21K0343, 21K0367, and 21K0382 – The samples submitted for sulfite analysis exceeded the method holding time, which is 15 minutes. Meeting this holding time is not practical for most field sites. The samples were analyzed within 24 hours of collection but the sulfite results are assumed to have a low analytical bias.

See Table 4 for the complete list of flagged samples from Quarter 4.

Additional sample handling discrepancies were noted by the laboratory; however, the minor discrepancies did not affect the data quality. Refer to the LDRCs for details.

Sensitivity

The laboratory's detection limit (DL) is the lowest analyte concentration that can be measured. The laboratory's reporting limit (RL) is the lowest analyte concentration that can be routinely measured with confidence in the sampled matrix, the point at which a concentration is considered quantitative. Sample matrix, instrument performance, sample dilutions, and other factors may affect the DL and RL. Analytes may be present in samples at concentrations less than the DL. In cases where analytes were not detected at concentrations above their DL, the analytical results are presented in our data-summary tables with reference to their RLs. If the analyte is detected between the DL and the RL, its concentration is considered an estimate; in our tables this value is flagged with a 'J'. The flag is applied by the laboratory.

Prior to collecting the first quarter samples, the current laboratory NELAP certifications were obtained and the RLs were compared to the project specified DQOs for the requested analytes. The laboratory RLs were sufficiently sensitive for reporting purposes with several exceptions, as reported in Attachment 2 of the QAPP. Analytes not detected in the samples that have RLs

exceeding the DQOs are identified in bold in the results tables. Refer to the reporting tables for details.

Method Blanks

Laboratory method blanks (MBs) were analyzed in association with samples collected for this project to check for contributions to the analytical results possibly attributable to laboratory-introduced contamination. The project samples are only affected by the MB detections if the analyte is detected in the project sample at a concentration less than ten times the concentration detected in the MB. Sample results detected less than five times the MB detection are considered non-detect and are flagged 'B' at the RL or detected value, whichever is greater. Samples results detected less than ten times but greater than five times the MB detection are considered estimated, biased high, and are flagged 'JH' on the data tables. The following analytes were detected in the MB samples:

2021 Quarter 1

- WO 21B0309 – The metal analytes chromium-52 and iron-54 were detected in the associated method blank and affected one or more project samples.
- WO 21B0239 – The metal analyte nickel-60 was detected in the associated method blank and affected one or more project samples.
- WO 21B0272 – The metal analyte zinc-66 was detected in the associated method blank and affected one or more project sample.
- WOs 21B0227, 21B0255, 21B0296, and 21B0322 – The metal analyte dissolved chromium-52 was detected in the associated method blanks and affected one or more project samples.
- WOs 21B0005, 21B0227, 21B0239, 21B0255, and 21B0296 – The metal analyte dissolved iron-54 was detected in the associated method blanks and affected one or more project samples.
- WOs 21B0081, 21B0087, and 21B0126 – The metal analyte mercury was detected in the associated method blanks and affected one or more project samples.
- WO 21B0005 – The metal analyte dissolved mercury was detected in the associated method blank and affected one or more project sample.
- WOs 21B0081, 21B0087, 21B0160, and 21B0174 – The PAH analyte 1-methylnaphthalene was detected in the associated method blanks and affected one or more project samples.
- WOs 21B0005, 21B0081, 21B0087, 21B0174, and 21B0192 – The PAH analyte 2-methylnaphthalene was detected in the associated method blanks and affected one or more project samples.
- WO 21D0061 – The PAH analyte chrysene was detected in the associated method blank and affected one or more project sample.

- WOs 21A0352 and 21D0061 – The PAH analyte fluoranthene was detected in the associated method blanks and affected one or more project samples.
- WOs 21B0160, 21B0174, 21B0192, 21B0322, and 21B0344 – The PAH analyte naphthalene was detected in the associated method blanks and affected one or more project samples.
- WO 21D0061 – The PAH analyte pyrene was detected in the associated method blank and affected one or more project sample.

See Table 1 for the complete list of flagged samples from Quarter 1.

2021 Quarter 2

- WOs 21E0290 and 21E0302 – The metal analyte nickel-60 was detected in the associated method blanks and affected one or more project samples.
- WO 21E0260 – The metal analyte dissolved manganese-55 was detected in the associated method blank and affected one or more project samples.
- WOs 21E0190, 21E0194, 21E0244, and 21E0260 – The metal analyte dissolved mercury was detected in the associated method blank and affected one or more samples.
- WO 21E0290 – The SVOC analyte bis(2-ethylhexyl)phthalate was detected in the associated method blank and affected one or more samples.
- WOs 21E0244 and 21E0260 – The SVOC analyte di-n-butylphthalate was detected in the associated method blank and affected one or more samples.
- WOs 21E0206, 21E0213, 21E0260, 21E0290, and 21E0352 – The PAH analytes 1-methylnaphthalene and 2-methylnaphthalene were detected in the associated method blanks and affected one or more samples.
- WOs 21E0174, 21E0194, 21E0206, 21E0213, 21E0260, 21E0290, and 21E0352 – The PAH analyte naphthalene was detected in the associated method blanks and affected one or more samples.
- WO 21E0260 – The PAH analyte phenanthrene was detected in the associated method blank and affected one or more samples.
- WOs 21E0174 and 21E0194 – The PAH analyte pyrene was detected in the associated method blanks and affected one or more samples.

See Table 2 for the complete list of flagged samples from Quarter 2.

2021 Quarter 3

- WO 21H0282 – The metal analyte dissolved copper-63 was detected in the associated method blank and affected one or more project samples.

- WO 21I0040 – The metal analyte dissolved manganese-55 was detected in the associated method blank and affected one or more project samples.
- WOs 21H0320, 21H0341, 21H0367, and 21I0001 – The metal analyte mercury was detected in the associated method blanks and affected one or more samples.
- WOs 21H0209, 21H0222, 21H0282, 21H0341, 21H0367, 21I0001, 21I0012, and 21I0040 – The metal analyte dissolved mercury was detected in the associated method blanks and affected one or more samples.
- WOs 21I0012 and 21I0040 – The VOC analyte vinyl chloride was detected in the associated method blanks and affected one or more samples.
- WO 21H0209 – The SVOC analyte phenol was detected in the associated method blank and affected one or more samples.
- WOs 21H0304, 21H0320, 21H0341, 21I0001, and 21I0040 – The PAH analyte 1-methylnaphthalene was detected in the associated method blanks and affected one or more samples.
- WOs 21H0248, 21H0304, 21H0320, 21H0341, 21H0367, 21I0001, 21I0012, and 21I0040 – The PAH analyte 2-methylnaphthalene was detected in the associated method blanks and affected one or more samples.
- WO 21H0367 – The PAH analytes benzo(a)anthracene, benzo(b)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene were detected in the associated method blank and affected one or more samples.
- WOs 21H0304, 21H0367, 21I0001, 21I0012, and 21I0040 – The PAH analyte dibenzofuran was detected in the associated method blanks and affected one or more samples.
- WOs 21H0207, 21H0209, 21H0248, 21H0304, 21H0320, 21H0341, 21H0367, 21I0001, 21I0012, and 21I0040 – The PAH analyte naphthalene was detected in the associated method blanks and affected one or more samples.

See Table 3 for the complete list of flagged samples from Quarter 3.

2021 Quarter 4

- WO 21L0031 – The metal analyte dissolved selenium-78 was detected in the associated method blank and affected one or more project samples.
- WOs 21K0165, 21K0213, 21K0240, and 21K0245 – The metal analyte mercury was detected in the associated method blanks and affected one or more samples.
- WOs 21K0213 and 21K0419 – The metal analyte dissolved mercury was detected in the associated method blanks and affected one or more samples.
- WO 21K0245 – The SVOC analyte diethyl phthalate was detected in the associated method blank and affected one or more samples.

- WOs 21K0240, 21K0245, 21K0284, 21K0322, 21K0367, 21K0382, 21K0419, 21K0444, and 21L0078 – The PAH analyte 2-methylnaphthalene was detected in the associated method blanks and affected one or more samples.
- WO 21L0031 – The PAH analytes anthracene and benzo(a)anthracene were detected in the associated method blank and affected one or more samples.
- WOs 21L0003, 21L0031, and 21L0078 – The PAH analyte benzo(b)fluoranthene was detected in the associated method blanks and affected one or more samples.
- WOs 21K0165 and 21K0213 – The PAH analytes carbazole, dibenzofuran, was detected in the associated method blanks and affected one or more samples.
- WOs 21K0444, 21L0031, and 21L0078 – The PAH analyte chrysene was detected in the associated method blanks and affected one or more samples.
- WO 21L0003 – The PAH analyte indeno(1,2,3-c,d)pyrene was detected in the associated method blank and affected one or more samples.
- WOs 21K0165, 21K0213, 21K0240, 21K0284, 21K0322, 21K0367, 21K0382, 21K0419, 21K0444, 21L0003, 21L0031, and 21L0078 – The PAH analyte naphthalene was detected in the associated method blanks and affected one or more samples.
- WOs 21K0444 and 21L0031 – The PAH analyte phenanthrene was detected in the associated method blanks and affected one or more samples.
- WOs 21K0165, 21K0213, 21K0444, 21L0031, and 21L0078 – The PAH analyte phenanthrene was detected in the associated method blanks and affected one or more samples.

See Table 4 for the complete list of flagged samples from Quarter 4.

Additional analytes may have been detected in the associated method blanks, but the sample results are not affected. Refer to the LDRCs for further details.

Trip Blanks

To evaluate the potential for cross-contamination between samples or introduction of contamination from an outside source, laboratory-supplied trip blanks were carried in the same cooler with the volatile samples during transport in the field, storage, and shipping. The trip blanks were analyzed for VOC, BTEX, and gasoline analyses. The following trip blank samples had detections that affected the data quality:

2021 Quarter 1

- WO 21A0376 – The VOC analyte ethylbenzene was detected in the associated trip blank and affected one or more project samples.

- WOs 21A0376, 21B0005, and 21B0081 – The VOC analyte toluene was detected in the associated trip blanks and affected one or more project samples.

See Table 1 for the complete list of flagged samples from Quarter 1.

2021 Quarter 2

There were not trip blank detections that affected the project samples for 2021 Quarter 2.

2021 Quarter 3

- WOs 21H0210, 21H0282, 21H0291, and 21I0012 – The VOC analyte toluene was detected in the associated trip blanks and affected one or more project samples.

See Table 3 for the complete list of flagged samples from Quarter 3.

2021 Quarter 4

- WO 21K0419 – The VOC analyte toluene was detected in the associated trip blank and affected one or more project samples.

See Table 4 for the complete list of flagged samples from Quarter 4.

The remaining trip blank samples did not have detections for the target analytes that affected the project samples.

Equipment Blanks

To evaluate the effectiveness of decontamination procedures for reusable sampling equipment, an equipment blank was collected periodically with the soil and groundwater samples. The equipment blanks were analyzed for the same analytes as the project samples. The following equipment blank samples had detections that affected the data quality:

2021 Quarter 1

There were not equipment blank detections that affected the project samples for 2021 Quarter 1.

2021 Quarter 2

- WO 21E0352 – The metal analyte silver-107 was detected in the associated equipment blank and affected one or more project samples.
- WO 21E0194 – The metal analyte mercury and the PAH analytes 1-methylnaphthalene and 2-methylnaphthalene were detected in the associated equipment blank and affected one or more project samples.

See Table 2 for the complete list of flagged samples from Quarter 2.

2021 Quarter 3

- WO 21H0248 – The PAH analyte 1-methylnaphthalene was detected in the associated equipment blank and affected one or more project samples.
- WO 21H0304 – The PAH analyte phenanthrene was detected in the associated equipment blank and affected one or more project samples.

See Table 3 for the complete list of flagged samples from Quarter 3.

2021 Quarter 4

- WO 21K0367 – The metal analyte barium-135 was detected in the associated equipment blank and affected one or more project samples.
- WO 21K0284 – The metal analyte copper-63 was detected in the associated equipment blank and affected one or more project samples.
- WOs 21K0284 and 21K0367 – The PAH analyte 1-methylnaphthalene was detected in the associated equipment blanks and affected one or more project samples.
- WO 21K0213 – The PAH analyte 2-methylnaphthalene was detected in the associated equipment blank and affected one or more project samples.
- WO 21K0284 – The PAH analyte acenaphthylene was detected in the associated equipment blank and affected one or more project samples.

See Table 4 for the complete list of flagged samples from Quarter 4.

Accuracy

Accuracy refers to determining the correct analyte concentration and is a comparison between the measured value and a known or expected value. Laboratory analytical accuracy may be assessed through the analyte recoveries from LCS/LCSD and MS/MSD analyses, and the recovery of analyte surrogates (for organic analytes) added to project samples.

LCS, LCSD, MS, and MSD Samples

LCS samples are prepared by the laboratory for each preparatory batch, at a minimum of one LCS per 20 samples, where required. In some cases, analytical protocol requires the laboratory also analyze an LCSD. LCSs and LCSDs are blank samples that are spiked with a known concentration of analyte(s) and prepared using the same method that is applied to field samples to extract/analyze the analyte(s). The laboratory reports a percent recovery (%R) of the spiked amount for each analyte added to the blank sample. Project samples in the same preparation batch are considered affected by LCS/LCSD recovery failures.

For certain methods, the laboratory analyzes an MS and/or an MSD in addition to the LCS. MS/MSDs are prepared and analyzed on a preparatory-batch basis and are analyzed with every 20 samples, when required. MS/MSD samples are field (native) samples that are spiked with a known concentration of analyte(s) and prepared using the same method that is applied to project samples to extract/analyze the analyte(s). The MS and MSD are used to determine the presence of matrix interferences and evaluate the analytical accuracy for a given method and matrix, expressed as a percent recovery of the spiked amount added to the field sample. The parent sample used to prepare the MS/MSD samples is considered affected by MS/MSD recovery failures.

High recoveries in the LCS, LCSD, MS, and MSD samples indicate a high analytical bias and affected samples are considered estimated, biased high, and are flagged "JH" in the data tables. Conversely, low recoveries in these samples indicate a low analytical bias and affected samples are considered estimated, biased low. Detected results are flagged "JL" and non-detect results are flagged "J" in the data tables.

The following samples are affected by the recoveries reported for the LCS, LCSD, MS, and MSD samples:

2021 Quarter 1

- WOs 21A0376 and 21B0174 – The metal analyte hexavalent chromium had gross MS and/or MSD recovery failures. The parent samples non-detect results are considered unusable and are flagged "R" in the analytical database.
- WO 21B0322 – The metal analyte hexavalent chromium had low MS and MSD recovery failures. The parent sample result is considered affected.
- WO 21B0005 – The PCB analyte Aroclor 1016 had low MS and MSD recovery failures. The parent sample result is considered affected.
- WOs 21B0081 and 21B0160 – The PCB analyte Aroclor 1260 had low MS and MSD recovery failures. The parent sample results are considered affected.
- WOs 21B0255 and 21B0272 – The VOC analytes benzene, cis-1,2-dichloroethene, ethylbenzene, m,p-xylene, o-xylene, toluene, and trichloroethene had low LCSD recovery failures. The associated sample results are considered affected.
- WO 21A0352 – The VOC analyte tetrachloroethene had a high recovery failure. The associated sample results are considered affected.
- WO 21B0126 – The VOC analyte trans-1,2-dichloroethene had gross low LCS recovery failures. The associated samples with non-detect results are considered unusable and are flagged "R" in the analytical database.

- WO 21B0160 – The VOC analyte trans-1,2-dichloroethene had low MS and MSD recovery failures. The parent sample results are considered affected.
- WO 21B0081 – The SVOC analyte 3,3'-dichlorobenzidine had gross MS and MSD recovery failures. The parent samples non-detect results are considered unusable and are flagged "R" in the analytical database.
- WOs 21B0227 and 21B0255 - The SVOC analyte 3,3'-dichlorobenzidine had MS and MSD recovery failures. The parent samples are considered affected.
- WO 21B0160 – The SVOC analyte 4-chloroaniline had a low LCS recovery failure. The associated sample results are considered affected.
- WOs 21B0227, 21B0255, 21B0309, and 21B0322 – The SVOC analyte 4-chloroaniline had gross LCS and LCSD recovery failures. The associated samples with non-detect results are considered unusable and are flagged "R" in the analytical database.
- WO 21B0322 – The SVOC analyte 4-nitrophenol had gross LCS and LCSD recovery failures. The associated samples with non-detect results are considered unusable and are flagged "R" in the analytical database.
- WOs 21B0005 and 21G0121 – The SVOC analyte N-nitrosodiphenylamine had low LCS recovery failures. The associated sample results are considered affected.
- WOs 21B0227 and 21B0255 - The SVOC analyte phenol had low LCS and LCSD recovery failures. The parent samples are considered affected.
- WO 21A0376 – The PAH analytes benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(j)fluoranthene, dibenzo(a,h)anthracene, fluoranthene, and indeno(1,2,3-c,d)pyrene had low MS recovery failures. The parent sample results are considered affected.
- WO 21B0005 – The PAH analyte naphthalene had low MS and MSD recovery failures. The parent sample is considered affected.
- WO 21B0081 – The C8-C10 Aliphatics MS and MSD had gross recovery failures. The parent samples non-detect results are considered unusable and are flagged "R" in the analytical database.

See Table 1 for the complete list of flagged samples from Quarter 1.

2021 Quarter 2

- WO 21E0352 – The metal analyte lead-208 had low MS and MSD recovery failures. The parent sample result is considered affected.
- WOs 21E0174, 21E0244, 21E0290, 21E0260 and 21E0323 – The SVOC analyte 4-chloroaniline had a low LCS and/or LCSD recovery failures. The associated sample results are considered affected.

See Table 2 for the complete list of flagged samples from Quarter 2.

2021 Quarter 3

- WOs 21H0248 and 21H0320 – The anion analyte nitrate-N had low MS recovery failures. The parent sample results are considered affected.
- WO 21H0230 – The metal analytes chromium-52 and manganese-55 had had low MS recovery failures. The parent sample results are considered affected.
- WO 21H0304 – The PCB analyte Aroclor 1260 had LCS and LCSD recovery failures. The associated sample results are considered affected.
- WO 21I0001 – The SVOC analyte 2,4-dichlorophenol had a low LCS recovery failure. The associated sample results are considered affected.
- WO 21H0341 – The SVOC analyte 2,4-dichlorophenol had low LCS and LCSD recovery failures. The associated sample results are considered affected.
- WOs 21H0341, 21I0001, and 21I0012 – The SVOC analytes 4-chloroaniline and hexachlorocyclopentadiene had low LCS and/or LCSD recovery failures. The associated sample results are considered affected.
- WOs 21H0222 and 21H0320 – The SVOC analytes 4-chloroaniline had LCS and LCSD recovery failures. The associated sample results are considered affected.
- WOs 21H0209, 21H0222, and 21H0320 – The SVOC analytes 4-nitrophenol had LCS and LCSD recovery failures. The associated sample results are considered affected.
- WOs 21H0222, 21H0248, 21H0291, 21H0304, 21H0320, 21H0341, 21I0001, 21I0012, and 21I0040 – The SVOC analyte benzoic acid had low LCS and/or LCSD recovery failures. The associated sample results are considered affected.
- WO 21H320 – The SVOC analyte benzyl alcohol had low LCS and LCSD recovery failures. The associated sample results are considered affected.
- WOs 21H0222, 21H0320, and 21I0012 – The SVOC analyte phenol had low LCS and LCSD recovery failures. The associated sample results are considered affected.
- WO 21H0320 – The NWTPH-Dx analyte DRO had a high LCS recovery. The associated samples with detected results are considered affected.
- WO 21H0207 – The metal analyte hexavalent chromium had a low MS recovery failure. The parent sample result is considered affected.
- WOs 21H0291 and 21H0304 – The metal analyte had gross MS recovery failures. The parent samples non-detect results are considered unusable and are flagged “R” in the analytical database.

See Table 3 for the complete list of flagged samples from Quarter 3.

2021 Quarter 4

- WO 21K0343 – The metal analyte had a gross MS recovery failure. The parent sample non-detect result is considered unusable and is flagged “R” in the analytical database.
- WO 21K0240 – The metal analyte copper-63 had a high MS recovery failure. The detected result in the parent sample is considered affected.
- WO 21K0245 – The metal analyte chromium-52 had a low MS recovery failure. The parent sample result is considered affected.
- WOs 21K0444 and 21L0031 – The SVOC analytes 3,3'-dichlorobenzadine, 4-chloroaniline, 4-nitrophenol, and benzoic acid had low LCS and LCSD recovery failures. The associated samples are considered affected.
- WOs 21K0245, 21K0284, 21K0303, 21K0322, and 21K0343 – The SVOC analyte 4-chloroaniline had low LCS and/or LCSD recovery failures. The associated samples are considered affected.
- WOs 21K0284, 21K0303, 21K0322, and 21K0343 – The SVOC analyte 4-nitrophenol had low LCS and/or LCSD recovery failures. The associated samples are considered affected.
- WOs 21K0284, 21K0303, 21K0322, 21L0046, and 21L0078 – The SVOC analyte benzoic acid had low LCS and/or LCSD recovery failures. The associated samples are considered affected.
- WOs 21K0245, 21K0284, 21K0303, and 21K0322 – The SVOC analyte 4-chloroaniline had low LCS and/or LCSD recovery failures. The associated samples are considered affected.

See Table 4 for the complete list of flagged samples from Quarter 4.

Additional QC failures were observed that did not affect the data. Refer to the LDRCs for further details.

Surrogates

Surrogates are organic compounds that are similar to the analytes being evaluated for a given analytical method (often a deuterated version of the one of the analytes). They are used to identify matrix interferences and inefficiencies in the sample extraction process for organic analyses. The surrogates are introduced into a field or laboratory-QC sample prior to sample preparation and analysis. Accuracy is expressed as a percent recovery of the spiked amount. Some methods require analysis using an isotope dilution method, which uses isotope dilution analytes (IDAs) instead of a surrogate and corrects the raw data of the associated analyte concentration based on the recovery of the IDA.

As with LCS, LCSD, MS, and MSD samples, high surrogate recoveries indicate a high analytical bias and affected samples are considered estimated, biased high, and are flagged “JH” in the data tables. Conversely, low surrogate recoveries in these samples indicate a low analytical bias and affected samples are considered estimated, biased low. Detected results are flagged “JL” in the data tables and non-detect results are flagged “J” in the data tables. IDA recoveries do not impart a bias to the data since these analytes are self-correcting.

The following samples are affected by the recoveries reported for the surrogates:

2021 Quarter 1

- WO 21B0005 – One or more DRO surrogates for sample *SB-2021-006:10-01292021* had low recovery failures. The associated analytes are affected.
- WO 21B0087 – One or more DRO surrogates for sample *MW-22R:5.5-02032021* had high recovery failures. The associated analytes are affected.
- WO21B0160 - One or more PCB surrogates for sample *MW-51-20211002* had low recovery failures. The associated analytes are affected.
- WO 21D0061 – One or more PCB surrogates for samples *MW-58:8.4-01272021* had high recovery failures. The associated analytes with detections are affected.
- WO 21B0101 – One or more VOC surrogates for sample *MW-71:20.5-02042021* had low recovery failures. The associated analytes are affected.
- WO 21A0376 - One or more VOC surrogates for samples *TSA-2021-004:1.7-01252021* had high recovery failures. The associated analytes with detections are affected.
- WOs 21B0227, 21B0239, 21B0255, 21B0272, 21B0296, 21B0309, 21B0322, and 21B0344 – One or more SVOC surrogates for several samples had low recovery failure. The associated analytes are affected.

See Table 1 for the complete list of flagged samples from Quarter 1.

2021 Quarter 2

- WO 21E0174 – One or more SVOC surrogates for sample *MW-76-20211305* had high recovery failure. The associated analytes with detections are affected.
- WOs 21E0290, 21E0302, and 21E0352 – One or more SVOC surrogates for several samples had low recovery failure. The associated analytes are affected.

See Table 2 for the complete list of flagged samples from Quarter 2.

2021 Quarter 3

- WOs 21H0207 and 21H0209 – One or more PCB surrogates for samples *MW-68-20211708* and *MW-71-20211708* had low recovery failures. The associated analytes are affected.
- WO 21H0304 – One or more SVOC surrogates for sample *MW-58-20212508* had high recovery failures. The associated analytes with detections are affected.
- WOs 21H0222, 21H0248, 21H0291, 21H0304, 21H0320, 21H0341, 21I0001, 21I0012, and 21I0040 – One or more SVOC surrogates for several samples had low recovery failure. The associated analytes are affected.

See Table 3 for the complete list of flagged samples from Quarter 3.

2021 Quarter 4

- WO 21K0245 – One or more dissolved gas surrogates for sample *MW-30-20211211* had low recovery failures. The associated analytes are affected.
- WO 21J0060 – One or more PCB surrogates for samples *SB-2021-048:1.5-10042021*, *SB-2021-049:1-10042021*, and *SB-2021-051:1.2-10042021* had high recovery failures. The associated analytes with detections are affected.
- WO 21K0245 – One or more VOC surrogates for sample *MW-58-20211211* had high recovery failures. The associated analytes with detections are affected.
- WOs 21K0165, 21K0213, 21K0240, 21K0245, 21K0284, 21K0303, 21K0322, 21K0367, 21K0419, 21L0031, 21L0046, and 21L0078 – One or more SVOC surrogates for several samples had low recovery failure. The associated analytes are affected.

See Table 4 for the complete list of flagged samples from Quarter 4.

Calibration Verification Samples

The laboratory also assesses analytical batch accuracy using recovery information from initial calibration verification (ICV) and continuing calibration verification (CCV) samples. Assessment of ICV/CCV recoveries is beyond the scope of a Level II data review. However, the laboratory reported ICV/CCV recovery discrepancies for several WOs in the case narratives and identified a bias to the analytical results. The following samples were affected by ICV/CCV failures:

2021 Quarter 1

- WO 21D0061 – The PAH analytes acenaphthene, benzo(b)fluoranthene, and dibenzofuran had low ICV recovery failures. The associated samples are affected.

See Table 1 for the complete list of flagged samples from Quarter 1.

2021 Quarter 2

There were no ICV or CCV failures that affected the data for 2021 Quarter 2.

2021 Quarter 3

There were no ICV or CCV failures that affected the data for 2021 Quarter 3.

2021 Quarter 4

There were no ICV or CCV failures that affected the data for 2021 Quarter 4.

Additional ICV/CCV failures may have been observed but did not affect the data. Refer to the LDRCs for further details.

Precision

Laboratory analytical precision can be assessed by comparing the results of duplicate analyses performed on LCS/LCSD, MS/MSD, and laboratory-duplicate samples, and evaluating the associated relative percent differences (RPDs; difference between the sample and its duplicate divided by the mean of the two). The data quality objective for RPDs is 20 percent for the laboratory QC samples. In addition, we collected field-duplicate samples at the required frequency for the project to evaluate the precision of the analytical measurements and reproducibility of our sampling technique. The data quality objective is 50 percent for soil field-duplicate samples and 30 percent for water field-duplicate samples.

LCS/LCSD, MS/MSD, and Laboratory Duplicate RPDs

The laboratory LCS/LCSD, MS/MSD, and laboratory duplicate samples were evaluated to assess laboratory precision. Samples associated with preparation batches with LCS/LCSD RPD failures are considered affected by the precision failures. The parent samples associated with the MS/MSD or laboratory duplicate samples are considered affected by the precision failures. Affected samples with detections and non-detections are flagged “J” in the data tables. The following samples had RPDs that did not meet the project data quality objectives:

2021 Quarter 1

- WO 21B0005 - The metals analyte arsenic-75a, cadmium-111, lead-208, mercury, nickel-60, selenium-78, silver-107, and zinc-66 had laboratory duplicate RPD failures. The parent sample results are considered affected.
- WO 21B0239 – The metal analytes cadmium-111 and zinc-66 had laboratory duplicate RPD failures. The parent sample results are considered affected.

- WO 21D0061 – The metal analyte cadmium-111 and selenium-78 had laboratory duplicate RPD failures. The parent sample results are considered affected.
- WOs 21A0376, 21B0005, 21B0081, and 21B0239 – The metal analyte selenium-78 had laboratory duplicate RPD failures. The parent sample results are considered affected.
- WOs 21A0352 and 21A0376 – The metal analyte silver-107 had laboratory duplicate RPD failures. The parent sample results are considered affected.
- WO 21B0255 – The metal analyte zinc-66 had a laboratory duplicate RPD failure. The parent sample result is considered affected.
- WOs 21B0081, 21B0272, and 21B0296 – The metal analyte mercury had laboratory duplicate RPD failures. The parent sample results are considered affected.
- WOs 21B0227 and 21B0255 – The SVOC analyte 3-nitroaniline had an LCS/LCSD RPD failure. The associated sample results are considered affected.
- WO 21B0160 – The SVOC analyte hexachlorobutadiene had an LCS/LCSD RPD failure. The associated sample results are considered affected.
- WO 21B0101 – The SVOC analyte pentachlorophenol had an LCS/LCSD RPD failure. The associated sample results are considered affected.

WO 21A0376 – The PAH analytes anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, fluorene, indeno(1,2,3-c,d)pyrene, and phenanthrene had MS/MSD RPD failures. The parent sample results are considered affected.

See Table 1 for the complete list of flagged samples from Quarter 1.

2021 Quarter 2

- WO 21E0290 – The metal analytes copper-63 and lead-208 had laboratory duplicate RPD failures. The parent sample results are considered affected.
- WOs 21E0213 and 21E0290 – The metal analyte dissolved copper-63 had laboratory duplicate RPD failures. The parent sample results are considered affected.
- WO 21E0323 – The SVOC analytes 3,3'-dichlorobenzidine and hexachlorocyclopentadiene had LCS/LCSD RPD failures. The associated sample results are considered affected.

See Table 2 for the complete list of flagged samples from Quarter 2.

2021 Quarter 3

- WO 21H0222 – The anion analyte sulfate had a laboratory duplicate RPD failure. The parent sample result is considered affected.

- WO 21H0291 – The metal analyte nickel-60 had a laboratory duplicate RPD failure. The parent sample result is considered affected.
- WO 21H0367 – The metal analyte dissolved nickel-60 had a laboratory duplicate RPD failure. The parent sample result is considered affected.
- WOs 21H0341 and 21H0367 – The VOC analyte vinyl chloride had LCS/LCSD RPD failures. The associated sample results are considered affected.
- WO 21H0320 – The SVOC analyte 2-nitrophenol had an LCS/LCSD RPD failure. The associated sample results are considered affected.
- WOs 21H0222 and 21H0230 – The NWTHP-Dx analyte DRO had LCS/LCSD RPD failures. The associated sample results are considered affected.

See Table 3 for the complete list of flagged samples from Quarter 3.

2021 Quarter 4

- WO 21L0031 – The metal analytes cobalt-59, dissolved copper-52, and dissolved cobalt-59 had laboratory duplicate RPD failures. The parent sample results are considered affected.
- WOs 21K0284 and 21K0419 – The metal analyte copper-52 had laboratory duplicate RPD failures. The parent sample results are considered affected.
- WO 21K0419 – The metal analyte selenium-78 had a laboratory duplicate RPD failure. The parent sample results are considered affected.
- WO 21L0078 – The metal analyte dissolved cobalt-59 had a laboratory duplicate RPD failure. The parent sample results are considered affected.
- WO 21K0303 – The metal analyte dissolved manganese-55 had a laboratory duplicate RPD failure. The parent sample results are considered affected.
- WO 21K0303 and 21K0419 – The metal analyte selenium-78 had laboratory duplicate RPD failures. The parent sample results are considered affected.
- WO 21K0303 – The SVOC analytes 2,4-dichlorophenol and 4-chlorophenylphenyl ether had LCS/LCSD RPD failures. The associated sample results are considered affected.
- WO 21K0284 – The SVOC analytes 2,4-dichlorophenol, 4-chlorophenylphenyl ether, and hexachlorocyclopentadiene had LCS/LCSD RPD failures. The associated sample results are considered affected.
- WO 21K0322 – The SVOC analytes 2,4-dinitrotoluene and 4-chlorophenylphenyl ether had LCS/LCSD RPD failures. The associated sample results are considered affected.

See Table 4 for the complete list of flagged samples from Quarter 4.

Additional LCS/LCSD, MS/MSD, and laboratory duplicate RPD failures may have been observed but did not affect the data. Refer to the LDRCs for further details.

Field Duplicate RPDs

The field-duplicate samples were evaluated to assess laboratory precision and the reproducibility of our sampling technique. Analytes need to be detected in both the primary and field-duplicate samples in order to calculate an RPD. Affected samples are flagged “J” in the associated data tables. The following samples had field-duplicate precision failures that did not meet the project data quality objectives:

2021 Quarter 1

- WO 21A0352 – Several target analytes had field duplicate RPD failures for the field duplicate pairs *SB-2021-011:1-01252021 / SB-2021-101:1-01252021* and *SB-2021-034:10.7-01252021 / SB-2021-102:10.7-01252021*. The field duplicate samples results are considered affected.
- WO 21A0376 – Several target analytes had field duplicate RPD failures for the field duplicate pairs *MW-76:5.0-01262021 / MW-100:5.0-01262021* and *SB-2021-021:2.5-01272021 / SB-2021-103:2.5-01272021*. The field duplicate samples results are considered affected.
- WO 21B0005 – Several target analytes had field duplicate RPD failures for the field duplicate pairs *SB-2021-002:6-01282021 / SB-2021-104:6-01282021*, *SB-2021-041:2-01282021 / SB-2021-106:2-01282021*, *SB-2021-010:6-01282021 / SB-2021-104:6-01282021*, and *SB-2021-042:11-01292021 / SB-2021-106:11-01292021*. The field duplicate samples results are considered affected.
- WO 21B0081 – Several target analytes had field duplicate RPD failures for the field duplicate pairs *MW-56:8.0-02022021 / MW-101:8.0-02022021* and *MW-74:10.3-02022021 / MW-101:10.3-02022021*. The field duplicate samples results are considered affected.
- WO 21B0126 – Several target analytes had field duplicate RPD failures for the field duplicate pairs *MW-10R:9-02052021 / MW-104:9-02052021*. The field duplicate samples results are considered affected.
- WO 21B0081 – Several target analytes had field duplicate RPD failures for the field duplicate pairs *MW-63-20211702 / MW-103-20211702* and *MW-76-20211002 / MW-100-20211002*. The field duplicate samples results are considered affected.
- WO 21B0309 – Several target analytes had field duplicate RPD failures for the field duplicate pairs *MW-53-20212202 / MW-101-20212202* and *MW-37-20212302 / MW-102-20212302*. The field duplicate samples results are considered affected.

- WO 21G0121 – The SVOC analyte diethyl phthalate had a field duplicate RPD failures for the field duplicate pairs *MW-76:5.0-01262021* / *MW-100:5.0-01262021*. The field duplicate samples results are considered affected.

See Table 1 for the complete list of flagged samples from Quarter 1.

2021 Quarter 2

- WO 21E0244 – Several target analytes had field duplicate RPD failures for the field duplicate pairs *MW-62-20211905* / *MW-103-20211905*. The field duplicate samples results are considered affected.
- WO 21E0290 – The NWTPH-Dx analyte DRO had a field duplicate RPD failures for the field duplicate pairs *MW-32-20212405* / *MW-102-20212405*. The field duplicate samples results are considered affected.

See Table 2 for the complete list of flagged samples from Quarter 2.

2021 Quarter 3

- WO 21H0222 – The metal analyte dissolved manganese-55 had a field duplicate RPD failure for the field duplicate pairs *MW-38-20211808* / *MW-103-20211808*. The field duplicate samples results are considered affected.
- WO 21H0282 – Several target analytes had field duplicate RPD failures for the field duplicate pairs *MW-66-20212308* / *MW-102-20212308*. The field duplicate samples results are considered affected.
- WO 21I0001 – Several target analytes had field duplicate RPD failures for the field duplicate pairs *MW-75-20213108* / *MW-101-20213108*. The field duplicate samples results are considered affected.

See Table 3 for the complete list of flagged samples from Quarter 3.

2021 Quarter 4

- WO 21J0060 – The PCB analyte Aroclor 1254 had a field duplicate RPD failure for samples *SB-2021-050:6.5-10042021* and *SB-2021-Dup*. The field duplicate samples results are considered affected.
- WO 21K0165 – The metal analyte manganese-55 had a field duplicate RPD failure for samples *MW-50-20210911* and *MW-103-20210911*. The field duplicate samples results are considered affected.
- WO 21K0240 – Several target analytes had field duplicate RPD failures for the field duplicate pairs *MW-40-20211111* and *MW-102-20211111*. The field duplicate samples results are considered affected.

See Table 4 for the complete list of flagged samples from Quarter 4.

Additional Precision Failures

In addition to the assessments of precision listed above, the analysis of PCBs was conducted using a primary and confirmation column. Per the method, the RPD data quality objective is 40 percent for the results obtained for the two columns. The laboratory noted the following confirmation column RPD failure:

- WO 21D0061 – The PCB analyte Aroclor 1254 result for sample *SB-2021-025:10-1272021* had a confirmation column RPD failure. The sample result is considered estimated and is flagged “J” in the data table.
- WO 21J0060 – The PCB analytes Aroclor 1260, Aroclor 1262, and/or Aroclor 1268 results for samples *SB-2021-048:8.5-10042021*, *SB-2021-049:7.5-10042021*, *SB-2021-051:8.0-10042021*, *SB-2021-052:0.1-10042021*, *SB-2021-056:5.5-10042021*, and *SB-2021-057:0.8-10042021* had confirmation column RPD failures. The sample results are considered estimated and is flagged “J” in the data table.

See the flag summary tables for applied qualifiers.

Additional Qualifiers

The transition mass ratio for perfluorooctanesulfonic acid was outside laboratory acceptance criteria for sample MW-68-20211602 in WO 320-70313. The laboratory analyst used professional judgement to positively identify the analyte but noted that there is some uncertainty in the identification and a possible high bias. The sample result is considered estimated and is flagged “JH” in the analytical tables.

The laboratory analyst identified that the project samples *MW-6-20212911* and *MW-73-20212911* in WO 21L0003 had positive detections for DRO. However, the laboratory noted that the elution pattern was not consistent with a fuel pattern. The sample result is flagged “J” in the analytical tables.

Representativeness

Sample log sheets were reviewed to ensure the samples were collected according to the SAP, and the results, therefore, represent the location and depth sampled. In addition, where possible, the analytical result for each sample will be compared to the historical results to check that the result is consistent with the broader data set for that location.

Comparability

Our reviewers qualitatively assess the comparability between historical and current data sets and use caution in combining data sets if the quality of the data is uncertain. For example,

current analytical methods used to analyze for BTEX may not be comparable to historical BTEX methods where the RL was elevated.

Completeness

The overall data set from this sampling event was evaluated to determine if the completeness goal of 90 percent useable data was achieved. Completeness is calculated by comparing the amount of useable data to the overall number of samples. There were over 15,000 data points reported for this project between January 2021 and December 2021. There were thirteen unusable results in 2021 Quarter 1, no unusable results in 2021 Quarter 2, two unusable results in 2021 Quarter 3, and one unusable result in 2021 Quarter 4. A total of sixteen unusable data points amount to approximately 0.1-percent of the data set being considered unusable. The target of 90 percent completion for the project was achieved.

DATA QUALITY SUMMARY

Based on the methods outlined in the site-specific QAPP, the samples detailed in the laboratory reports for 2021 Quarters 1 through 4 are considered to be representative of site conditions at the locations and times they were obtained. Results affected by QC anomalies are qualified with the appropriate data flags and are considered usable with the applied qualifiers. A summary of the applied qualifiers are presented in Tables 1 through 4. The quality of the analytical data for this sample batch does not appear to have been compromised by analytical irregularities.

We appreciate the opportunity to be of service to you on this project. If you have any questions concerning this report, or we may be of further service, please contact us.

Sincerely,

SHANNON & WILSON, INC.

Michael Jaramillo
Senior Chemist

Enc: Table 1 – 2021 Quarter 1 Result Flags

Table 2 – 2021 Quarter 2 Result Flags

Table 3 – 2021 Quarter 3 Result Flags

Table 4 – 2021 Quarter 4 Result Flags

Laboratory Data Review Checklists

Table 1 - 2021 Quarter 1 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21A0352	MW-66:1.2-0112521	Soil	Tetrachloroethene	SW8260D	JH*	High	LCS Recovery Failure
21A0352	MW-66:5.5-0112521	Soil	Fluoranthene	SW8270E-SIM	JH*	High	Method Blank Detection
21A0352	SB-2021-009:10.8-01252021	Soil	Fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21A0352	SB-2021-009:2-01252021	Soil	Fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21A0352	SB-2021-009:6-01252021	Soil	Fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21A0352	SB-2021-011:1-01252021	Soil	Copper-63	SW6020	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-011:1-01252021	Soil	Nickel-60	SW6020	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-011:1-01252021	Soil	Vanadium-51a	SW6020	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-011:1-01252021	Soil	Acenaphthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-011:1-01252021	Soil	Acenaphthylene	SW8270E-SIM	JL*	Low	MS/MSD Recovery Failure
21A0352	SB-2021-011:1-01252021	Soil	Benzo(a)pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-011:1-01252021	Soil	Benzo(g,h,i)perylene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-011:1-01252021	Soil	Dibenzo(a,h)anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-011:1-01252021	Soil	Naphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-012:10.4-01252021	Soil	Fluoranthene	SW8270E-SIM	JH*	High	Method Blank Detection
21A0352	SB-2021-017:2-01252021	Soil	Silver-107	SW6020	J*	None	Laboratory Duplicate RPD Failure
21A0352	SB-2021-017:5-01252021	Soil	Fluoranthene	SW8270E-SIM	JH*	High	Method Blank Detection
21A0352	SB-2021-034:10.7-01252021	Soil	Diesel Range Organics	NWTPH-Dx	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-034:10.7-01252021	Soil	Gasoline Range Organics	NWTPHg	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-034:10.7-01252021	Soil	Benzene	SW8260D	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-034:10.7-01252021	Soil	m,p-Xylene	SW8260D	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-034:10.7-01252021	Soil	Toluene	SW8260D	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-039:2-01252021	Soil	Fluoranthene	SW8270E-SIM	JH*	High	Method Blank Detection
21A0352	SB-2021-101:1-01252021	Soil	Copper-63	SW6020	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-101:1-01252021	Soil	Nickel-60	SW6020	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-101:1-01252021	Soil	Vanadium-51b	SW6020	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-101:1-01252021	Soil	Acenaphthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-101:1-01252021	Soil	Benzo(a)pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-101:1-01252021	Soil	Benzo(g,h,i)perylene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-101:1-01252021	Soil	Dibenzo(a,h)anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-101:1-01252021	Soil	Naphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-102:10.7-01252021	Soil	Diesel Range Organics	NWTPH-Dx	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-102:10.7-01252021	Soil	Gasoline Range Organics	NWTPHg	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-102:10.7-01252021	Soil	Benzene	SW8260D	J*	None	Field Duplicate RPD Failure
21A0352	SB-2021-102:10.7-01252021	Soil	m,p-Xylene	SW8260D	J*	None	Field Duplicate RPD Failure

Table 1 - 2021 Quarter 1 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21A0352	SB-2021-102:10.7-01252021	Soil	Toluene	SW8260D	J*	None	Field Duplicate RPD Failure
21A0376	MW-100:5.0-01262021	Soil	DRO	NWTPH-Dx	J*	None	Field Duplicate RPD Failure
21A0376	MW-100:5.0-01262021	Soil	Arsenic-75a	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-100:5.0-01262021	Soil	Barium-135	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-100:5.0-01262021	Soil	Cadmium-111	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-100:5.0-01262021	Soil	Copper-63	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-100:5.0-01262021	Soil	Lead-208	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-100:5.0-01262021	Soil	Nickel-60	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-100:5.0-01262021	Soil	Selenium-78	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-100:5.0-01262021	Soil	Silver-107	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-100:5.0-01262021	Soil	Zinc-66	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-100:5.0-01262021	Soil	Mercury	SW7471	J*	None	Field Duplicate RPD Failure
21A0376	MW-100:5.0-01262021	Soil	Acenaphthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0376	MW-100:5.0-01262021	Soil	Benzo(a)anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0376	MW-100:5.0-01262021	Soil	Fluorene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0376	MW-100:5.0-01262021	Soil	Phenanthrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0376	MW-57:10-01272021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21A0376	MW-58:1.5-01272021	Soil	Benzo(a)pyrene	SW8270E-SIM	J*	None	MS/MSD RPD Failure
21A0376	MW-58:1.5-01272021	Soil	Benzo(g,h,i)perylene	SW8270E-SIM	J*	None	MS/MSD RPD Failure
21A0376	MW-58:1.5-01272021	Soil	Dibenzo(a,h)anthracene	SW8270E-SIM	J*	None	MS/MSD RPD Failure
21A0376	MW-58:1.5-01272021	Soil	Indeno(1,2,3-c,d)pyrene	SW8270E-SIM	J*	None	MS/MSD RPD Failure
21A0376	MW-58:1.5-01272021	Soil	Phenanthrene	SW8270E-SIM	J*	None	MS/MSD RPD Failure
21A0376	MW-58:8.4-01272021	Soil	Benzene	SW8260D	JH*	High	Surrogate Recovery Failure
21A0376	MW-67:0.5-01262021	Soil	Hexavalent Chromium	SM 3500-Cr B-09	R*	Low	Gross MS Recovery Failure
21A0376	MW-76:5.0-01262021	Soil	DRO	NWTPH-Dx	J*	None	Field Duplicate RPD Failure
21A0376	MW-76:5.0-01262021	Soil	Arsenic-75a	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-76:5.0-01262021	Soil	Barium-135	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-76:5.0-01262021	Soil	Cadmium-111	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-76:5.0-01262021	Soil	Copper-63	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-76:5.0-01262021	Soil	Lead-208	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-76:5.0-01262021	Soil	Nickel-60	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-76:5.0-01262021	Soil	Selenium-78	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-76:5.0-01262021	Soil	Silver-107	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-76:5.0-01262021	Soil	Zinc-66	SW6020	J*	None	Field Duplicate RPD Failure
21A0376	MW-76:5.0-01262021	Soil	Mercury	SW7471	J*	None	Field Duplicate RPD Failure

Table 1 - 2021 Quarter 1 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21A0376	MW-76:5.0-01262021	Soil	Acenaphthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0376	MW-76:5.0-01262021	Soil	Benzo(a)anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0376	MW-76:5.0-01262021	Soil	Fluorene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0376	MW-76:5.0-01262021	Soil	Phenanthrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21A0376	SB-2021-003:10.3-01262020	Soil	Toluene	SW8260D	UB*	High	Trip Blank Detection
21A0376	SB-2021-021:2.5-01272021	Soil	RRO	NWTPH-Dx	UJ*	None	Field Duplicate RPD Failure
21A0376	SB-2021-021:2.5-01272021	Soil	Aroclor 1260	SW8082A	J*	None	Field Duplicate RPD Failure
21A0376	SB-2021-033:15-01262021	Soil	Ethylbenzene	SW8260D	UB*	High	Trip Blank Detection
21A0376	SB-2021-033:15-01262021	Soil	Toluene	SW8260D	UB*	High	Trip Blank Detection
21A0376	SB-2021-035:13.8-01262021	Soil	Toluene	SW8260D	UB*	High	Trip Blank Detection
21A0376	SB-2021-038:2-01262021	Soil	Anthracene	SW8270E-SIM	J*	None	MS/MSD RPD Failure
21A0376	SB-2021-038:2-01262021	Soil	Benzo(a) anthracene	SW8270E-SIM	JL*	Low	MS Recovery and MS/MSD RPD Failures
21A0376	SB-2021-038:2-01262021	Soil	Benzo(a) pyrene	SW8270E-SIM	JL*	Low	MS Recovery Failure
21A0376	SB-2021-038:2-01262021	Soil	Benzo(b) fluoranthene	SW8270E-SIM	JL*	Low	MS Recovery Failure
21A0376	SB-2021-038:2-01262021	Soil	Benzo(g,h,i) perylene	SW8270E-SIM	JL*	Low	MS Recovery Failure
21A0376	SB-2021-038:2-01262021	Soil	Benzo(j) fluoranthene	SW8270E-SIM	JL*	Low	MS Recovery Failure
21A0376	SB-2021-038:2-01262021	Soil	Dibenzo(a,h)anthracene	SW8270E-SIM	JL*	Low	MS Recovery and MS/MSD RPD Failures
21A0376	SB-2021-038:2-01262021	Soil	Fluoranthene	SW8270E-SIM	JL*	Low	MS Recovery Failure
21A0376	SB-2021-038:2-01262021	Soil	Fluorene	SW8270E-SIM	J*	None	MS/MSD RPD Failure
21A0376	SB-2021-038:2-01262021	Soil	Indeno(1,2,3-c,d)pyrene	SW8270E-SIM	JL*	Low	MS Recovery Failure
21A0376	SB-2021-046:2-01262021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21A0376	SB-2021-046:2-01262021	Soil	Silver-107	SW6020	J*	None	Laboratory Duplicate RPD Failure
21A0376	SB-2021-103:2.5-01272021	Soil	RRO	NWTPH-Dx	J*	None	Field Duplicate RPD Failure
21A0376	SB-2021-103:2.5-01272021	Soil	Aroclor 1260	SW8082A	J*	None	Field Duplicate RPD Failure
21B0005	AugerWater-01292021	Decon Water	Cadmium-111	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0005	AugerWater-01292021	Decon Water	Lead-208	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0005	AugerWater-01292021	Decon Water	Nickel-60	SW6020 (Dissolved)	J*	None	Laboratory Duplicate RPD Failure
21B0005	AugerWater-01292021	Decon Water	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21B0005	MW-75:21.0-01282021	Soil	Toluene	SW8260D	JH	High	Trip Blank Detection
21B0005	MW-75:8.5-01282021	Soil	Toluene	SW8260D	B*	High	Trip Blank Detection
21B0005	ProbeWater-01292021	Decon Water	Iron-54	SW6020 (Dissolved)	B*	High	Method Blank Detection
21B0005	ProbeWater-01292021	Decon Water	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21B0005	SB-2021-002:6-01282021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate and Field Duplicate RPD Failures
21B0005	SB-2021-002:6-01282021	Soil	Silver-107	SW6020	J*	None	Laboratory Duplicate and Field Duplicate RPD Failures
21B0005	SB-2021-002:6-01282021	Soil	Zinc-66	SW6020	J*	None	Laboratory Duplicate RPD Failure

Table 1 - 2021 Quarter 1 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0005	SB-2021-002:6-01282021	Soil	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0005	SB-2021-002:6-01282021	Soil	Anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-002:6-01282021	Soil	Benzo(a)anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-002:6-01282021	Soil	Benzo(a)pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-002:6-01282021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-002:6-01282021	Soil	Benzo(g,h,i)perylene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-002:6-01282021	Soil	Chrysene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-002:6-01282021	Soil	Fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-002:6-01282021	Soil	Fluorene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-002:6-01282021	Soil	Pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-006:10-01292021	Soil	Diesel Range Organics	NWTPH-Dx	JL*	Low	Surrogate Recovery Failure
21B0005	SB-2021-006:10-01292021	Soil	Residual Range Organics	NWTPH-Dx	JL*	Low	Surrogate Recovery Failure
21B0005	SB-2021-006:6-01292021	Soil	Naphthalene	SW8270E-SIM	JL	Low	MS and MSD Recovery Failures
21B0005	SB-2021-010:1.5-01282021	Soil	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0005	SB-2021-010:11-01282021	Soil	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0005	SB-2021-010:6-01282021	Soil	Lead-208	SW6020	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-010:6-01282021	Soil	2-Methylnaphthalene	SW8270E-SIM	JH	High	Method Blank Detection
21B0005	SB-2021-040:2-01282021	Soil	Arsenic-75a	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0005	SB-2021-040:2-01282021	Soil	Cadmium-111	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0005	SB-2021-040:2-01282021	Soil	Silver-107	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0005	SB-2021-040:2-01282021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0005	SB-2021-040:2-01282021	Soil	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0005	SB-2021-041:10.5-01282021	Soil	Toluene	SW8260D	B*	High	Trip Blank Detection
21B0005	SB-2021-041:2-01282021	Soil	Cadmium-111	SW6020	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-041:2-01282021	Soil	Zinc-67	SW6020	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-041:2-01282021	Soil	Trichloroethene	SW8260D	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-041:2-01282021	Soil	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0005	SB-2021-041:2-01282021	Soil	Pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-041:6-01282021	Soil	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0005	SB-2021-042:11-01292021	Soil	Diesel Range Organics	NWTPH-Dx	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-042:11-01292021	Soil	1-Methylnaphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-042:11-01292021	Soil	2-Methylnaphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-042:11-01292021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-042:11-01292021	Soil	Benzo(j)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-042:11-01292021	Soil	Benzo(k)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure

Table 1 - 2021 Quarter 1 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0005	SB-2021-042:11-01292021	Soil	Dibenzofuran	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-042:11-01292021	Soil	Naphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-068:1.0-01262021	Soil	Toluene	SW8260D	B*	High	Trip Blank Detection
21B0005	SB-2021-068:1.0-01262021	Soil	N-Nitrosodiphenylamine	SW8270E	J*	Low	LCS Recovery Failure
21B0005	SB-2021-068:5.5-01262021	Soil	Toluene	SW8260D	B*	High	Trip Blank Detection
21B0005	SB-2021-068:5.5-01262021	Soil	N-Nitrosodiphenylamine	SW8270E	J*	Low	LCS Recovery Failure
21B0005	SB-2021-104:6-01282021	Soil	Lead-208	SW6020	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-104:6-01282021	Soil	2-Methylnaphthalene	SW8270E-SIM	JH	High	Method Blank Detection
21B0005	SB-2021-105:6-01282021	Soil	Selenium-78	SW6020	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-105:6-01282021	Soil	Silver-107	SW6020	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-105:6-01282021	Soil	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0005	SB-2021-105:6-01282021	Soil	Anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-105:6-01282021	Soil	Benzo(a)anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-105:6-01282021	Soil	Benzo(a)pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-105:6-01282021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-105:6-01282021	Soil	Benzo(g,h,i)perylene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-105:6-01282021	Soil	Chrysene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-105:6-01282021	Soil	Fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-105:6-01282021	Soil	Fluorene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-105:6-01282021	Soil	Pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-106:11-01292021	Soil	Diesel Range Organics	NWTPH-Dx	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-106:11-01292021	Soil	1-Methylnaphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-106:11-01292021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-106:11-01292021	Soil	Benzo(j)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-106:11-01292021	Soil	Benzo(k)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-106:11-01292021	Soil	Dibenzofuran	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-106:11-01292021	Soil	Naphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-106:2-01282021	Soil	Cadmium-111	SW6020	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-106:2-01282021	Soil	Zinc-66	SW6020	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-106:2-01282021	Soil	Trichloroethene	SW8260D	J*	None	Field Duplicate RPD Failure
21B0005	SB-2021-106:2-01282021	Soil	Pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0005	Stain-001-01292021	Soil	Aroclor 1016	SW8082A	J*	None	MS and MSD Recovery Failures
21B0005	TB-3-01282021	Soil	Gasoline Range Organics (Tol-	NWTPHg	J*	Low	Headspace
21B0005	TB-3-01282021	Soil	1,1-Dichloroethene	SW8260D	J*	Low	Headspace
21B0005	TB-3-01282021	Soil	Benzene	SW8260D	J*	Low	Headspace

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Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0005	TB-3-01282021	Soil	cis-1,2-Dichloroethene	SW8260D	J*	Low	Headspace
21B0005	TB-3-01282021	Soil	Ethylbenzene	SW8260D	JL*	Low	Headspace
21B0005	TB-3-01282021	Soil	m,p-Xylene	SW8260D	J*	Low	Headspace
21B0005	TB-3-01282021	Soil	o-Xylene	SW8260D	J*	Low	Headspace
21B0005	TB-3-01282021	Soil	Tetrachloroethene	SW8260D	J*	Low	Headspace
21B0005	TB-3-01282021	Soil	Toluene	SW8260D	JL*	Low	Headspace
21B0005	TB-3-01282021	Soil	trans-1,2-Dichloroethene	SW8260D	J*	Low	Headspace
21B0005	TB-3-01282021	Soil	Trichloroethene	SW8260D	J*	Low	Headspace
21B0005	TB-3-01282021	Soil	Vinyl Chloride	SW8260D	J*	Low	Headspace
21B0005	TB-3-01282021	Soil	Xylenes, total	SW8260D	J*	Low	Headspace
21B0081	MW-101:10.3-02022021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	1-Methylnaphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	2-Methylnaphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Acenaphthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Acenaphthylene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Benzo(a)anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Benzo(a)pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Benzo(g,h,i)perylene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Benzo(j)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Benzo(k)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Chrysene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Dibenzofuran	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Fluorene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Indeno(1,2,3-cd)pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Naphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Phenanthrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:10.3-02022021	Soil	Pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Residual Range Organics	NWTPH-Dx	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Copper-63	SW6020	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Silver-107	SW6020	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Mercury	SW7470	B*	High	Method Blank Detection

Table 1 - 2021 Quarter 1 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0081	MW-101:8.0-02022021	Soil	1-Methylnaphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	2-Methylnaphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Acenaphthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Acenaphthylene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Benzo(a)anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Benzo(a)pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Benzo(g,h,i)perylene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Benzo(j)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Benzo(k)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Chrysene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Dibenzo(a,h)anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Dibenzofuran	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Fluorene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Indeno(1,2,3-cd)pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Naphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Phenanthrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-101:8.0-02022021	Soil	Pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:1.0-02022021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0081	MW-56:1.0-02022021	Soil	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0081	MW-56:1.0-02022021	Soil	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0081	MW-56:8.0-02022021	Soil	Diesel Range Organics	NWTPH-Dx	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Copper-63	SW6020	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Silver-107	SW6020	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0081	MW-56:8.0-02022021	Soil	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0081	MW-56:8.0-02022021	Soil	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0081	MW-56:8.0-02022021	Soil	Acenaphthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Acenaphthylene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Benzo(a)anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Benzo(a)pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure

Table 1 - 2021 Quarter 1 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0081	MW-56:8.0-02022021	Soil	Benzo(g,h,i)perylene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Benzo(j)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Benzo(k)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Chrysene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Dibenzo(a,h)anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Dibenzofuran	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Fluorene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Indeno(1,2,3-cd)pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Naphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Phenanthrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-56:8.0-02022021	Soil	Pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-60:1.5-02012021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-60:1.5-02012021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-60:1.5-02012021	Soil	Aroclor 1260	SW8082A	J*	Low	MS/MSD Recovery Failure
21B0081	MW-60:1.5-02012021	Soil	Toluene	SW8260D	B*	None	Trip Blank Detection
21B0081	MW-60:5-02012021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-60:5-02012021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-60:9-02012021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-60:9-02012021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-60:9-02012021	Soil	Toluene	SW8260D	B*	None	Trip Blank Detection
21B0081	MW-61:1.5-02012021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-61:1.5-02012021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-61:11-02012021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-61:11-02012021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-61:6-02012021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-61:6-02012021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-68:8.5-02022021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0081	MW-68:8.5-02022021	Soil	Toluene	SW8260D	B*	None	Trip Blank Detection
21B0081	MW-70:0-02022021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0081	MW-70:0-02022021	Soil	Toluene	SW8260D	B*	None	Trip Blank Detection
21B0081	MW-70:4.3-02022021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0081	MW-70:4.3-02022021	Soil	1-Methylnaphthalene	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:4.3-02022021	Soil	2-Methylnaphthalene	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:4.3-02022021	Soil	Acenaphthene	SW8270E-SIM	JL*	Low	Holding Time Exceedance

Table 1 - 2021 Quarter 1 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0081	MW-70:4.3-02022021	Soil	Acenaphthylene	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:4.3-02022021	Soil	Anthracene	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:4.3-02022021	Soil	Benzo(a)anthracene	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:4.3-02022021	Soil	Benzo(a)pyrene	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:4.3-02022021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:4.3-02022021	Soil	Benzo(g,h,i)perylene	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:4.3-02022021	Soil	Benzo(j)fluoranthene	SW8270E-SIM	J*	None	Holding Time Exceedance and Method Blank Detection
21B0081	MW-70:4.3-02022021	Soil	Benzo(k)fluoranthene	SW8270E-SIM	J*	None	Holding Time Exceedance and Method Blank Detection
21B0081	MW-70:4.3-02022021	Soil	Chrysene	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:4.3-02022021	Soil	Dibenzo(a,h)anthracene	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:4.3-02022021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:4.3-02022021	Soil	Fluoranthene	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:4.3-02022021	Soil	Fluorene	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:4.3-02022021	Soil	Indeno(1,2,3-cd)pyrene	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:4.3-02022021	Soil	Naphthalene	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:4.3-02022021	Soil	Phenanthrene	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:4.3-02022021	Soil	Pyrene	SW8270E-SIM	JL*	Low	Holding Time Exceedance
21B0081	MW-70:8-02022021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0081	MW-70:8-02022021	Soil	Toluene	SW8260D	B*	None	Trip Blank Detection
21B0081	MW-72:10.9-02022021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0081	MW-72:10.9-02022021	Soil	3,3'-Dichlorobenzidine	SW8270E	R*	Low	Gross MS/MSD Recovery Failure
21B0081	MW-72:1-02022021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0081	MW-72:5-02022021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0081	MW-73:11-02022021	Soil	Gasoline Range Organics (Tot-)	NWTPHg	JL*	Low	Holding Time Exceedance
21B0081	MW-73:11-02022021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-73:11-02022021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-73:11-02022021	Soil	Toluene	SW8260D	B*	None	Trip Blank Detection
21B0081	MW-73:11-02022021	Soil	C8-C10 Aliphatics	WA VPH	R*	Low	Gross MS/MSD Recovery Failure
21B0081	MW-73:15-02022021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-73:15-02022021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-73:15-02022021	Soil	Toluene	SW8260D	B*	None	Trip Blank Detection
21B0081	MW-73:17.7-02022021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-73:17.7-02022021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-73:17.7-02022021	Soil	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0081	MW-73:17.7-02022021	Soil	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection

Table 1 - 2021 Quarter 1 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0081	MW-73:3.2-02022021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-73:3.2-02022021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-73:7-02022021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-73:7-02022021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-73:7-02022021	Soil	Toluene	SW8260D	B*	None	Trip Blank Detection
21B0081	MW-74:10.3-02022021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	1-Methylnaphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	2-Methylnaphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Acenaphthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Acenaphthylene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Benzo(a)anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Benzo(a)pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Benzo(g,h,i)perylene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Benzo(j)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Benzo(k)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Chrysene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Dibenzofuran	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Fluorene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Indeno(1,2,3-cd)pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Naphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Phenanthrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:10.3-02022021	Soil	Pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0081	MW-74:3-02022021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-74:3-02022021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-74:6-02022021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	MW-74:6-02022021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	SB-2021-047:1.5-02022021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	SB-2021-047:1.5-02022021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	SB-2021-047:7.1-02022021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0081	SB-2021-047:7.1-02022021	Soil	Mercury	SW7470	J*	None	Laboratory Duplicate RPD Failure
21B0081	SB-2021-047:7.1-02022021	Soil	Toluene	SW8260D	B*	None	Trip Blank Detection

Table 1 - 2021 Quarter 1 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0081	SB-2021-065:13-02022021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0087	MW-22R:1.0-02032021	Soil	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0087	MW-22R:1.0-02032021	Soil	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0087	MW-22R:20.5-02032021	Soil	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0087	MW-22R:20.5-02032021	Soil	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0087	MW-22R:5.5-02032021	Soil	Diesel Range Organics	NWTPH-Dx	JH*	High	Surrogate Recovery Failure
21B0087	MW-22R:5.5-02032021	Soil	Residual Range Organics	NWTPH-Dx	JH*	High	Surrogate Recovery Failure
21B0087	MW-54:1-02032021	Soil	1-Methylnaphthalene	SW8270E-SIM	JH*	High	Method Blank Detection
21B0087	MW-54:1-02032021	Soil	2-Methylnaphthalene	SW8270E-SIM	JH*	High	Method Blank Detection
21B0087	MW-54:9-02032021	Soil	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0087	MW-54:9-02032021	Soil	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0087	MW-55:1.5-02032021	Soil	1-Methylnaphthalene	SW8270E-SIM	JH*	High	Method Blank Detection
21B0087	MW-55:1.5-02032021	Soil	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0087	MW-59:1.0-02032021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0087	MW-59:6.5-02032021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0087	MW-59:9.5-02032021	Soil	Mercury	SW7470	JH*	High	Method Blank Detection
21B0087	MW-59:9.5-02032021	Soil	1-Methylnaphthalene	SW8270E-SIM	JH*	High	Method Blank Detection
21B0087	MW-59:9.5-02032021	Soil	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0101	MW-71:1.5-02042021	Soil	Pentachlorophenol	SW8270E	J*	None	MS/MSD RPD Failure
21B0101	MW-71:20.5-02042021	Soil	1,1-Dichloroethene	SW8260D	J*	Low	Surrogate Recovery Failure
21B0101	MW-71:20.5-02042021	Soil	Benzene	SW8260D	JL*	Low	Surrogate Recovery Failure
21B0101	MW-71:20.5-02042021	Soil	cis-1,2-Dichloroethene	SW8260D	JL*	Low	Holding Time Exceedance
21B0101	MW-71:20.5-02042021	Soil	trans-1,2-Dichloroethene	SW8260D	J*	Low	Surrogate Recovery Failure
21B0101	MW-71:20.5-02042021	Soil	Trichloroethene	SW8260D	J*	Low	Surrogate Recovery Failure
21B0101	MW-71:20.5-02042021	Soil	Vinyl Chloride	SW8260D	JL*	Low	Holding Time Exceedance
21B0126	MW-104:9-02052021	Soil	Cadmium-111	SW6020	J*	None	Field Duplicate RPD Failure
21B0126	MW-104:9-02052021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0126	MW-104:9-02052021	Soil	Benzene	SW8260D	J*	None	Field Duplicate RPD Failure
21B0126	MW-104:9-02052021	Soil	Benzo(a)anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-104:9-02052021	Soil	Benzo(a)pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-104:9-02052021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-104:9-02052021	Soil	Benzo(g,h,i)perylene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-104:9-02052021	Soil	Benzo(j)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-104:9-02052021	Soil	Benzo(k)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-104:9-02052021	Soil	Chrysene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure

Table 1 - 2021 Quarter 1 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0126	MW-104:9-02052021	Soil	Dibenzo(a,h)anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-104:9-02052021	Soil	Dibenzofuran	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-104:9-02052021	Soil	Fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-104:9-02052021	Soil	Fluorene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-104:9-02052021	Soil	Indeno(1,2,3-cd)pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-104:9-02052021	Soil	Naphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-104:9-02052021	Soil	Phenanthrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-104:9-02052021	Soil	Pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:2-02052021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0126	MW-10R:2-02052021	Soil	trans-1,2-Dichloroethene	SW8260D	R*	None	Gross LCS Recovery Failure
21B0126	MW-10R:5.4-02052021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0126	MW-10R:5.4-02052021	Soil	trans-1,2-Dichloroethene	SW8260D	R*	None	Gross LCS Recovery Failure
21B0126	MW-10R:9-02052021	Soil	Cadmium-111	SW6020	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:9-02052021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0126	MW-10R:9-02052021	Soil	Benzene	SW8260D	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:9-02052021	Soil	Benzo(a)anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:9-02052021	Soil	Benzo(a)pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:9-02052021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:9-02052021	Soil	Benzo(g,h,i)perylene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:9-02052021	Soil	Benzo(j)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:9-02052021	Soil	Benzo(k)fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:9-02052021	Soil	Chrysene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:9-02052021	Soil	Dibenzo(a,h)anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:9-02052021	Soil	Dibenzofuran	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:9-02052021	Soil	Fluoranthene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:9-02052021	Soil	Fluorene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:9-02052021	Soil	Indeno(1,2,3-cd)pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:9-02052021	Soil	Naphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:9-02052021	Soil	Phenanthrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-10R:9-02052021	Soil	Pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21B0126	MW-65:20-02052021	Soil	Mercury	SW7470	B*	High	Method Blank Detection
21B0126	MW-65:20-02052021	Soil	trans-1,2-Dichloroethene	SW8260D	R*	None	Gross LCS Recovery Failure
21B0160	MW-100-20211002	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS Recovery Failure
21B0160	MW-100-20211002	Groundwater	Diethyl phthalate	SW8270E	J*	None	Field Duplicate RPD Failure
21B0160	MW-100-20211002	Groundwater	Hexachlorobutadiene	SW8270E	J*	None	LCS/LCSD RPD Failure

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Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0160	MW-51-20211002	Groundwater	Aroclor 1016	SW8082A	J*	Low	Surrogate Recovery Failure
21B0160	MW-51-20211002	Groundwater	Aroclor 1221	SW8082A	J*	Low	Surrogate Recovery Failure
21B0160	MW-51-20211002	Groundwater	Aroclor 1232	SW8082A	J*	Low	Surrogate Recovery Failure
21B0160	MW-51-20211002	Groundwater	Aroclor 1242	SW8082A	J*	Low	Surrogate Recovery Failure
21B0160	MW-51-20211002	Groundwater	Aroclor 1248	SW8082A	J*	Low	Surrogate Recovery Failure
21B0160	MW-51-20211002	Groundwater	Aroclor 1254	SW8082A	J*	Low	Surrogate Recovery Failure
21B0160	MW-51-20211002	Groundwater	Aroclor 1260	SW8082A	J*	Low	Surrogate Recovery Failure
21B0160	MW-51-20211002	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS Recovery Failure
21B0160	MW-51-20211002	Groundwater	Hexachlorobutadiene	SW8270E	J*	None	LCS/LCSD RPD Failure
21B0160	MW-56-20211002	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding time exceedance
21B0160	MW-56-20211002	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0160	MW-56-20211002	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0160	MW-66-20211002	Groundwater	Aroclor 1260	SW8082A	J*	Low	MS/MSD Recovery Failure
21B0160	MW-66-20211002	Groundwater	trans-1,2-Dichloroethene	SW8260D	JH*	High	MS/MSD Recovery Failure
21B0160	MW-66-20211002	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0160	MW-66-20211002	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0160	MW-76-20211002	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS Recovery Failure
21B0160	MW-76-20211002	Groundwater	Diethyl phthalate	SW8270E	J*	None	Field Duplicate RPD Failure
21B0160	MW-76-20211002	Groundwater	Hexachlorobutadiene	SW8270E	J*	None	LCS/LCSD RPD Failure
21B0174	EB-2-20211102	Distilled Water	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0174	EB-2-20211102	Distilled Water	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0174	EB-2-20211102	Distilled Water	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0174	MW-24-20211102	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0174	MW-24-20211102	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0174	MW-24-20211102	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0174	MW-25-20211102	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0174	MW-25-20211102	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0174	MW-25-20211102	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0174	MW-55-20211102	Groundwater	Hexavalent Chromium	SM 3500-Cr B-09	R*	Low	Gross MS/MSD Recovery Failure
21B0174	MW-55-20211102	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0174	MW-70-20211102	Groundwater	1-Methylnaphthalene	SW8270E-SIM	JH*	High	Method Blank Detection
21B0174	MW-70-20211102	Groundwater	2-Methylnaphthalene	SW8270E-SIM	JH*	High	Method Blank Detection
21B0174	MW-70-20211102	Groundwater	Naphthalene	SW8270E-SIM	JH*	High	Method Blank Detection
21B0192	MW-23-20211202	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding time exceedance
21B0192	MW-52-20211202	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection

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Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0192	MW-52-20211202	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0192	MW-59-20211202	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0192	MW-59-20211202	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0227	MW-68-20211602	Groundwater	Iron-54	SW6020 (Dissolved)	B*	High	Method Blank Detection
21B0227	MW-68-20211602	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-68-20211602	Groundwater	1,3-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-68-20211602	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-68-20211602	Groundwater	2-Chlorophenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-68-20211602	Groundwater	2-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-68-20211602	Groundwater	3,3'-Dichlorobenzidine	SW8270E	J*	Low	MS/MSD Recovery Failure
21B0227	MW-68-20211602	Groundwater	3-Nitroaniline	SW8270E	J*	None	LCS/LCSD RPD Failure
21B0227	MW-68-20211602	Groundwater	4-Chloroaniline	SW8270E	R*	Low	Gross LCS/LCSD Recovery Failure
21B0227	MW-68-20211602	Groundwater	Benzyl Alcohol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-68-20211602	Groundwater	bis(2-chloroethyl) ether	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-68-20211602	Groundwater	Hexachloroethane	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-68-20211602	Groundwater	N-Nitroso-di-n-Propylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-68-20211602	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-68-20211602	Groundwater	Phenol	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21B0227	MW-72-20211602	Groundwater	Chromium-52	SW6020 (Dissolved)	B*	High	Method Blank Detection
21B0227	MW-72-20211602	Groundwater	Iron-54	SW6020 (Dissolved)	B*	High	Method Blank Detection
21B0227	MW-72-20211602	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-72-20211602	Groundwater	1,3-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-72-20211602	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-72-20211602	Groundwater	2-Chlorophenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-72-20211602	Groundwater	2-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-72-20211602	Groundwater	3,3'-Dichlorobenzidine	SW8270E	J*	Low	MS/MSD Recovery Failure
21B0227	MW-72-20211602	Groundwater	3-Nitroaniline	SW8270E	J*	None	LCS/LCSD RPD Failure
21B0227	MW-72-20211602	Groundwater	4-Chloroaniline	SW8270E	R*	Low	Gross LCS/LCSD Recovery Failure
21B0227	MW-72-20211602	Groundwater	Benzyl Alcohol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-72-20211602	Groundwater	bis(2-chloroethyl) ether	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-72-20211602	Groundwater	Hexachloroethane	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-72-20211602	Groundwater	N-Nitroso-di-n-Propylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-72-20211602	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0227	MW-72-20211602	Groundwater	Phenol	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21B0239	MW-103-20211702	Groundwater	Arsenic-75a	SW6020	J*	None	Field Duplicate RPD Failure

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Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0239	MW-103-20211702	Groundwater	Barium-135	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-103-20211702	Groundwater	Cadmium-111	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-103-20211702	Groundwater	Chromium-52	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-103-20211702	Groundwater	Cobalt-59	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-103-20211702	Groundwater	Copper-63	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-103-20211702	Groundwater	Iron-54	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-103-20211702	Groundwater	Lead-208	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-103-20211702	Groundwater	Manganese-55	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-103-20211702	Groundwater	Nickel-60	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-103-20211702	Groundwater	Vanadium-51a	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-103-20211702	Groundwater	Zinc-66	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-103-20211702	Groundwater	Cadmium-111	SW6020 (Dissolved)	J*	None	Field Duplicate RPD Failure
21B0239	MW-103-20211702	Groundwater	Iron-54	SW6020 (Dissolved)	J*	None	Field Duplicate RPD Failure
21B0239	MW-103-20211702	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-103-20211702	Groundwater	1,3-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-103-20211702	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-103-20211702	Groundwater	2-Chlorophenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-103-20211702	Groundwater	2-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-103-20211702	Groundwater	4-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-103-20211702	Groundwater	Benzyl Alcohol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-103-20211702	Groundwater	bis(2-chloroethyl) ether	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-103-20211702	Groundwater	Hexachloroethane	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-103-20211702	Groundwater	N-Nitroso-di-n-Propylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-103-20211702	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-103-20211702	Groundwater	Phenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-60-20211702	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21B0239	MW-63-20211702	Groundwater	Arsenic-75a	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-63-20211702	Groundwater	Barium-135	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-63-20211702	Groundwater	Cadmium-111	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0239	MW-63-20211702	Groundwater	Chromium-52	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-63-20211702	Groundwater	Cobalt-59	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-63-20211702	Groundwater	Copper-63	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-63-20211702	Groundwater	Iron-54	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-63-20211702	Groundwater	Lead-208	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-63-20211702	Groundwater	Manganese-55	SW6020	J*	None	Field Duplicate RPD Failure

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Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0239	MW-63-20211702	Groundwater	Nickel-60	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-63-20211702	Groundwater	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0239	MW-63-20211702	Groundwater	Vanadium-51a	SW6020	J*	None	Field Duplicate RPD Failure
21B0239	MW-63-20211702	Groundwater	Zinc-66	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0239	MW-63-20211702	Groundwater	Cadmium-111	SW6020 (Dissolved)	J*	None	Field Duplicate RPD Failure
21B0239	MW-63-20211702	Groundwater	Iron-54	SW6020 (Dissolved)	JH*	High	Method Blank Detection
21B0239	MW-63-20211702	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-63-20211702	Groundwater	1,3-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-63-20211702	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-63-20211702	Groundwater	2-Chlorophenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-63-20211702	Groundwater	2-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-63-20211702	Groundwater	4-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-63-20211702	Groundwater	Benzyl Alcohol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-63-20211702	Groundwater	bis(2-chloroethyl) ether	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-63-20211702	Groundwater	Hexachloroethane	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-63-20211702	Groundwater	N-Nitroso-di-n-Propylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-63-20211702	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-63-20211702	Groundwater	Phenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0239	MW-71-20211702	Groundwater	Nickel-60	SW6020	JH*	High	Method Blank Detection
21B0255	MW-30-20211802	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21B0255	MW-30-20211802	Groundwater	cis-1,2-Dichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-30-20211802	Groundwater	Trichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-54-20211802	Groundwater	Chromium-52	SW6020 (Dissolved)	JH*	High	Method Blank Detection
21B0255	MW-54-20211802	Groundwater	Benzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-54-20211802	Groundwater	cis-1,2-Dichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-54-20211802	Groundwater	Ethylbenzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-54-20211802	Groundwater	m,p-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-54-20211802	Groundwater	o-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-54-20211802	Groundwater	Toluene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-54-20211802	Groundwater	Trichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-54-20211802	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0255	MW-54-20211802	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0255	MW-54-20211802	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0255	MW-57-20211802	Groundwater	Benzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-57-20211802	Groundwater	cis-1,2-Dichloroethene	SW8260D	J*	Low	LCSD Recovery Failure

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Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0255	MW-57-20211802	Groundwater	Ethylbenzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-57-20211802	Groundwater	m,p-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-57-20211802	Groundwater	o-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-57-20211802	Groundwater	Toluene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-57-20211802	Groundwater	Trichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-58-20211802	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21B0255	MW-58-20211802	Groundwater	Iron-54	SW6020 (Dissolved)	B*	High	Method Blank Detection
21B0255	MW-58-20211802	Groundwater	Benzene	SW8260D	JL*	Low	LCSD Recovery Failure
21B0255	MW-58-20211802	Groundwater	cis-1,2-Dichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-58-20211802	Groundwater	Ethylbenzene	SW8260D	JL*	Low	LCSD Recovery Failure
21B0255	MW-58-20211802	Groundwater	m,p-Xylene	SW8260D	JL*	Low	LCSD Recovery Failure
21B0255	MW-58-20211802	Groundwater	o-Xylene	SW8260D	JL*	Low	LCSD Recovery Failure
21B0255	MW-58-20211802	Groundwater	Toluene	SW8260D	JL*	Low	LCSD Recovery Failure
21B0255	MW-58-20211802	Groundwater	Trichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-62-20211802	Groundwater	Chromium-52	SW6020 (Dissolved)	B*	High	Method Blank Detection
21B0255	MW-62-20211802	Groundwater	Benzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-62-20211802	Groundwater	cis-1,2-Dichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-62-20211802	Groundwater	Ethylbenzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-62-20211802	Groundwater	m,p-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-62-20211802	Groundwater	o-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-62-20211802	Groundwater	Toluene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-62-20211802	Groundwater	Trichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-75-20211802	Groundwater	Zinc-66	SW6020	J*	None	Laboratory Duplicate RPD Failure
21B0255	MW-75-20211802	Groundwater	Iron-54	SW6020 (Dissolved)	JH*	High	Method Blank Detection
21B0255	MW-75-20211802	Groundwater	Benzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-75-20211802	Groundwater	cis-1,2-Dichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-75-20211802	Groundwater	Ethylbenzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-75-20211802	Groundwater	m,p-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-75-20211802	Groundwater	o-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-75-20211802	Groundwater	Toluene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-75-20211802	Groundwater	Trichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-75-20211802	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0255	MW-75-20211802	Groundwater	1,3-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0255	MW-75-20211802	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0255	MW-75-20211802	Groundwater	2-Chlorophenol	SW8270E	J*	Low	Surrogate Recovery Failure

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Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0255	MW-75-20211802	Groundwater	2-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0255	MW-75-20211802	Groundwater	3,3'-Dichlorobenzidine	SW8270E	J*	Low	MS/MSD Recovery Failure
21B0255	MW-75-20211802	Groundwater	3-Nitroaniline	SW8270E	J*	None	LCS/LCSD RPD Failure
21B0255	MW-75-20211802	Groundwater	4-Chloroaniline	SW8270E	R*	Low	Gross LCS/LCSD Recovery Failure
21B0255	MW-75-20211802	Groundwater	4-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0255	MW-75-20211802	Groundwater	Benzyl Alcohol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0255	MW-75-20211802	Groundwater	bis(2-chloroethyl) ether	SW8270E	J*	Low	Surrogate Recovery Failure
21B0255	MW-75-20211802	Groundwater	Hexachloroethane	SW8270E	J*	Low	Surrogate Recovery Failure
21B0255	MW-75-20211802	Groundwater	N-Nitroso-di-n-Propylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0255	MW-75-20211802	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0255	MW-75-20211802	Groundwater	Phenol	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21B0255	MW-9-20211802	Groundwater	Benzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-9-20211802	Groundwater	Ethylbenzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-9-20211802	Groundwater	m,p-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-9-20211802	Groundwater	o-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	MW-9-20211802	Groundwater	Toluene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	TB-6-20211802	Distilled Water	Benzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	TB-6-20211802	Distilled Water	cis-1,2-Dichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	TB-6-20211802	Distilled Water	Ethylbenzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	TB-6-20211802	Distilled Water	m,p-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	TB-6-20211802	Distilled Water	o-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	TB-6-20211802	Distilled Water	Toluene	SW8260D	J*	Low	LCSD Recovery Failure
21B0255	TB-6-20211802	Distilled Water	Trichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-10R-20211902	Groundwater	Zinc-66	SW6020	B*	High	Method Blank Detection
21B0272	MW-10R-20211902	Groundwater	Mercury	SW7470	J*	None	MS/MSD RPD Failure
21B0272	MW-14-20211902	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21B0272	MW-14-20211902	Groundwater	Zinc-66	SW6020	B*	High	Method Blank Detection
21B0272	MW-14-20211902	Groundwater	Benzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-14-20211902	Groundwater	cis-1,2-Dichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-14-20211902	Groundwater	Ethylbenzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-14-20211902	Groundwater	m,p-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-14-20211902	Groundwater	o-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-14-20211902	Groundwater	Toluene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-14-20211902	Groundwater	Trichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-14-20211902	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure

Table 1 - 2021 Quarter 1 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0272	MW-14-20211902	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0272	MW-14-20211902	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0272	MW-15-20211902	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21B0272	MW-3-20211902	Groundwater	Benzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-3-20211902	Groundwater	cis-1,2-Dichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-3-20211902	Groundwater	Ethylbenzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-3-20211902	Groundwater	m,p-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-3-20211902	Groundwater	o-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-3-20211902	Groundwater	Toluene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-3-20211902	Groundwater	Trichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-4-20211902	Groundwater	Zinc-66	SW6020	B*	High	Method Blank Detection
21B0272	MW-4-20211902	Groundwater	Benzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-4-20211902	Groundwater	Ethylbenzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-4-20211902	Groundwater	m,p-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-4-20211902	Groundwater	o-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	MW-4-20211902	Groundwater	Toluene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	TB-7-20211902	Distilled Water	Benzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	TB-7-20211902	Distilled Water	cis-1,2-Dichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	TB-7-20211902	Distilled Water	Ethylbenzene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	TB-7-20211902	Distilled Water	m,p-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	TB-7-20211902	Distilled Water	o-Xylene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	TB-7-20211902	Distilled Water	Toluene	SW8260D	J*	Low	LCSD Recovery Failure
21B0272	TB-7-20211902	Distilled Water	Trichloroethene	SW8260D	J*	Low	LCSD Recovery Failure
21B0296	MW-101-20212202	Groundwater	Zinc-66	SW6020	J*	None	Field Duplicate RPD Failure
21B0296	MW-101-20212202	Groundwater	Chromium-52	SW6020 (Dissolved)	B*	High	Method Blank Detection
21B0296	MW-101-20212202	Groundwater	Iron-54	SW6020 (Dissolved)	JH*	High	Method Blank Detection
21B0296	MW-101-20212202	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0296	MW-101-20212202	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0296	MW-101-20212202	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0296	MW-32-20212202	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0296	MW-32-20212202	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0296	MW-32-20212202	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0296	MW-36-20212202	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21B0296	MW-36-20212202	Groundwater	Chromium-52	SW6020 (Dissolved)	B*	High	Method Blank Detection
21B0296	MW-53-20212202	Groundwater	Zinc-66	SW6020	J*	None	Field Duplicate RPD Failure

Table 1 - 2021 Quarter 1 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0296	MW-53-20212202	Groundwater	Chromium-52	SW6020 (Dissolved)	B*	High	Method Blank Detection
21B0296	MW-53-20212202	Groundwater	Iron-54	SW6020 (Dissolved)	B*	High	Method Blank Detection
21B0296	MW-53-20212202	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0296	MW-53-20212202	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0296	MW-53-20212202	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0296	MW-61-20212202	Groundwater	Chromium-52	SW6020 (Dissolved)	B*	High	Method Blank Detection
21B0296	MW-61-20212202	Groundwater	Iron-54	SW6020 (Dissolved)	JH*	High	Method Blank Detection
21B0296	MW-61-20212202	Groundwater	Mercury	SW7470	J*	None	MS/MSD RPD Failure
21B0296	MW-73-20212202	Groundwater	Chromium-52	SW6020 (Dissolved)	B*	High	Method Blank Detection
21B0296	MW-74-20212202	Groundwater	Chromium-52	SW6020 (Dissolved)	JH*	High	Method Blank Detection
21B0309	MW-102-20212302	Groundwater	Manganese-55	SW6020	J*	None	Field Duplicate RPD Failure
21B0309	MW-102-20212302	Groundwater	Manganese-55	SW6020 (Dissolved)	J*	None	Field Duplicate RPD Failure
21B0309	MW-102-20212302	Groundwater	Zinc-66	SW6020 (Dissolved)	J*	None	Field Duplicate RPD Failure
21B0309	MW-37-20212302	Groundwater	Manganese-55	SW6020	J*	None	Field Duplicate RPD Failure
21B0309	MW-37-20212302	Groundwater	Manganese-55	SW6020 (Dissolved)	J*	None	Field Duplicate RPD Failure
21B0309	MW-37-20212302	Groundwater	Zinc-66	SW6020 (Dissolved)	J*	None	Field Duplicate RPD Failure
21B0309	MW-67-20212302	Groundwater	Iron-54	SW6020	B*	High	Method Blank Detection
21B0309	MW-67-20212302	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0309	MW-67-20212302	Groundwater	1,3-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0309	MW-67-20212302	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0309	MW-67-20212302	Groundwater	2-Chlorophenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0309	MW-67-20212302	Groundwater	2-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0309	MW-67-20212302	Groundwater	4-Chloroaniline	SW8270E	R*	Low	Gross LCS/LCSD Recovery Failure
21B0309	MW-67-20212302	Groundwater	4-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0309	MW-67-20212302	Groundwater	Benzyl Alcohol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0309	MW-67-20212302	Groundwater	bis(2-chloroethyl) ether	SW8270E	J*	Low	Surrogate Recovery Failure
21B0309	MW-67-20212302	Groundwater	Hexachloroethane	SW8270E	J*	Low	Surrogate Recovery Failure
21B0309	MW-67-20212302	Groundwater	N-Nitroso-di-n-Propylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0309	MW-67-20212302	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0309	MW-67-20212302	Groundwater	Phenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0309	MW-7-20212302	Groundwater	Chromium-52	SW6020	B*	High	Method Blank Detection
21B0322	MW-31-20212402	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-31-20212402	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-31-20212402	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-31-20212402	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection

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Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21B0322	MW-39-20212402	Groundwater	Hexavalent Chromium	SM 3500-Cr B-09	J*	None	MS and MSD Recovery Failures
21B0322	MW-46-20212402	Groundwater	Chromium-52	SW6020 (Dissolved)	B*	High	Method Blank Detection
21B0322	MW-46-20212402	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-46-20212402	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-46-20212402	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-47-20212402	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-47-20212402	Groundwater	1,3-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-47-20212402	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-47-20212402	Groundwater	2-Chlorophenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-47-20212402	Groundwater	2-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-47-20212402	Groundwater	4-Chloroaniline	SW8270E	R*	Low	Gross LCS/LCSD Recovery Failure
21B0322	MW-47-20212402	Groundwater	4-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-47-20212402	Groundwater	4-Nitrophenol	SW8270E	R*	Low	Gross LCS/LCSD Recovery Failure
21B0322	MW-47-20212402	Groundwater	Benzyl Alcohol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-47-20212402	Groundwater	bis(2-chloroethyl) ether	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-47-20212402	Groundwater	Hexachloroethane	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-47-20212402	Groundwater	N-Nitroso-di-n-Propylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-47-20212402	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0322	MW-47-20212402	Groundwater	Phenol	SW8270E	J*	Low	Surrogate Recovery Failure
21B0344	MW-40-20212502	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0344	MW-40-20212502	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0344	MW-40-20212502	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0344	MW-40-20212502	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0344	MW-41-20212502	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0344	MW-41-20212502	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0344	MW-41-20212502	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0344	MW-41-20212502	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21B0344	MW-65-20212502	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0344	MW-65-20212502	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21B0344	MW-65-20212502	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21B0344	MW-65-20212502	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	MW-10R:15-02052021	Soil	Acenaphthylene	SW8270E-SIM	J*	Low	ICV Recovery Failure
21D0061	MW-10R:15-02052021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-10R:15-02052021	Soil	Chrysene	SW8270E-SIM	JH*	High	Method Blank Detection
21D0061	MW-10R:15-02052021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	ICV Recovery Failure

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Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21D0061	MW-10R:15-02052021	Soil	Fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	MW-10R:15-02052021	Soil	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	MW-53:15.8-02032021	Soil	Acenaphthylene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-53:15.8-02032021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-53:15.8-02032021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-55:15.5-02032021	Soil	Acenaphthylene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-55:15.5-02032021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-55:15.5-02032021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-57:15.3-01272021	Soil	Acenaphthylene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-57:15.3-01272021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-57:15.3-01272021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-57:15.3-01272021	Soil	Fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	MW-57:15.3-01272021	Soil	Pyrene	SW8270E-SIM	JH*	High	Method Blank Detection
21D0061	MW-58:15-01272021	Soil	Acenaphthylene	SW8270E-SIM	J*	Low	ICV Recovery Failure
21D0061	MW-58:15-01272021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-58:15-01272021	Soil	Chrysene	SW8270E-SIM	JH*	High	Method Blank Detection
21D0061	MW-58:15-01272021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-58:15-01272021	Soil	Fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	MW-58:15-01272021	Soil	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	MW-62:15-01272021	Soil	Acenaphthylene	SW8270E-SIM	J*	Low	ICV Recovery Failure
21D0061	MW-62:15-01272021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-62:15-01272021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-62:15-01272021	Soil	Fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	MW-62:15-01272021	Soil	Pyrene	SW8270E-SIM	JH*	High	Method Blank Detection
21D0061	MW-68:15.5-02022021	Soil	Acenaphthylene	SW8270E-SIM	J*	Low	ICV Recovery Failure
21D0061	MW-68:15.5-02022021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-68:15.5-02022021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-68:15.5-02022021	Soil	Fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	MW-68:15.5-02022021	Soil	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	MW-70:15-02022021	Soil	Acenaphthylene	SW8270E-SIM	J*	Low	ICV Recovery Failure
21D0061	MW-70:15-02022021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-70:15-02022021	Soil	Chrysene	SW8270E-SIM	JH*	High	Method Blank Detection
21D0061	MW-70:15-02022021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-70:15-02022021	Soil	Fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	MW-70:15-02022021	Soil	Pyrene	SW8270E-SIM	JH*	High	Method Blank Detection

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Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21D0061	MW-71:15.5-02042021	Soil	Acenaphthylene	SW8270E-SIM	J*	Low	ICV Recovery Failure
21D0061	MW-71:15.5-02042021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-71:15.5-02042021	Soil	Chrysene	SW8270E-SIM	JH*	High	Method Blank Detection
21D0061	MW-71:15.5-02042021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-71:15.5-02042021	Soil	Fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	MW-71:15.5-02042021	Soil	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	MW-76:15.5-01262021	Soil	Acenaphthylene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-76:15.5-01262021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	MW-76:15.5-01262021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	SB-2021-006:20-01292021	Soil	Acenaphthylene	SW8270E-SIM	J*	Low	ICV Recovery Failure
21D0061	SB-2021-006:20-01292021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	SB-2021-006:20-01292021	Soil	Chrysene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	SB-2021-006:20-01292021	Soil	Dibenzofuran	SW8270E-SIM	J*	Low	ICV Recovery Failure
21D0061	SB-2021-006:20-01292021	Soil	Fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	SB-2021-006:20-01292021	Soil	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	SB-2021-009:13.3-01252021	Soil	Cadmium-111	SW6020	J*	None	Laboratory Duplicate RPD Failure
21D0061	SB-2021-009:13.3-01252021	Soil	Selenium-78	SW6020	J*	None	Laboratory Duplicate RPD Failure
21D0061	SB-2021-025:10-1272021	Soil	Aroclor 1254	SW8082A	J*	None	Confirmation Column RPD failure
21D0061	SB-2021-038:12.9-1262021	Soil	Acenaphthylene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	SB-2021-038:12.9-1262021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	SB-2021-038:12.9-1262021	Soil	Chrysene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	SB-2021-038:12.9-1262021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	SB-2021-038:12.9-1262021	Soil	Fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	SB-2021-038:12.9-1262021	Soil	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	SB-2021-040:13.7-01282021	Soil	Acenaphthylene	SW8270E-SIM	J*	Low	ICV Recovery Failure
21D0061	SB-2021-040:13.7-01282021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	SB-2021-040:13.7-01282021	Soil	Chrysene	SW8270E-SIM	JH*	High	Method Blank Detection
21D0061	SB-2021-040:13.7-01282021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	SB-2021-040:13.7-01282021	Soil	Fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	SB-2021-040:13.7-01282021	Soil	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	SB-2021-041:13.3-01282021	Soil	Acenaphthylene	SW8270E-SIM	J*	Low	ICV Recovery Failure
21D0061	SB-2021-041:13.3-01282021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	SB-2021-041:13.3-01282021	Soil	Chrysene	SW8270E-SIM	JH*	High	Method Blank Detection
21D0061	SB-2021-041:13.3-01282021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	SB-2021-041:13.3-01282021	Soil	Fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection

Table 1 - 2021 Quarter 1 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21D0061	SB-2021-041:13.3-01282021	Soil	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	SB-2021-046:13.9-1262021	Soil	Acenaphthylene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	SB-2021-046:13.9-1262021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	SB-2021-046:13.9-1262021	Soil	Chrysene	SW8270E-SIM	JH*	High	Method Blank Detection
21D0061	SB-2021-046:13.9-1262021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	SB-2021-046:13.9-1262021	Soil	Fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	SB-2021-046:13.9-1262021	Soil	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	SB-2021-047:10.5-02022021	Soil	Acenaphthylene	SW8270E-SIM	J*	Low	ICV Recovery Failure
21D0061	SB-2021-047:10.5-02022021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	SB-2021-047:10.5-02022021	Soil	Chrysene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	SB-2021-047:10.5-02022021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	SB-2021-047:10.5-02022021	Soil	Fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	SB-2021-047:10.5-02022021	Soil	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21D0061	SB-2021-65:11.9-02022021	Soil	Acenaphthylene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	SB-2021-65:11.9-02022021	Soil	Benzo(b)fluoranthene	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	SB-2021-65:11.9-02022021	Soil	Dibenzofuran	SW8270E-SIM	JL*	Low	ICV Recovery Failure
21D0061	TSA-2021-004:1.7-01252021	Soil	Aroclor 1254	SW8082A	JH*	High	Surrogate Recovery Failure
21D0061	TSA-2021-004:1.7-01252021	Soil	Aroclor 1268	SW8082A	JH*	High	Surrogate Recovery Failure
21G0121	MW-100:5.0-01262021	Soil	Diethyl phthalate	SW8270E	J*	None	Field Duplicate RPD Failure
21G0121	MW-100:5.0-01262021	Soil	N-Nitrosodiphenylamine	SW8270E	UJ*	Low	LCS Recovery Failure
21G0121	MW-67:0.5-01262021	Soil	N-Nitrosodiphenylamine	SW8270E	UJ*	Low	LCS Recovery Failure
21G0121	MW-67:16.0-01262021	Soil	N-Nitrosodiphenylamine	SW8270E	UJ*	Low	LCS Recovery Failure
21G0121	MW-67:20.5-01262021	Soil	N-Nitrosodiphenylamine	SW8270E	UJ*	Low	LCS Recovery Failure
21G0121	MW-67:5.5-01262021	Soil	N-Nitrosodiphenylamine	SW8270E	UJ*	Low	LCS Recovery Failure
21G0121	MW-67:9.0-01262021	Soil	N-Nitrosodiphenylamine	SW8270E	UJ*	Low	LCS Recovery Failure
21G0121	MW-76:1.5-01262021	Soil	N-Nitrosodiphenylamine	SW8270E	UJ*	Low	LCS Recovery Failure
21G0121	MW-76:5.0-01262021	Soil	Diethyl phthalate	SW8270E	J*	None	Field Duplicate RPD Failure
21G0121	MW-76:5.0-01262021	Soil	N-Nitrosodiphenylamine	SW8270E	UJ*	Low	LCS Recovery Failure
320-70313	MW-68-20211602	Groundwater	Perfluorooctanesulfonic acid (PFOS)	537 (Modified)	JH*	High	Transition Mass Ratio Failure

LCS = laboratory control sample; LCSD = laboratory control sample duplicate; MS = matrix spike; MSD = matrix spike duplicate; RPD = relative percent difference

Table 2 - 2021 Quarter 2 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21E0174	MW-65-20211305	Groundwater	Naphthalene	SW8270E-SIM	JH*	High	Method Blank Detection
21E0174	MW-65-20211305	Groundwater	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21E0174	MW-66-20211305	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0174	MW-76-20211305	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21E0174	MW-76-20211305	Groundwater	Phenanthrene	SW8270E	JH*	High	Surrogate Recovery Failure
21E0174	MW-76-20211305	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0174	MW-76-20211305	Groundwater	Pyrene	SW8270E-SIM	JH*	High	Method Blank Detection
21E0190	MW-14-20211405	Groundwater	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0190	MW-46-20211405	Groundwater	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0190	MW-55-20211405	Groundwater	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0194	EB-1-20211705	Distilled Water	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0194	EB-1-20211705	Distilled Water	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0194	MW-36-20211705	Groundwater	Nitrate-N	EPA 300.0	J*	Low	Holding Time Exceedance
21E0194	MW-36-20211705	Groundwater	Nitrite-N	EPA 300.0	J*	Low	Holding Time Exceedance
21E0194	MW-36-20211705	Groundwater	Mercury	SW7470	B*	High	Equipment Blank Detection
21E0194	MW-36-20211705	Groundwater	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0194	MW-56-20211705	Groundwater	Mercury	SW7470	B*	High	Equipment Blank Detection
21E0194	MW-56-20211705	Groundwater	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0194	MW-56-20211705	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Equipment Blank Detection
21E0194	MW-56-20211705	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Equipment Blank Detection
21E0194	MW-56-20211705	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0194	MW-56-20211705	Groundwater	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21E0194	MW-58-20211705	Groundwater	Nitrate-N	EPA 300.0	J*	Low	Holding Time Exceedance
21E0194	MW-58-20211705	Groundwater	Nitrite-N	EPA 300.0	J*	Low	Holding Time Exceedance
21E0194	MW-58-20211705	Groundwater	Mercury	SW7470	B*	High	Equipment Blank Detection
21E0194	MW-58-20211705	Groundwater	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0194	MW-58-20211705	Groundwater	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21E0194	MW-60-20211705	Groundwater	Nitrate-N	EPA 300.0	J*	Low	Holding Time Exceedance
21E0194	MW-60-20211705	Groundwater	Nitrite-N	EPA 300.0	J*	Low	Holding Time Exceedance
21E0194	MW-60-20211705	Groundwater	Mercury	SW7470	B*	High	Equipment Blank Detection
21E0194	MW-60-20211705	Groundwater	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0194	MW-60-20211705	Groundwater	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection

Table 2 - 2021 Quarter 2 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21E0206	MW-25-20211805	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0206	MW-31-20211805	Groundwater	1-Methylnaphthalene	SW8270E-SIM	JH*	High	Method Blank Detection
21E0206	MW-31-20211805	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0206	MW-31-20211805	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0206	MW-59-20211805	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0206	MW-71-20211805	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0206	MW-71-20211805	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0206	MW-71-20211805	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0213	MW-101-20211905	Groundwater	Copper-63	SW6020B (Dissolved)	J*	None	Laboratory Duplicate RPD Failure
21E0213	MW-101-20211905	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0213	MW-101-20211905	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0213	MW-101-20211905	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0213	MW-30-20211905	Groundwater	Nitrate-N	EPA 300.0	J*	Low	Holding Time Exceedance
21E0213	MW-30-20211905	Groundwater	Nitrite-N	EPA 300.0	J*	Low	Holding Time Exceedance
21E0213	MW-30-20211905	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21E0213	MW-57-20211905	Groundwater	Copper-63	SW6020B (Dissolved)	J*	None	Laboratory Duplicate RPD Failure
21E0213	MW-57-20211905	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0213	MW-57-20211905	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0213	MW-57-20211905	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0244	MW-103-20211905	Groundwater	Iron-54	SW6020B	J*	None	Field Duplicate RPD Failure
21E0244	MW-103-20211905	Groundwater	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0244	MW-103-20211905	Groundwater	1-Methylnaphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21E0244	MW-103-20211905	Groundwater	2-Methylnaphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21E0244	MW-103-20211905	Groundwater	Naphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21E0244	MW-103-20211905	Groundwater	Perylene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21E0244	MW-40-20212005	Groundwater	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0244	MW-40-20212005	Groundwater	Di-n-Butylphthalate	SW8270E	B*	High	Method Blank Detection
21E0244	MW-41-20212005	Groundwater	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0244	MW-41-20212005	Groundwater	Di-n-Butylphthalate	SW8270E	B*	High	Method Blank Detection
21E0244	MW-62-20211905	Groundwater	Iron-54	SW6020B	J*	None	Field Duplicate RPD Failure
21E0244	MW-62-20211905	Groundwater	1-Methylnaphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21E0244	MW-62-20211905	Groundwater	2-Methylnaphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure

Table 2 - 2021 Quarter 2 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21E0244	MW-62-20211905	Groundwater	Naphthalene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21E0244	MW-62-20211905	Groundwater	Perylene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21E0244	MW-63-20212005	Groundwater	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0244	MW-63-20212005	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21E0244	MW-64-20212005	Groundwater	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0244	MW-73-20212005	Groundwater	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0244	MW-74-20211905	Groundwater	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0260	MW-37-20212105	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0260	MW-37-20212105	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0260	MW-37-20212105	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0260	MW-37-20212105	Groundwater	Phenanthrene	SW8270E-SIM	B*	High	Method Blank Detection
21E0260	MW-38-20212105	Groundwater	Manganese-55	SW6020B (Dissolved)	JH*	High	Method Blank Detection
21E0260	MW-51-20212105	Groundwater	Di-n-Butylphthalate	SW8270E	B*	High	Method Blank Detection
21E0260	MW-61-20212105	Groundwater	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0260	MW-61-20212105	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0260	MW-61-20212105	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0260	MW-61-20212105	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0260	MW-61-20212105	Groundwater	Phenanthrene	SW8270E-SIM	B*	High	Method Blank Detection
21E0260	MW-72-20212105	Groundwater	Mercury	SW7470 (Dissolved)	B*	High	Method Blank Detection
21E0260	MW-72-20212105	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS Recovery Failure
21E0260	MW-72-20212105	Groundwater	Di-n-Butylphthalate	SW8270E	B*	High	Method Blank Detection
21E0290	MW-102-20212405	Groundwater	Diesel Range Organics	NWTPH-Dx	J*	None	Field Duplicate RPD Failure
21E0290	MW-102-20212405	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-102-20212405	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-102-20212405	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-102-20212405	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0290	MW-102-20212405	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0290	MW-102-20212405	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0290	MW-32-20212405	Groundwater	Diesel Range Organics	NWTPH-Dx	J*	None	Field Duplicate RPD Failure
21E0290	MW-32-20212405	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-32-20212405	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-32-20212405	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure

Table 2 - 2021 Quarter 2 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21E0290	MW-32-20212405	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0290	MW-32-20212405	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0290	MW-42-20212405	Groundwater	Mercury	SW7470 (Dissolved)	J*	Low	Holding Time Exceedance
21E0290	MW-44-20212405	Groundwater	Mercury	SW7470 (Dissolved)	J*	Low	Holding Time Exceedance
21E0290	MW-54-20212405	Groundwater	Nickel-60	SW6020B	B*	High	Method Blank Detection
21E0290	MW-54-20212405	Groundwater	Mercury	SW7470 (Dissolved)	J*	Low	Holding Time Exceedance
21E0290	MW-54-20212405	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-54-20212405	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-54-20212405	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-54-20212405	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0290	MW-54-20212405	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0290	MW-54-20212405	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0290	MW-67-20212405	Groundwater	Copper-63	SW6020B	J*	None	Laboratory Duplicate RPD Failure
21E0290	MW-67-20212405	Groundwater	Lead-208	SW6020B	J*	None	Laboratory Duplicate RPD Failure
21E0290	MW-67-20212405	Groundwater	Mercury	SW7470 (Dissolved)	J*	Low	Holding Time Exceedance
21E0290	MW-67-20212405	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-67-20212405	Groundwater	1,3-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-67-20212405	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-67-20212405	Groundwater	2-Chlorophenol	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-67-20212405	Groundwater	2-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-67-20212405	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21E0290	MW-67-20212405	Groundwater	Benzyl Alcohol	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-67-20212405	Groundwater	bis(2-chloroethyl) ether	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-67-20212405	Groundwater	Hexachloroethane	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-67-20212405	Groundwater	N-Nitroso-di-n-Propylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-67-20212405	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-67-20212405	Groundwater	Phenol	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-75-20212405	Groundwater	Copper-63	SW6020B (Dissolved)	J*	None	Laboratory Duplicate RPD Failure
21E0290	MW-75-20212405	Groundwater	Mercury	SW7470 (Dissolved)	J*	Low	Holding Time Exceedance
21E0290	MW-75-20212405	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-75-20212405	Groundwater	1,3-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-75-20212405	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure

Table 2 - 2021 Quarter 2 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21E0290	MW-75-20212405	Groundwater	2-Chlorophenol	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-75-20212405	Groundwater	2-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-75-20212405	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21E0290	MW-75-20212405	Groundwater	Benzyl Alcohol	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-75-20212405	Groundwater	bis(2-chloroethyl) ether	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-75-20212405	Groundwater	bis(2-Ethylhexyl)phthalate	SW8270E	B*	High	Method Blank Detection
21E0290	MW-75-20212405	Groundwater	Hexachloroethane	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-75-20212405	Groundwater	N-Nitroso-di-n-Propylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-75-20212405	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21E0290	MW-75-20212405	Groundwater	Phenol	SW8270E	J*	Low	Surrogate Recovery Failure
21E0302	EB-2-20212505	Distilled Water	Mercury	SW7470 (Dissolved)	J*	Low	Holding Time Exceedance
21E0302	EB-2-20212505	Distilled Water	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21E0302	EB-2-20212505	Distilled Water	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21E0302	EB-2-20212505	Distilled Water	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21E0302	MW-10R-20212505	Groundwater	Nickel-60	SW6020B	JH*	High	Method Blank Detection
21E0302	MW-10R-20212505	Groundwater	Mercury	SW7470 (Dissolved)	J*	Low	Holding Time Exceedance
21E0302	MW-53-20212505	Groundwater	Nickel-60	SW6020B	B*	High	Method Blank Detection
21E0302	MW-53-20212505	Groundwater	Mercury	SW7470 (Dissolved)	J*	Low	Holding Time Exceedance
21E0323	MW-47-20212705	Groundwater	Mercury	SW7470 (Dissolved)	J*	Low	Holding Time Exceedance
21E0323	MW-47-20212705	Groundwater	3,3'-Dichlorobenzidine	SW8270E	J*	None	LCS/LCSD RPD Failure
21E0323	MW-47-20212705	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS Recovery Failure
21E0323	MW-47-20212705	Groundwater	Hexachlorocyclopentadiene	SW8270E	J*	None	LCS/LCSD RPD Failure
21E0323	MW-7-20212705	Groundwater	Mercury	SW7470 (Dissolved)	J*	Low	Holding Time Exceedance
21E0352	Decon-20212605	Decon Water	Mercury	SW7470	J*	Low	Holding Time Exceedance
21E0352	Decon-20212605	Decon Water	Mercury	SW7470 (Dissolved)	J*	Low	Holding Time Exceedance
21E0352	Decon-20212605	Decon Water	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21E0352	Decon-20212605	Decon Water	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21E0352	Decon-20212605	Decon Water	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21E0352	MW-4-20212605	Groundwater	Mercury	SW7470	J*	Low	Holding Time Exceedance
21E0352	MW-4-20212605	Groundwater	Mercury	SW7470 (Dissolved)	J*	Low	Holding Time Exceedance
21E0352	MW-52-20212605	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0352	MW-52-20212605	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection

Table 2 - 2021 Quarter 2 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21E0352	MW-52-20212605	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0352	MW-69-20212605	Groundwater	Lead-208	SW6020B (Dissolved)	J*	Low	MS/MSD Recovery Failure
21E0352	MW-69-20212605	Groundwater	Mercury	SW7470	J*	Low	Holding Time Exceedance
21E0352	MW-69-20212605	Groundwater	Mercury	SW7470 (Dissolved)	J*	Low	Holding Time Exceedance
21E0352	MW-69-20212605	Groundwater	1,2-Dichlorobenzene	SW8270E	JL*	Low	Surrogate Recovery Failure
21E0352	MW-69-20212605	Groundwater	1,4-Dichlorobenzene	SW8270E	JL*	Low	Surrogate Recovery Failure
21E0352	MW-69-20212605	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21E0352	MW-70-20212605	Groundwater	Mercury	SW7470	J*	Low	Holding Time Exceedance
21E0352	MW-70-20212605	Groundwater	Mercury	SW7470 (Dissolved)	J*	Low	Holding Time Exceedance
21E0352	MW-70-20212605	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0352	MW-70-20212605	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0352	MW-70-20212605	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21E0352	MW-8-20212605	Groundwater	Silver-107	SW6020B (Dissolved)	B*	High	Equipment Blank Detection
21E0352	MW-8-20212605	Groundwater	Mercury	SW7470	J*	Low	Holding Time Exceedance
21E0352	MW-8-20212605	Groundwater	Mercury	SW7470 (Dissolved)	J*	Low	Holding Time Exceedance

LCS = laboratory control sample; LCSD = laboratory control sample duplicate; MS = matrix spike; MSD = matrix spike duplicate; RPD = relative percent difference

Table 3 - 2021 Quarter 3 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21H0207	MW-46-20211708	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0207	MW-46-20211708	Groundwater	Hexavalent Chromium	SM 3500-Cr B-09	J*	Low	MS Recovery Failure
21H0207	MW-71-20211708	Groundwater	Aroclor 1016	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0207	MW-71-20211708	Groundwater	Aroclor 1221	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0207	MW-71-20211708	Groundwater	Aroclor 1232	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0207	MW-71-20211708	Groundwater	Aroclor 1242	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0207	MW-71-20211708	Groundwater	Aroclor 1248	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0207	MW-71-20211708	Groundwater	Aroclor 1254	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0207	MW-71-20211708	Groundwater	Aroclor 1260	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0207	MW-71-20211708	Groundwater	Aroclor 1262	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0207	MW-71-20211708	Groundwater	Aroclor 1268	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0207	MW-71-20211708	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0209	MW-68-20211708	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21H0209	MW-68-20211708	Groundwater	Aroclor 1016	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0209	MW-68-20211708	Groundwater	Aroclor 1221	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0209	MW-68-20211708	Groundwater	Aroclor 1232	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0209	MW-68-20211708	Groundwater	Aroclor 1242	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0209	MW-68-20211708	Groundwater	Aroclor 1248	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0209	MW-68-20211708	Groundwater	Aroclor 1254	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0209	MW-68-20211708	Groundwater	Aroclor 1260	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0209	MW-68-20211708	Groundwater	Aroclor 1262	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0209	MW-68-20211708	Groundwater	Aroclor 1268	EPA 8082A	J*	Low	Surrogate Recovery Failure
21H0209	MW-68-20211708	Groundwater	4-Chloroaniline	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0209	MW-68-20211708	Groundwater	Phenol	EPA 8270E	B*	High	Method Blank Detection
21H0209	MW-76-20211708	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21H0209	MW-76-20211708	Groundwater	4-Chloroaniline	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0209	MW-76-20211708	Groundwater	Phenol	EPA 8270E	B*	High	Method Blank Detection
21H0209	MW-76-20211708	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0210	MW-71-20211708	Groundwater	Toluene	EPA 8260D	B*	High	Trip Blank Detection
21H0222	MW-103-20211808	Groundwater	Manganese-55	EPA 6020B (Dissolved)	J*	None	Field Duplicate RPD Failure

Table 3 - 2021 Quarter 3 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21H0222	MW-103-20211808	Groundwater	Diesel Range Organics	NWTPH-Dx	J*	None	LCS/LCSD RPD Failure
21H0222	MW-36-20211808	Groundwater	Sulfate	EPA 300.0	J*	None	Laboratory Duplicate RPD Failure
21H0222	MW-36-20211808	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21H0222	MW-36-20211808	Groundwater	Diesel Range Organics	NWTPH-Dx	J*	None	LCS/LCSD RPD Failure
21H0222	MW-38-20211808	Groundwater	Manganese-55	EPA 6020B (Dissolved)	J*	None	Field Duplicate RPD Failure
21H0222	MW-38-20211808	Groundwater	Diesel Range Organics	NWTPH-Dx	J*	None	LCS/LCSD RPD Failure
21H0222	MW-42-20211808	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21H0222	MW-42-20211808	Groundwater	Diesel Range Organics	NWTPH-Dx	J*	None	LCS/LCSD RPD Failure
21H0222	MW-67-20211808	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21H0222	MW-67-20211808	Groundwater	1,2-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0222	MW-67-20211808	Groundwater	1,3-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0222	MW-67-20211808	Groundwater	1,4-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0222	MW-67-20211808	Groundwater	2-Chlorophenol	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0222	MW-67-20211808	Groundwater	2-Methylphenol	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0222	MW-67-20211808	Groundwater	4-Chloroaniline	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0222	MW-67-20211808	Groundwater	4-Methylphenol	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0222	MW-67-20211808	Groundwater	4-Nitrophenol	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0222	MW-67-20211808	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0222	MW-67-20211808	Groundwater	Benzyl Alcohol	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0222	MW-67-20211808	Groundwater	bis(2-chloroethyl) ether	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0222	MW-67-20211808	Groundwater	Hexachloroethane	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0222	MW-67-20211808	Groundwater	N-Nitroso-di-n-Propylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0222	MW-67-20211808	Groundwater	Phenol	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0230	MW-39-20211908	Groundwater	Chromium-52	EPA 6020B (Dissolved)	JL*	Low	MS Recovery Failure
21H0230	MW-39-20211908	Groundwater	Manganese-55	EPA 6020B (Dissolved)	JL*	Low	MS Recovery Failure
21H0230	MW-39-20211908	Groundwater	Diesel Range Organics	NWTPH-Dx	J*	None	LCS/LCSD RPD Failure
21H0230	MW-43-20211908	Groundwater	Diesel Range Organics	NWTPH-Dx	J*	None	LCS/LCSD RPD Failure
21H0230	MW-67-20211908	Groundwater	Diesel Range Organics	NWTPH-Dx	J*	None	LCS/LCSD RPD Failure
21H0248	EB-1-20212008	Distilled Water	1,2-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0248	EB-1-20212008	Distilled Water	1,4-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure

Table 3 - 2021 Quarter 3 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21H0248	EB-1-20212008	Distilled Water	Benzoic acid	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0248	EB-1-20212008	Distilled Water	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0248	EB-1-20212008	Distilled Water	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0248	MW-15-20212008	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21H0248	MW-30-20212008	Groundwater	Nitrite-N	EPA 300.0	J*	Low	MS Recovery Failure
21H0248	MW-30-20212008	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21H0248	MW-54-20212008	Groundwater	1,2-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0248	MW-54-20212008	Groundwater	1,4-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0248	MW-54-20212008	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0248	MW-54-20212008	Groundwater	N-Nitrosodiphenylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0248	MW-54-20212008	Groundwater	1-Methylnaphthalene	EPA 8270E-SIM	B*	High	Equipment Blank Detection
21H0248	MW-54-20212008	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0248	MW-54-20212008	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0282	MW-102-20212308	Groundwater	Arsenic-75a	EPA 6020B	J*	None	Field Duplicate RPD Failure
21H0282	MW-102-20212308	Groundwater	Copper-63	EPA 6020B	J*	None	Field Duplicate RPD Failure
21H0282	MW-102-20212308	Groundwater	Iron-54	EPA 6020B	J*	None	Field Duplicate RPD Failure
21H0282	MW-102-20212308	Groundwater	Vanadium-51a	EPA 6020B	J*	None	Field Duplicate RPD Failure
21H0282	MW-102-20212308	Groundwater	Copper-63	EPA 6020B (Dissolved)	B*	High	Method Blank Detection
21H0282	MW-102-20212308	Groundwater	Iron-57	EPA 6020B (Dissolved)	J*	None	Field Duplicate RPD Failure
21H0282	MW-102-20212308	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21H0282	MW-66-20212308	Groundwater	Arsenic-75a	EPA 6020B	J*	None	Field Duplicate RPD Failure
21H0282	MW-66-20212308	Groundwater	Copper-63	EPA 6020B	J*	None	Field Duplicate RPD Failure
21H0282	MW-66-20212308	Groundwater	Iron-54	EPA 6020B	J*	None	Field Duplicate RPD Failure
21H0282	MW-66-20212308	Groundwater	Vanadium-51a	EPA 6020B	J*	None	Field Duplicate RPD Failure
21H0282	MW-66-20212308	Groundwater	Copper-63	EPA 6020B (Dissolved)	B*	High	Method Blank Detection
21H0282	MW-66-20212308	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21H0282	MW-70-20212308	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21H0282	MW-70-20212308	Groundwater	Toluene	EPA 8260D	B*	High	Trip Blank Detection
21H0291	MW-48-20212408	Groundwater	Toluene	EPA 8260D	JH*	High	Trip Blank Detection
21H0291	MW-51-20212408	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure

Table 3 - 2021 Quarter 3 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21H0291	MW-55-20212408	Groundwater	Toluene	EPA 8260D	B*	High	Trip Blank Detection
21H0291	MW-55-20212408	Groundwater	Hexavalent Chromium	SM 3500-Cr B-09	R*	None	Gross MS/PS Recovery Failure
21H0291	MW-69-20212408	Groundwater	Nickel-60	EPA 6020B	J*	None	Laboratory Duplicate RPD Failure
21H0291	MW-69-20212408	Groundwater	Toluene	EPA 8260D	B*	High	Trip Blank Detection
21H0291	MW-69-20212408	Groundwater	1,2-Dichlorobenzene	EPA 8270E	JL*	Low	Surrogate Recovery Failure
21H0291	MW-69-20212408	Groundwater	1,4-Dichlorobenzene	EPA 8270E	JL*	Low	Surrogate Recovery Failure
21H0291	MW-69-20212408	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0304	EB-2-20212508	Distilled Water	Aroclor 1260	EPA 8082A	J*	Low	LCS/LCSD Recovery Failure
21H0304	EB-2-20212508	Distilled Water	1,2-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0304	EB-2-20212508	Distilled Water	1,4-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0304	EB-2-20212508	Distilled Water	Benzoic acid	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0304	EB-2-20212508	Distilled Water	N-Nitrosodiphenylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0304	EB-2-20212508	Distilled Water	1-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0304	EB-2-20212508	Distilled Water	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0304	EB-2-20212508	Distilled Water	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0304	MW-23-20212508	Groundwater	Chloride	EPA 300.0	JL*	Low	Holding Time Exceedance
21H0304	MW-23-20212508	Groundwater	Hexavalent Chromium	SM 3500-Cr B-09	R*	Low	Gross MS Recovery Failure
21H0304	MW-23-20212508	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21H0304	MW-24-20212508	Groundwater	1,2-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0304	MW-24-20212508	Groundwater	1,4-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0304	MW-24-20212508	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0304	MW-24-20212508	Groundwater	N-Nitrosodiphenylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0304	MW-58-20212508	Groundwater	Chloride	EPA 300.0	JL*	Low	Holding Time Exceedance
21H0304	MW-58-20212508	Groundwater	Benzene	EPA 8260D	JH*	High	Surrogate Recovery Failure
21H0304	MW-58-20212508	Groundwater	Dibenzofuran	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0304	MW-58-20212508	Groundwater	Phenanthrene	EPA 8270E-SIM	B*	High	Equipment Blank Detection
21H0304	MW-58-20212508	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21H0304	MW-59-20212508	Groundwater	1-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0304	MW-59-20212508	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0304	MW-59-20212508	Groundwater	Dibenzofuran	EPA 8270E-SIM	B*	High	Method Blank Detection

Table 3 - 2021 Quarter 3 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21H0304	MW-59-20212508	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0304	MW-59-20212508	Groundwater	Phenanthrene	EPA 8270E-SIM	B*	High	Equipment Blank Detection
21H0320	MW-11-20212608	Groundwater	Diesel Range Organics	NWTPH-Dx	JH*	High	LCS Recovery Failure
21H0320	MW-14-20212608	Groundwater	Nitrite-N	EPA 300.0	J*	Low	MS Recovery Failure
21H0320	MW-14-20212608	Groundwater	Mercury	EPA 7470A	B*	High	Method Blank Detection
21H0320	MW-14-20212608	Groundwater	Ferrous Iron	SM 3500-Fe B-97	JL*	Low	Headspace
21H0320	MW-14-20212608	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21H0320	MW-32-20212608	Groundwater	1,2-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0320	MW-32-20212608	Groundwater	1,4-Dichlorobenzene	EPA 8270E	JL*	Low	Surrogate Recovery Failure
21H0320	MW-32-20212608	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0320	MW-32-20212608	Groundwater	N-Nitrosodiphenylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0320	MW-32-20212608	Groundwater	1-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0320	MW-32-20212608	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0320	MW-32-20212608	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0320	MW-32-20212608	Groundwater	Diesel Range Organics	NWTPH-Dx	JH*	High	LCS Recovery Failure
21H0320	MW-34-20212608	Groundwater	Diesel Range Organics	NWTPH-Dx	JH*	High	LCS Recovery Failure
21H0320	MW-72-20212608	Groundwater	Mercury	EPA 7470A	B*	High	Method Blank Detection
21H0320	MW-72-20212608	Groundwater	1,2-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0320	MW-72-20212608	Groundwater	1,3-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0320	MW-72-20212608	Groundwater	1,4-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0320	MW-72-20212608	Groundwater	2-Chlorophenol	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0320	MW-72-20212608	Groundwater	2-Methylphenol	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0320	MW-72-20212608	Groundwater	2-Nitrophenol	EPA 8270E	J*	None	LCS/LCSD RPD Failure
21H0320	MW-72-20212608	Groundwater	4-Chloroaniline	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0320	MW-72-20212608	Groundwater	4-Nitrophenol	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0320	MW-72-20212608	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0320	MW-72-20212608	Groundwater	Benzyl Alcohol	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0320	MW-72-20212608	Groundwater	bis(2-chloroethyl) ether	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0320	MW-72-20212608	Groundwater	Hexachloroethane	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0320	MW-72-20212608	Groundwater	N-Nitroso-di-n-Propylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure

Table 3 - 2021 Quarter 3 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21H0320	MW-72-20212608	Groundwater	N-Nitrosodiphenylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0320	MW-72-20212608	Groundwater	Phenol	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0341	MW-31-20212708	Groundwater	1,1-Dichloroethene	EPA 8260D	J*	Low	Headspace
21H0341	MW-31-20212708	Groundwater	cis-1,2-Dichloroethene	EPA 8260D	J*	Low	Headspace
21H0341	MW-31-20212708	Groundwater	Tetrachloroethene	EPA 8260D	J*	Low	Headspace
21H0341	MW-31-20212708	Groundwater	trans-1,2-Dichloroethene	EPA 8260D	J*	Low	Headspace
21H0341	MW-31-20212708	Groundwater	Trichloroethene	EPA 8260D	J*	Low	Headspace
21H0341	MW-31-20212708	Groundwater	Vinyl Chloride	EPA 8260D	J*	Low	Headspace
21H0341	MW-31-20212708	Groundwater	Vinyl chloride	EPA 8260D-SIM	JL*	Low	Headspace
21H0341	MW-31-20212708	Groundwater	2,4-Dimethylphenol	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0341	MW-31-20212708	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0341	MW-31-20212708	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0341	MW-31-20212708	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0341	MW-45-20212708	Groundwater	Vinyl chloride	EPA 8260D-SIM	J*	None	LCS/LCSD RPD Failure
21H0341	MW-47-20212708	Groundwater	Vinyl chloride	EPA 8260D-SIM	J*	None	LCS/LCSD RPD Failure
21H0341	MW-47-20212708	Groundwater	1,2-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0341	MW-47-20212708	Groundwater	1,3-Dichlorobenzene	EPA 8270E	JL*	Low	Surrogate Recovery Failure
21H0341	MW-47-20212708	Groundwater	1,4-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0341	MW-47-20212708	Groundwater	2,4-Dimethylphenol	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0341	MW-47-20212708	Groundwater	2-Chlorophenol	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0341	MW-47-20212708	Groundwater	2-Methylphenol	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0341	MW-47-20212708	Groundwater	4-Chloroaniline	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0341	MW-47-20212708	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0341	MW-47-20212708	Groundwater	Benzyl Alcohol	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0341	MW-47-20212708	Groundwater	bis(2-chloroethyl) ether	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0341	MW-47-20212708	Groundwater	Hexachlorocyclopentadiene	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21H0341	MW-47-20212708	Groundwater	Hexachloroethane	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0341	MW-47-20212708	Groundwater	N-Nitroso-di-n-Propylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0341	MW-47-20212708	Groundwater	N-Nitrosodiphenylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
21H0341	MW-47-20212708	Groundwater	Phenol	EPA 8270E	J*	Low	Surrogate Recovery Failure

Table 3 - 2021 Quarter 3 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21H0341	MW-52-20212708	Groundwater	1-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0341	MW-52-20212708	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0341	MW-52-20212708	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0341	MW-73-20212708	Groundwater	Mercury	EPA 7470A	B*	High	Method Blank Detection
21H0341	MW-73-20212708	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21H0341	MW-73-20212708	Groundwater	Vinyl chloride	EPA 8260D-SIM	J*	None	LCS/LCSD RPD Failure
21H0341	MW-73-20212708	Groundwater	1-Methylnaphthalene	EPA 8270E-SIM	JH*	High	Method Blank Detection
21H0341	MW-73-20212708	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0341	MW-73-20212708	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0341	TB-9-20212708	Distilled Water	Vinyl chloride	EPA 8260D-SIM	J*	None	LCS/LCSD RPD Failure
21H0367	MW-3-20213008	Groundwater	Vinyl chloride	EPA 8260D-SIM	J*	None	LCS/LCSD RPD Failure
21H0367	MW-4-20213008	Groundwater	Mercury	EPA 7470A	B*	High	Method Blank Detection
21H0367	MW-4-20213008	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21H0367	MW-56-20213008	Groundwater	Nickel-60	EPA 6020B (Dissolved)	J*	None	Laboratory Duplicate RPD Failure
21H0367	MW-56-20213008	Groundwater	Mercury	EPA 7470A	B*	High	Method Blank Detection
21H0367	MW-56-20213008	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21H0367	MW-56-20213008	Groundwater	Vinyl chloride	EPA 8260D-SIM	J*	None	LCS/LCSD RPD Failure
21H0367	MW-56-20213008	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0367	MW-56-20213008	Groundwater	Benzo(a)anthracene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0367	MW-56-20213008	Groundwater	Benzo(b)fluoranthene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0367	MW-56-20213008	Groundwater	Chrysene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0367	MW-56-20213008	Groundwater	Dibenzofuran	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0367	MW-56-20213008	Groundwater	Fluoranthene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0367	MW-56-20213008	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0367	MW-56-20213008	Groundwater	Phenanthrene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0367	MW-56-20213008	Groundwater	Pyrene	EPA 8270E-SIM	B*	High	Method Blank Detection
21H0367	MW-56-20213008	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21H0367	MW-8-20213008	Groundwater	Mercury	EPA 7470A	B*	High	Method Blank Detection
21H0367	MW-8-20213008	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21H0367	TB-10-20213008	Distilled Water	Vinyl chloride	EPA 8260D-SIM	J*	None	LCS/LCSD RPD Failure

Table 3 - 2021 Quarter 3 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21I0001	MW-101-20213108	Groundwater	Iron-57	EPA 6020B	J*	None	Field Duplicate RPD Failure
21I0001	MW-101-20213108	Groundwater	Vanadium-51a	EPA 6020B	J*	None	Field Duplicate RPD Failure
21I0001	MW-101-20213108	Groundwater	Mercury	EPA 7470A	B*	High	Method Blank Detection
21I0001	MW-101-20213108	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21I0001	MW-101-20213108	Groundwater	1,2-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0001	MW-101-20213108	Groundwater	1,3-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0001	MW-101-20213108	Groundwater	1,4-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0001	MW-101-20213108	Groundwater	2,4-Dichlorophenol	EPA 8270E	J*	Low	LCS Recovery Failure
21I0001	MW-101-20213108	Groundwater	2-Chlorophenol	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0001	MW-101-20213108	Groundwater	2-Methylphenol	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0001	MW-101-20213108	Groundwater	4-Chloroaniline	EPA 8270E	J*	Low	LCS Recovery Failure
21I0001	MW-101-20213108	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCS Recovery Failure
21I0001	MW-101-20213108	Groundwater	Benzyl Alcohol	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0001	MW-101-20213108	Groundwater	bis(2-chloroethyl) ether	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0001	MW-101-20213108	Groundwater	Diethyl phthalate	EPA 8270E	J*	None	Field Duplicate RPD Failure
21I0001	MW-101-20213108	Groundwater	Hexachlorocyclopentadiene	EPA 8270E	J*	Low	LCS Recovery Failure
21I0001	MW-101-20213108	Groundwater	Hexachloroethane	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0001	MW-101-20213108	Groundwater	N-Nitroso-di-n-Propylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0001	MW-101-20213108	Groundwater	N-Nitrosodiphenylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0001	MW-101-20213108	Groundwater	Phenol	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0001	MW-10R-20213108	Groundwater	Mercury	EPA 7470A	B*	High	Method Blank Detection
21I0001	MW-10R-20213108	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21I0001	MW-10R-20213108	Groundwater	1-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21I0001	MW-10R-20213108	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21I0001	MW-10R-20213108	Groundwater	Dibenzofuran	EPA 8270E-SIM	B*	High	Method Blank Detection
21I0001	MW-10R-20213108	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21I0001	MW-57-20213108	Groundwater	Mercury	EPA 7470A	B*	High	Method Blank Detection
21I0001	MW-57-20213108	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21I0001	MW-57-20213108	Groundwater	1-Methylnaphthalene	EPA 8270E-SIM	JH*	High	Method Blank Detection
21I0001	MW-57-20213108	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	JH*	High	Method Blank Detection

Table 3 - 2021 Quarter 3 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
2110001	MW-57-20213108	Groundwater	Dibenzofuran	EPA 8270E-SIM	B*	High	Method Blank Detection
2110001	MW-57-20213108	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
2110001	MW-62-20213108	Groundwater	Mercury	EPA 7470A	B*	High	Method Blank Detection
2110001	MW-62-20213108	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
2110001	MW-62-20213108	Groundwater	1-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
2110001	MW-62-20213108	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
2110001	MW-62-20213108	Groundwater	Dibenzofuran	EPA 8270E-SIM	B*	High	Method Blank Detection
2110001	MW-62-20213108	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
2110001	MW-75-20213108	Groundwater	Iron-54	EPA 6020B	J*	None	Field Duplicate RPD Failure
2110001	MW-75-20213108	Groundwater	Vanadium-51a	EPA 6020B	J*	None	Field Duplicate RPD Failure
2110001	MW-75-20213108	Groundwater	Mercury	EPA 7470A	B*	High	Method Blank Detection
2110001	MW-75-20213108	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
2110001	MW-75-20213108	Groundwater	1,2-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
2110001	MW-75-20213108	Groundwater	1,3-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
2110001	MW-75-20213108	Groundwater	1,4-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
2110001	MW-75-20213108	Groundwater	2,4-Dichlorophenol	EPA 8270E	J*	Low	LCS Recovery Failure
2110001	MW-75-20213108	Groundwater	2-Chlorophenol	EPA 8270E	J*	Low	Surrogate Recovery Failure
2110001	MW-75-20213108	Groundwater	2-Methylphenol	EPA 8270E	J*	Low	Surrogate Recovery Failure
2110001	MW-75-20213108	Groundwater	4-Chloroaniline	EPA 8270E	J*	Low	LCS Recovery Failure
2110001	MW-75-20213108	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCS Recovery Failure
2110001	MW-75-20213108	Groundwater	Benzyl Alcohol	EPA 8270E	J*	Low	Surrogate Recovery Failure
2110001	MW-75-20213108	Groundwater	bis(2-chloroethyl) ether	EPA 8270E	J*	Low	Surrogate Recovery Failure
2110001	MW-75-20213108	Groundwater	Diethyl phthalate	EPA 8270E	J*	None	Field Duplicate RPD Failure
2110001	MW-75-20213108	Groundwater	Hexachlorocyclopentadiene	EPA 8270E	J*	Low	LCS Recovery Failure
2110001	MW-75-20213108	Groundwater	Hexachloroethane	EPA 8270E	J*	Low	Surrogate Recovery Failure
2110001	MW-75-20213108	Groundwater	N-Nitroso-di-n-Propylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
2110001	MW-75-20213108	Groundwater	N-Nitrosodiphenylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
2110001	MW-75-20213108	Groundwater	Phenol	EPA 8270E	J*	Low	Surrogate Recovery Failure
2110012	MW-40-20210109	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
2110012	MW-40-20210109	Groundwater	1,2-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure

Table 3 - 2021 Quarter 3 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21I0012	MW-40-20210109	Groundwater	1,4-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-40-20210109	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21I0012	MW-40-20210109	Groundwater	N-Nitrosodiphenylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-40-20210109	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21I0012	MW-40-20210109	Groundwater	Dibenzofuran	EPA 8270E-SIM	B*	High	Method Blank Detection
21I0012	MW-40-20210109	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21I0012	MW-41-20210109	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21I0012	MW-41-20210109	Groundwater	1,2-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-41-20210109	Groundwater	1,4-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-41-20210109	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21I0012	MW-41-20210109	Groundwater	N-Nitrosodiphenylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-41-20210109	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21I0012	MW-41-20210109	Groundwater	Dibenzofuran	EPA 8270E-SIM	B*	High	Method Blank Detection
21I0012	MW-41-20210109	Groundwater	Naphthalene	EPA 8270E-SIM	JH*	High	Method Blank Detection
21I0012	MW-53-20210109	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21I0012	MW-53-20210109	Groundwater	Vinyl chloride	EPA 8260D-SIM	B*	High	Method Blank Detection
21I0012	MW-53-20210109	Groundwater	1,2-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-53-20210109	Groundwater	1,4-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-53-20210109	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21I0012	MW-53-20210109	Groundwater	N-Nitrosodiphenylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-53-20210109	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21I0012	MW-53-20210109	Groundwater	Dibenzofuran	EPA 8270E-SIM	B*	High	Method Blank Detection
21I0012	MW-53-20210109	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21I0012	MW-60-20210109	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21I0012	MW-60-20210109	Groundwater	Toluene	EPA 8260D	B*	High	Trip Blank Detection
21I0012	MW-60-20210109	Groundwater	Vinyl chloride	EPA 8260D-SIM	B*	High	Method Blank Detection
21I0012	MW-60-20210109	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	JH*	High	Method Blank Detection
21I0012	MW-60-20210109	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21I0012	MW-60-20210109	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21I0012	MW-63-20210109	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection

Table 3 - 2021 Quarter 3 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21I0012	MW-63-20210109	Groundwater	1,2-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-63-20210109	Groundwater	1,3-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-63-20210109	Groundwater	1,4-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-63-20210109	Groundwater	2-Chlorophenol	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-63-20210109	Groundwater	2-Methylphenol	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-63-20210109	Groundwater	4-Chloroaniline	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21I0012	MW-63-20210109	Groundwater	4-Nitroaniline	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21I0012	MW-63-20210109	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21I0012	MW-63-20210109	Groundwater	Benzyl Alcohol	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-63-20210109	Groundwater	bis(2-chloroethyl) ether	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-63-20210109	Groundwater	Hexachlorocyclopentadiene	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21I0012	MW-63-20210109	Groundwater	Hexachloroethane	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-63-20210109	Groundwater	N-Nitroso-di-n-Propylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-63-20210109	Groundwater	N-Nitrosodiphenylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0012	MW-63-20210109	Groundwater	Phenol	EPA 8270E	J*	Low	LCS/LCSD Recovery Failure
21I0012	MW-64-20210109	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21I0012	MW-64-20210109	Groundwater	Toluene	EPA 8260D	B*	High	Trip Blank Detection
21I0012	MW-64-20210109	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21I0012	MW-64-20210109	Groundwater	Dibenzofuran	EPA 8270E-SIM	B*	High	Method Blank Detection
21I0012	MW-64-20210109	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
21I0040	EB-3-20210209	Distilled Water	Manganese-55	EPA 6020B (Dissolved)	JH*	High	Method Blank Detection
21I0040	EB-3-20210209	Distilled Water	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
21I0040	EB-3-20210209	Distilled Water	1,2-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0040	EB-3-20210209	Distilled Water	1,4-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0040	EB-3-20210209	Distilled Water	Benzoic acid	EPA 8270E	J*	Low	LCSD Recovery Failure
21I0040	EB-3-20210209	Distilled Water	N-Nitrosodiphenylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0040	MW-14-20210209	Groundwater	1,2-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0040	MW-14-20210209	Groundwater	1,4-Dichlorobenzene	EPA 8270E	J*	Low	Surrogate Recovery Failure
21I0040	MW-14-20210209	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCSD Recovery Failure
21I0040	MW-14-20210209	Groundwater	N-Nitrosodiphenylamine	EPA 8270E	J*	Low	Surrogate Recovery Failure

Table 3 - 2021 Quarter 3 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
2110040	MW-37-20210209	Groundwater	Vinyl chloride	EPA 8260D-SIM	B*	High	Method Blank Detection
2110040	MW-37-20210209	Groundwater	1-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
2110040	MW-37-20210209	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
2110040	MW-37-20210209	Groundwater	Dibenzofuran	EPA 8270E-SIM	B*	High	Method Blank Detection
2110040	MW-37-20210209	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
2110040	MW-61-20210209	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
2110040	MW-61-20210209	Groundwater	1-Methylnaphthalene	EPA 8270E-SIM	JH*	High	Method Blank Detection
2110040	MW-61-20210209	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	JH*	High	Method Blank Detection
2110040	MW-61-20210209	Groundwater	Dibenzofuran	EPA 8270E-SIM	JH*	High	Method Blank Detection
2110040	MW-61-20210209	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
2110040	MW-65-20210209	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
2110040	MW-65-20210209	Groundwater	Benzoic acid	EPA 8270E	J*	Low	LCSD Recovery Failure
2110040	MW-65-20210209	Groundwater	1-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
2110040	MW-65-20210209	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
2110040	MW-65-20210209	Groundwater	Dibenzofuran	EPA 8270E-SIM	B*	High	Method Blank Detection
2110040	MW-65-20210209	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection
2110040	MW-74-20210209	Groundwater	Mercury	EPA 7470A (Dissolved)	B*	High	Method Blank Detection
2110040	MW-74-20210209	Groundwater	1-Methylnaphthalene	EPA 8270E-SIM	JH*	High	Method Blank Detection
2110040	MW-74-20210209	Groundwater	2-Methylnaphthalene	EPA 8270E-SIM	JH*	High	Method Blank Detection
2110040	MW-74-20210209	Groundwater	Dibenzofuran	EPA 8270E-SIM	B*	High	Method Blank Detection
2110040	MW-74-20210209	Groundwater	Naphthalene	EPA 8270E-SIM	B*	High	Method Blank Detection

LCS = laboratory control sample; LCSD = laboratory control sample duplicate; MS = matrix spike; MSD = matrix spike duplicate; RPD = relative percent difference

Table 4 - 2021 Quarter 4 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21J0060	SB-2021-048:1.5-10042021	Soil	Diesel Range Organics (C12-	NWTPH-Dx	D*	None	Re-extraction result reported
21J0060	SB-2021-048:1.5-10042021	Soil	Motor Oil Range Organics (C	NWTPH-Dx	D*	None	Re-extraction result reported
21J0060	SB-2021-048:1.5-10042021	Soil	Aroclor 1254	SW8082A	JH*	High	Surrogate Recovery Failure
21J0060	SB-2021-048:1.5-10042021	Soil	Aroclor 1268	SW8082A	JH*	High	Surrogate Recovery Failure
21J0060	SB-2021-048:8.5-10042021	Soil	Aroclor 1268	SW8082A	J*	None	Confirmation Column RPD Failure
21J0060	SB-2021-049:1-10042021	Soil	Aroclor 1016	SW8082A	J*	Low	Surrogate Recovery Failure
21J0060	SB-2021-049:7.5-10042021	Soil	Aroclor 1268	SW8082A	J*	None	Confirmation Column RPD Failure
21J0060	SB-2021-050:6.5-10042021	Soil	Aroclor 1254	SW8082A	J*	None	Field Duplicate RPD Failure
21J0060	SB-2021-051:1.2-10042021	Soil	Aroclor 1254	SW8082A	JH*	High	Surrogate Recovery Failure
21J0060	SB-2021-051:1.2-10042021	Soil	Aroclor 1262	SW8082A	JH*	High	Surrogate Recovery Failure
21J0060	SB-2021-051:8.0-10042021	Soil	Aroclor 1260	SW8082A	J*	None	Confirmation Column RPD Failure
21J0060	SB-2021-052:0.1-10042021	Soil	Aroclor 1268	SW8082A	J*	None	Confirmation Column RPD Failure
21J0060	SB-2021-052:2.4-10042021	Soil	Aroclor 1268	SW8082A	J*	None	Confirmation Column RPD Failure
21J0060	SB-2021-056:5.5-10042021	Soil	Aroclor 1262	SW8082A	J*	None	Confirmation Column RPD Failure
21J0060	SB-2021-057:0.8-10042021	Soil	Aroclor 1262	SW8082A	J*	None	Confirmation Column RPD Failure
21J0060	SB-2021-Dup	Soil	Aroclor 1254	SW8082A	J*	None	Field Duplicate RPD Failure
21K0165	MW-103-20210911	Groundwater	Manganese-55	SW6020B	J*	None	Field Duplicate RPD Failure
21K0165	MW-50-20210911	Groundwater	Manganese-55	SW6020B	J*	None	Field Duplicate RPD Failure
21K0165	MW-65-20210911	Groundwater	Mercury	SW7470A	B*	High	Method Blank Detection
21K0165	MW-65-20210911	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0165	MW-65-20210911	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0165	MW-65-20210911	Groundwater	Carbazole	SW8270E-SIM	B*	High	Method Blank Detection
21K0165	MW-65-20210911	Groundwater	Dibenzofuran	SW8270E-SIM	B*	High	Method Blank Detection
21K0165	MW-65-20210911	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0165	MW-65-20210911	Groundwater	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21K0165	TB-1-20210911	Distilled Water	1,1-Dichloroethene	SW8260D	J*	Low	Headspace
21K0165	TB-1-20210911	Distilled Water	Benzene	SW8260D	J*	Low	Headspace
21K0165	TB-1-20210911	Distilled Water	cis-1,2-Dichloroethene	SW8260D	J*	Low	Headspace
21K0165	TB-1-20210911	Distilled Water	Ethylbenzene	SW8260D	J*	Low	Headspace
21K0165	TB-1-20210911	Distilled Water	m,p-Xylene	SW8260D	J*	Low	Headspace
21K0165	TB-1-20210911	Distilled Water	o-Xylene	SW8260D	J*	Low	Headspace
21K0165	TB-1-20210911	Distilled Water	Tetrachloroethene	SW8260D	J*	Low	Headspace
21K0165	TB-1-20210911	Distilled Water	Toluene	SW8260D	J*	Low	Headspace

Table 4 - 2021 Quarter 4 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21K0165	TB-1-20210911	Distilled Water	trans-1,2-Dichloroethene	SW8260D	J*	Low	Headspace
21K0165	TB-1-20210911	Distilled Water	Trichloroethene	SW8260D	J*	Low	Headspace
21K0165	TB-1-20210911	Distilled Water	Vinyl Chloride	SW8260D	J*	Low	Headspace
21K0165	TB-1-20210911	Distilled Water	Xylenes, total	SW8260D	J*	Low	Headspace
21K0165	TB-1-20210911	Distilled Water	Vinyl chloride	SW8260D-SIM	J*	Low	Headspace
21K0213	EB-1-20211011	Distilled Water	Mercury	SW7470A	B*	High	Method Blank Detection
21K0213	EB-1-20211011	Distilled Water	Mercury	SW7470A (Dissolved)	B*	High	Method Blank Detection
21K0213	EB-1-20211011	Distilled Water	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0213	EB-1-20211011	Distilled Water	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0213	EB-1-20211011	Distilled Water	Carbazole	SW8270E-SIM	B*	High	Method Blank Detection
21K0213	EB-1-20211011	Distilled Water	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0213	MW-25-20211011	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Equipment Blank Detection
21K0213	MW-25-20211011	Groundwater	Carbazole	SW8270E-SIM	B*	High	Method Blank Detection
21K0213	MW-25-20211011	Groundwater	Dibenzofuran	SW8270E-SIM	B*	High	Method Blank Detection
21K0213	MW-25-20211011	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0213	MW-25-20211011	Groundwater	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21K0213	MW-66-20211011	Groundwater	Mercury	SW7470A	B*	High	Method Blank Detection
21K0213	MW-66-20211011	Groundwater	Mercury	SW7470A (Dissolved)	B*	High	Method Blank Detection
21K0213	MW-66-20211011	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Equipment Blank Detection
21K0213	MW-66-20211011	Groundwater	Carbazole	SW8270E-SIM	B*	High	Method Blank Detection
21K0213	MW-66-20211011	Groundwater	Dibenzofuran	SW8270E-SIM	B*	High	Method Blank Detection
21K0213	MW-66-20211011	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0213	MW-66-20211011	Groundwater	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21K0213	TB-2-20211011	Distilled Water	Vinyl chloride	SW8260D-SIM	J*	Low	Headspace
21K0240	MW-102-20211111	Groundwater	Copper-63	SW6020B	J*	None	Field Duplicate RPD Failure
21K0240	MW-102-20211111	Groundwater	Lead-208	SW6020B	J*	None	Field Duplicate RPD Failure
21K0240	MW-102-20211111	Groundwater	Nickel-60	SW6020B	J*	None	Field Duplicate RPD Failure
21K0240	MW-102-20211111	Groundwater	Selenium-78	SW6020B (Dissolved)	J*	None	Field Duplicate RPD Failure
21K0240	MW-102-20211111	Groundwater	Mercury	SW7470A	B*	High	Method Blank Detection
21K0240	MW-102-20211111	Groundwater	Vinyl Chloride	SW8260D	J*	None	Field Duplicate RPD Failure
21K0240	MW-102-20211111	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0240	MW-102-20211111	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0240	MW-102-20211111	Groundwater	Anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure

Table 4 - 2021 Quarter 4 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21K0240	MW-102-20211111	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0240	MW-102-20211111	Groundwater	Pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21K0240	MW-40-20211111	Groundwater	Copper-63	SW6020B	JH*	High	MS Recovery and Field Duplicate RPD Failures
21K0240	MW-40-20211111	Groundwater	Lead-208	SW6020B	J*	None	Field Duplicate RPD Failure
21K0240	MW-40-20211111	Groundwater	Nickel-60	SW6020B	J*	None	Field Duplicate RPD Failure
21K0240	MW-40-20211111	Groundwater	Selenium-78	SW6020B (Dissolved)	J*	None	Field Duplicate RPD Failure
21K0240	MW-40-20211111	Groundwater	Mercury	SW7470A	B*	High	Method Blank Detection
21K0240	MW-40-20211111	Groundwater	Vinyl Chloride	SW8260D	J*	None	Field Duplicate RPD Failure
21K0240	MW-40-20211111	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0240	MW-40-20211111	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0240	MW-40-20211111	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0240	MW-40-20211111	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0240	MW-40-20211111	Groundwater	Anthracene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21K0240	MW-40-20211111	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0240	MW-40-20211111	Groundwater	Pyrene	SW8270E-SIM	J*	None	Field Duplicate RPD Failure
21K0240	MW-41-20211111	Groundwater	Mercury	SW7470A	B*	High	Method Blank Detection
21K0240	MW-41-20211111	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0240	MW-41-20211111	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0240	MW-41-20211111	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0240	MW-41-20211111	Groundwater	Naphthalene	SW8270E-SIM	JH*	Low	Method Blank Detection
21K0240	MW-57-20211111	Groundwater	Mercury	SW7470A	B*	High	Method Blank Detection
21K0240	MW-57-20211111	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0240	MW-57-20211111	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0240	MW-57-20211111	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0240	MW-62-20211111	Groundwater	Mercury	SW7470A	B*	High	Method Blank Detection
21K0240	MW-62-20211111	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0240	MW-62-20211111	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0240	MW-62-20211111	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0240	TB-3-20211111	Distilled Water	1,1-Dichloroethene	SW8260D	J*	Low	Headspace
21K0240	TB-3-20211111	Distilled Water	Benzene	SW8260D	J*	Low	Headspace
21K0240	TB-3-20211111	Distilled Water	cis-1,2-Dichloroethene	SW8260D	J*	Low	Headspace
21K0240	TB-3-20211111	Distilled Water	Ethylbenzene	SW8260D	J*	Low	Headspace
21K0240	TB-3-20211111	Distilled Water	m,p-Xylene	SW8260D	J*	Low	Headspace

Table 4 - 2021 Quarter 4 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21K0240	TB-3-20211111	Distilled Water	o-Xylene	SW8260D	J*	Low	Headspace
21K0240	TB-3-20211111	Distilled Water	Tetrachloroethene	SW8260D	J*	Low	Headspace
21K0240	TB-3-20211111	Distilled Water	Toluene	SW8260D	J*	Low	Headspace
21K0240	TB-3-20211111	Distilled Water	trans-1,2-Dichloroethene	SW8260D	J*	Low	Headspace
21K0240	TB-3-20211111	Distilled Water	Trichloroethene	SW8260D	J*	Low	Headspace
21K0240	TB-3-20211111	Distilled Water	Vinyl Chloride	SW8260D	J*	Low	Headspace
21K0240	TB-3-20211111	Distilled Water	Xylenes, total	SW8260D	J*	Low	Headspace
21K0240	TB-3-20211111	Distilled Water	Vinyl chloride	SW8260D-SIM	J*	Low	Headspace
21K0245	MW-30-20211211	Groundwater	Acetylene	EPA RSK-175	J*	Low	Surrogate Recovery Failure
21K0245	MW-30-20211211	Groundwater	Ethane	EPA RSK-175	J*	Low	Surrogate Recovery Failure
21K0245	MW-30-20211211	Groundwater	Ethene	EPA RSK-175	J*	Low	Surrogate Recovery Failure
21K0245	MW-30-20211211	Groundwater	Methane	EPA RSK-175	JL*	Low	Surrogate Recovery Failure
21K0245	MW-30-20211211	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21K0245	MW-36-20211211	Groundwater	Nitrate-N	EPA 300.0	J*	Low	Holding Time Exceedance
21K0245	MW-36-20211211	Groundwater	Nitrite-N	EPA 300.0	J*	Low	Holding Time Exceedance
21K0245	MW-36-20211211	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21K0245	MW-36-20211211	Groundwater	Mercury	SW7470A	B*	High	Method Blank Detection
21K0245	MW-58-20211211	Groundwater	Nitrate-N	EPA 300.0	J*	Low	Holding Time Exceedance
21K0245	MW-58-20211211	Groundwater	Nitrite-N	EPA 300.0	J*	Low	Holding Time Exceedance
21K0245	MW-58-20211211	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21K0245	MW-58-20211211	Groundwater	Chromium-52	SW6020B (Dissolved)	J*	Low	MS Recovery Failure
21K0245	MW-58-20211211	Groundwater	Mercury	SW7470A	B*	High	Method Blank Detection
21K0245	MW-58-20211211	Groundwater	Benzene	SW8260D	JH*	High	Surrogate Recovery Failure
21K0245	MW-58-20211211	Groundwater	2-Methylnaphthalene	SW8270E-SIM	JH*	High	Method Blank Detection
21K0245	MW-75-20211211	Groundwater	Mercury	SW7470A	B*	High	Method Blank Detection
21K0245	MW-75-20211211	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0245	MW-75-20211211	Groundwater	1,3-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0245	MW-75-20211211	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0245	MW-75-20211211	Groundwater	2-Chlorophenol	SW8270E	J*	Low	Surrogate Recovery Failure
21K0245	MW-75-20211211	Groundwater	2-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21K0245	MW-75-20211211	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0245	MW-75-20211211	Groundwater	4-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21K0245	MW-75-20211211	Groundwater	Benzyl Alcohol	SW8270E	J*	Low	Surrogate Recovery Failure

Table 4 - 2021 Quarter 4 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21K0245	MW-75-20211211	Groundwater	bis(2-chloroethyl) ether	SW8270E	J*	Low	Surrogate Recovery Failure
21K0245	MW-75-20211211	Groundwater	Diethyl phthalate	SW8270E	B*	High	Method Blank Detection
21K0245	MW-75-20211211	Groundwater	Hexachlorocyclopentadiene	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0245	MW-75-20211211	Groundwater	Hexachloroethane	SW8270E	J*	Low	Surrogate Recovery Failure
21K0245	MW-75-20211211	Groundwater	N-Nitroso-di-n-Propylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21K0245	MW-75-20211211	Groundwater	Phenol	SW8270E	J*	Low	Surrogate Recovery Failure
21K0245	TB-4-20211211	Distilled Water	1,1-Dichloroethene	SW8260D	J*	Low	Headspace
21K0245	TB-4-20211211	Distilled Water	Benzene	SW8260D	J*	Low	Headspace
21K0245	TB-4-20211211	Distilled Water	cis-1,2-Dichloroethene	SW8260D	J*	Low	Headspace
21K0245	TB-4-20211211	Distilled Water	Ethylbenzene	SW8260D	J*	Low	Headspace
21K0245	TB-4-20211211	Distilled Water	m,p-Xylene	SW8260D	J*	Low	Headspace
21K0245	TB-4-20211211	Distilled Water	o-Xylene	SW8260D	J*	Low	Headspace
21K0245	TB-4-20211211	Distilled Water	Tetrachloroethene	SW8260D	J*	Low	Headspace
21K0245	TB-4-20211211	Distilled Water	Toluene	SW8260D	J*	Low	Headspace
21K0245	TB-4-20211211	Distilled Water	trans-1,2-Dichloroethene	SW8260D	J*	Low	Headspace
21K0245	TB-4-20211211	Distilled Water	Trichloroethene	SW8260D	J*	Low	Headspace
21K0245	TB-4-20211211	Distilled Water	Vinyl Chloride	SW8260D	J*	Low	Headspace
21K0245	TB-4-20211211	Distilled Water	Xylenes, total	SW8260D	J*	Low	Headspace
21K0245	TB-4-20211211	Distilled Water	Vinyl chloride	SW8260D-SIM	J*	Low	Headspace
21K0284	EB-2-20211611	Distilled Water	Copper-63	SW6020B	J*	None	Laboratory Duplicate RPD Failure
21K0284	EB-2-20211611	Distilled Water	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0284	EB-2-20211611	Distilled Water	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0284	EB-2-20211611	Distilled Water	Benzoic acid	SW8270E	J*	Low	LCS Recovery Failure
21K0284	EB-2-20211611	Distilled Water	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0284	EB-2-20211611	Distilled Water	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0284	MW-63-20211611	Groundwater	Copper-63	SW6020B	JH*	High	Equipment Blank Detection
21K0284	MW-63-20211611	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0284	MW-63-20211611	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0284	MW-63-20211611	Groundwater	2,4-Dinitrophenol	SW8270E	J*	None	LCS/LCSD RPD Failure
21K0284	MW-63-20211611	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS Recovery Failure
21K0284	MW-63-20211611	Groundwater	4-Chlorophenylphenyl ether	SW8270E	J*	None	LCS/LCSD RPD Failure
21K0284	MW-63-20211611	Groundwater	4-Nitrophenol	SW8270E	J*	Low	LCS Recovery Failure
21K0284	MW-63-20211611	Groundwater	Benzoic acid	SW8270E	J*	Low	LCS Recovery Failure

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Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21K0284	MW-63-20211611	Groundwater	Hexachlorocyclopentadiene	SW8270E	J*	Low	LCS Recovery and LCS/LCSD RPD Failures
21K0284	MW-64-20211611	Groundwater	Acenaphthene	SW8270E-SIM	JH*	High	Equipment Blank Detection
21K0284	MW-64-20211611	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0284	MW-71-20211611	Groundwater	Copper-63	SW6020B	JH*	High	Equipment Blank Detection
21K0284	MW-71-20211611	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Equipment Blank Detection
21K0284	MW-71-20211611	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0284	MW-71-20211611	Groundwater	Acenaphthene	SW8270E-SIM	JH*	High	Equipment Blank Detection
21K0284	MW-71-20211611	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0284	TB-5-20211611	Distilled Water	Vinyl chloride	SW8260D-SIM	J*	Low	Headspace
21K0303	MW-60-20211711	Groundwater	Ferrous Iron	SM 3500-Fe B-97	JL*	Low	Headspace
21K0303	MW-60-20211711	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21K0303	MW-68-20211711	Groundwater	Manganese-55	SW6020B (Dissolved)	J*	None	Laboratory Duplicate RPD Failure
21K0303	MW-68-20211711	Groundwater	Selenium-78	SW6020B (Dissolved)	J*	None	Laboratory Duplicate RPD Failure
21K0303	MW-68-20211711	Groundwater	2,4-Dichlorophenol	SW8270E	J*	None	LCS/LCSD RPD Failure
21K0303	MW-68-20211711	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0303	MW-68-20211711	Groundwater	4-Chlorophenylphenyl ether	SW8270E	J*	None	LCS/LCSD RPD Failure
21K0303	MW-68-20211711	Groundwater	4-Nitrophenol	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0303	MW-68-20211711	Groundwater	Benzoic acid	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0303	MW-68-20211711	Groundwater	Hexachlorocyclopentadiene	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0303	MW-72-20211711	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0303	MW-72-20211711	Groundwater	1,3-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0303	MW-72-20211711	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0303	MW-72-20211711	Groundwater	2,4-Dichlorophenol	SW8270E	J*	None	LCS/LCSD RPD Failure
21K0303	MW-72-20211711	Groundwater	2-Chlorophenol	SW8270E	J*	Low	Surrogate Recovery Failure
21K0303	MW-72-20211711	Groundwater	2-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21K0303	MW-72-20211711	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0303	MW-72-20211711	Groundwater	4-Chlorophenylphenyl ether	SW8270E	J*	None	LCS/LCSD RPD Failure
21K0303	MW-72-20211711	Groundwater	4-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21K0303	MW-72-20211711	Groundwater	4-Nitrophenol	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0303	MW-72-20211711	Groundwater	Benzoic acid	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0303	MW-72-20211711	Groundwater	Benzyl Alcohol	SW8270E	JL*	Low	Surrogate Recovery Failure
21K0303	MW-72-20211711	Groundwater	bis(2-chloroethyl) ether	SW8270E	J*	Low	Surrogate Recovery Failure
21K0303	MW-72-20211711	Groundwater	Hexachlorocyclopentadiene	SW8270E	J*	Low	LCS/LCSD Recovery Failure

Table 4 - 2021 Quarter 4 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21K0303	MW-72-20211711	Groundwater	Hexachloroethane	SW8270E	J*	Low	Surrogate Recovery Failure
21K0303	MW-72-20211711	Groundwater	N-Nitroso-di-n-Propylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21K0303	MW-72-20211711	Groundwater	Phenol	SW8270E	J*	Low	Surrogate Recovery Failure
21K0303	TB-6-20211711	Distilled Water	Vinyl chloride	SW8260D-SIM	J*	Low	Headspace
21K0322	MW-31-20211811	Groundwater	Benzoic acid	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0322	MW-31-20211811	Groundwater	2-Methylnaphthalene	SW8270E-SIM	JH*	High	Method Blank Detection
21K0322	MW-31-20211811	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0322	MW-55-20211811	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0322	MW-55-20211811	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0322	MW-76-20211811	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0322	MW-76-20211811	Groundwater	1,3-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0322	MW-76-20211811	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0322	MW-76-20211811	Groundwater	2,4-Dinitrotoluene	SW8270E	J*	None	LCS/LCSD RPD Failure
21K0322	MW-76-20211811	Groundwater	2-Chlorophenol	SW8270E	J*	Low	Surrogate Recovery Failure
21K0322	MW-76-20211811	Groundwater	2-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21K0322	MW-76-20211811	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0322	MW-76-20211811	Groundwater	4-Chlorophenylphenyl ether	SW8270E	J*	None	LCS/LCSD RPD Failure
21K0322	MW-76-20211811	Groundwater	4-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21K0322	MW-76-20211811	Groundwater	4-Nitrophenol	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0322	MW-76-20211811	Groundwater	Benzoic acid	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0322	MW-76-20211811	Groundwater	Benzyl Alcohol	SW8270E	J*	Low	Surrogate Recovery Failure
21K0322	MW-76-20211811	Groundwater	bis(2-chloroethyl) ether	SW8270E	J*	Low	Surrogate Recovery Failure
21K0322	MW-76-20211811	Groundwater	Hexachlorocyclopentadiene	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0322	MW-76-20211811	Groundwater	Hexachloroethane	SW8270E	J*	Low	Surrogate Recovery Failure
21K0322	MW-76-20211811	Groundwater	N-Nitroso-di-n-Propylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21K0322	MW-76-20211811	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21K0322	MW-76-20211811	Groundwater	Phenol	SW8270E	J*	Low	Surrogate Recovery Failure
21K0322	MW-76-20211811	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0322	MW-76-20211811	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0322	TB-7-20211811	Distilled Water	Vinyl chloride	SW8260D-SIM	J*	Low	Headspace
21K0343	MW-15-20211911	Groundwater	Ferrous Iron	SM 3500-Fe B-97	JL*	Low	Headspace
21K0343	MW-15-20211911	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21K0343	MW-23-20211911	Groundwater	Hexavalent Chromium	SM 3500-Cr B-09	R*	Low	Gross Low MS and Post Spike Recovery

Table 4 - 2021 Quarter 4 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21K0343	MW-23-20211911	Groundwater	Ferrous Iron	SM 3500-Fe B-97	JL*	Low	Headspace
21K0343	MW-23-20211911	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21K0343	MW-47-20211911	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0343	MW-47-20211911	Groundwater	4-Nitrophenol	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0343	TB-8-20211911	Distilled Water	Vinyl chloride	SW8260D-SIM	J*	Low	Headspace
21K0367	EB-3-20212211	Distilled Water	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0367	EB-3-20212211	Distilled Water	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0367	EB-3-20212211	Distilled Water	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21K0367	EB-3-20212211	Distilled Water	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0367	EB-3-20212211	Distilled Water	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0367	MW-46-20212211	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0367	MW-46-20212211	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0367	MW-46-20212211	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21K0367	MW-56-20212211	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21K0367	MW-56-20212211	Groundwater	Barium-135	SW6020B	B*	High	Equipment Blank Detection
21K0367	MW-56-20212211	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Equipment Blank Detection
21K0367	MW-56-20212211	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0367	MW-56-20212211	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0382	MW-10R-20212311	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0382	MW-10R-20212311	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0382	MW-14-20212311	Groundwater	Sulfite	SM 4500-SO3 B-00	J*	Low	Holding Time Exceedance
21K0419	MW-14-20212411	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0419	MW-14-20212411	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21K0419	MW-14-20212411	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21K0419	MW-4-20212411	Groundwater	Mercury	SW7470A (Dissolved)	B*	High	Method Blank Detection
21K0419	MW-4-20212411	Groundwater	Toluene	SW8260D	B*	High	Trip Blank Detection
21K0419	MW-74-20212411	Groundwater	Copper-63	SW6020B	J*	None	Laboratory Duplicate RPD Failure
21K0419	MW-74-20212411	Groundwater	Selenium-78	SW6020B	J*	None	Laboratory Duplicate RPD Failure
21K0419	MW-74-20212411	Groundwater	Selenium-78	SW6020B (Dissolved)	J*	None	Laboratory Duplicate RPD Failure
21K0419	MW-74-20212411	Groundwater	Mercury	SW7470A (Dissolved)	B*	High	Method Blank Detection
21K0419	MW-74-20212411	Groundwater	2-Methylnaphthalene	SW8270E-SIM	JH*	High	Method Blank Detection
21K0419	MW-74-20212411	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0419	TB-11-20212411	Distilled Water	Gasoline Range Organics (Tr)	NWTPHg	J*	Low	Headspace

Table 4 - 2021 Quarter 4 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21K0419	TB-11-20212411	Distilled Water	1,1-Dichloroethene	SW8260D	J*	Low	Headspace
21K0419	TB-11-20212411	Distilled Water	Benzene	SW8260D	J*	Low	Headspace
21K0419	TB-11-20212411	Distilled Water	cis-1,2-Dichloroethene	SW8260D	J*	Low	Headspace
21K0419	TB-11-20212411	Distilled Water	Ethylbenzene	SW8260D	J*	Low	Headspace
21K0419	TB-11-20212411	Distilled Water	m,p-Xylene	SW8260D	J*	Low	Headspace
21K0419	TB-11-20212411	Distilled Water	Methyl tert-butyl Ether	SW8260D	J*	Low	Headspace
21K0419	TB-11-20212411	Distilled Water	o-Xylene	SW8260D	J*	Low	Headspace
21K0419	TB-11-20212411	Distilled Water	Tetrachloroethene	SW8260D	J*	Low	Headspace
21K0419	TB-11-20212411	Distilled Water	Toluene	SW8260D	JL*	Low	Headspace
21K0419	TB-11-20212411	Distilled Water	trans-1,2-Dichloroethene	SW8260D	J*	Low	Headspace
21K0419	TB-11-20212411	Distilled Water	Trichloroethene	SW8260D	J*	Low	Headspace
21K0419	TB-11-20212411	Distilled Water	Vinyl Chloride	SW8260D	J*	Low	Headspace
21K0419	TB-11-20212411	Distilled Water	Xylenes, total	SW8260D	J*	Low	Headspace
21K0419	TB-11-20212411	Distilled Water	Vinyl chloride	SW8260D-SIM	J*	Low	Headspace
21K0444	MW-59-20213011	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0444	MW-59-20213011	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0444	MW-59-20213011	Groundwater	Chrysene	SW8270E-SIM	B*	High	Method Blank Detection
21K0444	MW-59-20213011	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0444	MW-59-20213011	Groundwater	Phenanthrene	SW8270E-SIM	B*	High	Method Blank Detection
21K0444	MW-59-20213011	Groundwater	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21K0444	MW-70-20213011	Groundwater	1-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0444	MW-70-20213011	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0444	MW-70-20213011	Groundwater	Chrysene	SW8270E-SIM	B*	High	Method Blank Detection
21K0444	MW-70-20213011	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21K0444	MW-70-20213011	Groundwater	Phenanthrene	SW8270E-SIM	B*	High	Method Blank Detection
21K0444	MW-70-20213011	Groundwater	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21K0444	MW-72-20213011	Groundwater	3,3'-Dichlorobenzidine	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0444	MW-72-20213011	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0444	MW-72-20213011	Groundwater	4-Nitrophenol	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21K0444	MW-72-20213011	Groundwater	Benzoic acid	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21L0003	MW-6-20212911	Groundwater	Diesel Range Organics (C12-	NWTPH-Dx	J*	None	Irregular Elution Pattern
21L0003	MW-73-20212911	Groundwater	Diesel Range Organics (C12-	NWTPH-Dx	J*	None	Irregular Elution Pattern
21L0003	MW-73-20212911	Groundwater	Benzo(b)fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection

Table 4 - 2021 Quarter 4 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21L0003	MW-73-20212911	Groundwater	Indeno(1,2,3-cd)pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21L0003	MW-73-20212911	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21L0031	MW-100-20210112	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-100-20210112	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-100-20210112	Groundwater	Benzoic acid	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21L0031	MW-100-20210112	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-24-20210112	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-24-20210112	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-24-20210112	Groundwater	Benzoic acid	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21L0031	MW-24-20210112	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-52-20210112	Groundwater	Anthracene	SW8270E-SIM	B*	High	Method Blank Detection
21L0031	MW-52-20210112	Groundwater	Benzo(b)fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21L0031	MW-52-20210112	Groundwater	Chrysene	SW8270E-SIM	B*	High	Method Blank Detection
21L0031	MW-52-20210112	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21L0031	MW-52-20210112	Groundwater	Phenanthrene	SW8270E-SIM	B*	High	Method Blank Detection
21L0031	MW-52-20210112	Groundwater	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21L0031	MW-53-20210112	Groundwater	Selenium-78	SW6020B (Dissolved)	B*	High	Method Blank Detection
21L0031	MW-53-20210112	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-53-20210112	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-53-20210112	Groundwater	Benzoic acid	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21L0031	MW-53-20210112	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-53-20210112	Groundwater	Chrysene	SW8270E-SIM	B*	High	Method Blank Detection
21L0031	MW-53-20210112	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21L0031	MW-53-20210112	Groundwater	Phenanthrene	SW8270E-SIM	B*	High	Method Blank Detection
21L0031	MW-53-20210112	Groundwater	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21L0031	MW-61-20210112	Groundwater	Selenium-78	SW6020B (Dissolved)	B*	High	Method Blank Detection
21L0031	MW-61-20210112	Groundwater	Anthracene	SW8270E-SIM	B*	High	Method Blank Detection
21L0031	MW-61-20210112	Groundwater	Benzo(a)anthracene	SW8270E-SIM	B*	High	Method Blank Detection
21L0031	MW-61-20210112	Groundwater	Benzo(b)fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21L0031	MW-61-20210112	Groundwater	Chrysene	SW8270E-SIM	B*	High	Method Blank Detection
21L0031	MW-61-20210112	Groundwater	Pyrene	SW8270E-SIM	JH*	High	Method Blank Detection
21L0031	MW-67-20210112	Groundwater	Cobalt-59	SW6020B	J*	None	Laboratory Duplicate RPD Failure
21L0031	MW-67-20210112	Groundwater	Chromium-52	SW6020B (Dissolved)	J*	None	Laboratory Duplicate RPD Failure

Table 4 - 2021 Quarter 4 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21L0031	MW-67-20210112	Groundwater	Cobalt-59	SW6020B (Dissolved)	J*	None	Laboratory Duplicate RPD Failure
21L0031	MW-67-20210112	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-67-20210112	Groundwater	1,3-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-67-20210112	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-67-20210112	Groundwater	2-Chlorophenol	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-67-20210112	Groundwater	2-Methylphenol	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-67-20210112	Groundwater	3,3'-Dichlorobenzidine	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21L0031	MW-67-20210112	Groundwater	4-Chloroaniline	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21L0031	MW-67-20210112	Groundwater	4-Nitrophenol	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21L0031	MW-67-20210112	Groundwater	Benzoic acid	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21L0031	MW-67-20210112	Groundwater	Benzyl Alcohol	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-67-20210112	Groundwater	bis(2-chloroethyl) ether	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-67-20210112	Groundwater	Hexachloroethane	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-67-20210112	Groundwater	N-Nitroso-di-n-Propylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-67-20210112	Groundwater	N-Nitrosodiphenylamine	SW8270E	J*	Low	Surrogate Recovery Failure
21L0031	MW-67-20210112	Groundwater	Phenol	SW8270E	J*	Low	Surrogate Recovery Failure
21L0046	MW-51-20210212	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0046	MW-51-20210212	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0046	MW-51-20210212	Groundwater	Benzoic acid	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21L0046	MW-69-20210212	Groundwater	1,2-Dichlorobenzene	SW8270E	JL*	Low	Surrogate Recovery Failure
21L0046	MW-69-20210212	Groundwater	1,4-Dichlorobenzene	SW8270E	JL*	Low	Surrogate Recovery Failure
21L0046	MW-69-20210212	Groundwater	Benzoic acid	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21L0078	MW-101-20210312	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0078	MW-101-20210312	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0078	MW-101-20210312	Groundwater	Benzoic acid	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21L0078	MW-101-20210312	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-101-20210312	Groundwater	Benzo(b)fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-101-20210312	Groundwater	Chrysene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-101-20210312	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-101-20210312	Groundwater	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-32-20210312	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0078	MW-32-20210312	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0078	MW-32-20210312	Groundwater	Benzoic acid	SW8270E	J*	Low	LCS/LCSD Recovery Failure

Table 4 - 2021 Quarter 4 Result Flags

Work Order	Sample Name	Media	Analyte	Method	Result Flag	Bias	Note
21L0078	MW-32-20210312	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-32-20210312	Groundwater	Benzo(b)fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-32-20210312	Groundwater	Chrysene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-32-20210312	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-32-20210312	Groundwater	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-37-20210312	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-37-20210312	Groundwater	Benzo(b)fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-37-20210312	Groundwater	Chrysene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-37-20210312	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-37-20210312	Groundwater	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-54-20210312	Groundwater	Cobalt-59	SW6020B (Dissolved)	J*	None	Laboratory Duplicate RPD Failure
21L0078	MW-54-20210312	Groundwater	1,2-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0078	MW-54-20210312	Groundwater	1,4-Dichlorobenzene	SW8270E	J*	Low	Surrogate Recovery Failure
21L0078	MW-54-20210312	Groundwater	Benzoic acid	SW8270E	J*	Low	LCS/LCSD Recovery Failure
21L0078	MW-54-20210312	Groundwater	2-Methylnaphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-54-20210312	Groundwater	Benzo(b)fluoranthene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-54-20210312	Groundwater	Chrysene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-54-20210312	Groundwater	Naphthalene	SW8270E-SIM	B*	High	Method Blank Detection
21L0078	MW-54-20210312	Groundwater	Pyrene	SW8270E-SIM	B*	High	Method Blank Detection

LCS = laboratory control sample; LCSD = laboratory control sample duplicate; MS = matrix spike; MSD = matrix spike duplicate; RPD = relative percent difference

LABORATORY DATA REVIEW CHECKLISTS

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 14, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21A0352

Laboratory Report Date:

August 4, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21A0352

Laboratory Report Date:

August 4, 2021

Report Name:

Lower Duwamish

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The grain size analysis was subcontracted to Materials Testing & Consulting, Inc. located in Tukwila, WA.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

Per the project managers instruction, the samples IDs referencing the year 2020 were updated to reflect the correct year of 2021.

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that custody seals were not present on the cooler. However, the CoC record implies that the samples were hand delivered to the laboratory.

The sample receipt form notes that one 16-oz jar for sample *MW-66:5.5-012521* was mislabeled *MW-66:1.2-012521*. The jar was identified based on the recorded sample time and the number of containers present for each sample.

The sample receipt form notes that the labels on the vials for the samples *SB-2021-039:13.2-012521* were smeared. However, the vials were grouped by sample, so the lab was able to positively match the vials with the correct sample on the CoC.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The mislabeled jar and the samples with smeared labels were positively identified and processed within holding time.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The PCB Aroclor 1260 was recovered above the upper control limit in the continuing calibration verifications (CCV) on column zb-5 but passed on column zb-35. However, the internal standard hexabromobiphenyl exhibited low recovery on column zb-35 but passed on column zb-5. The samples were re-analyzed with similar results, indicating that the matrix was adversely affecting method performance. Results were reported from the second run of column zb-5.

The EPA method SW8260D initial calibration verification (ICV) and CCV had tetrachloroethane recovered above the upper control.

The EPA method SW8260D surrogate 1,4-dichlorobenzene-d4 exhibited low recovery in sample *MW-66:1.2-0112521*. The sample was analyzed twice with comparable results.

Phenanthrene, dibenzofuran, and benzo(b)fluoranthene were recovered below their lower control limits in the ICV and CCV associated with the PAH batch BJB0164. Similarly, phenanthrene and dibenzofuran were recovered below their lower control limit in the ICV and CCV associated with batch BJB0155.

The EPA method SW8260D surrogate 4-bromofluorobenzene exhibited low recovery in sample *MW-66:1.2-0112521*. The subsequent re-analysis of this sample exhibited low recoveries for the surrogates 4-bromofluorobenzene and 1,2-dichloroethane-d4. **Note that the analytical method listed in the case narrative is incorrect.**

One or more PAH analytes exhibited low recovery in the MS/MSD samples associated with batches BJB0164 and BJB0155.

The laboratory report was revised to correct the list of reported VOCs.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory re-analyzed the samples via EPA method SW8082A following CCV recovery failures.

The sample *MW-66:1.2-0112521* was re-analyzed via method SW8260D following a surrogate recovery failure. Both sets of results were reported.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The case narrative notes that samples *SB-2021-017:2-01252021*, *SB-2021-017:5-01252021*, *SB-2021-017:10.5-01252021*, *TSA-2021-004:1.2-01252021*, *Asphalt-001-01252021*, *TSA-2021-005:1.2-01252021*, *TSA-2021-100:1.2-01252021*, *Asphalt-002-01252021*, and *TSA-2021-006:1.2-01252021* were included in the batch with low CCV recovery for the PCB Aroclor 1260.

The laboratory applied the Q-flag to the tetrachloroethane results of the samples due to the recovery failures in the associated ICV and/or CCV.

The laboratory applied the Q-flag to the Phenanthrene, dibenzofuran, and/or benzo(b)fluoranthene results of the samples included in batches BJB0164 and BJB0155 due to the recovery failures in the associated ICV and CCV.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐

Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐

Comments:

c. All soils reported on a dry weight basis?

Yes ☒ No ☐ N/A ☐

Comments:

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐

Comments:

Several analytes had RLs that exceed the Ecology PCUL limits defined in the QAPP. Analytes with non-detect results that have RLs that exceed the Ecology PCUL are identified in bold in the analytical summary tables.

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e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, several analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Fluoranthene was detected at an estimated concentration in the method blank sample associated with batch BJB0155.

1-methylnaphthalene and 2-methylnaphthalene were detected at estimated concentrations in the method blank sample associated with batch BJB0164.

Nickel-60 was detected at an estimated concentration in the method blank sample associated with batch BJB0107.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples *SB-2021-017:5-01252021*, *SB-2021-039:2-01252021*, *SB-2021-012:10.4-01252021*, and *MW-66:5.5-0112521* contained fluoranthene at concentrations within 10X that of the concentration detected in the associated method blank. Samples *SB-2021-009:2-01252021*, *SB-2021-009:6-01252021*, and *SB-2021-009:10.8-01252021* contained fluoranthene concentrations within 5X the method blank concentration.

All samples included in batch BJB0164 contained both 1-methylnaphthalene and 2-methylnaphthalene concentrations greater than 10X the concentration detected in the method blank. The sample results are not meaningfully affected.

All samples included in batch BJB0107 contained nickel-60 concentrations greater than 10X the concentration detected in the method blank. The sample results are not meaningfully affected.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The fluoranthene results of samples *SB-2021-017:5-01252021*, *SB-2021-039:2-01252021*, *SB-2021-012:10.4-01252021*, and *MW-66:5.5-0112521* are assumed to have a high analytical bias and are flagged JH* for reporting purposes.

The fluoranthene results of samples *SB-2021-009:2-01252021*, *SB-2021-009:6-01252021*, and *SB-2021-009:10.8-01252021* are assumed to be artifacts of laboratory contamination and are flagged B* for reporting purposes.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS/LCSDs were reported for VOCs, GRO, and PCBs analyses.

An LCS was reported for PAHs, DRO, and RRO analyses. See MS/MSD for assessment of method precision.

An LCS was reported for TOC analysis. No measure of method precision was provided.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

An LCS and laboratory duplicate were reported for isotopic metals and mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Tetrachloroethene was detected at the upper control limit in the LCS associated with batch BJA0680. The laboratory qualified the recovery of this analyte implying that the recovery exceeded the upper control limit but was rounded off when reported.

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The isotopic metals laboratory duplicate sample associated with batch BJB0107 exhibited a precision failure for silver-107.

The isotopic metals laboratory duplicate sample associated with batch BJB0107 did not contain a detectable concentration of cadmium-111 despite this isotope being detected at an estimated concentration in the associated field sample.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Of the samples included in batch BJA0680, only *MW-66:1.2-0112521* contained a detectable concentration of tetrachloroethene. This result may be affected by elevated method recovery.

The silver-107 result of sample *SB-2021-017:2-01252021* may be affected by method imprecision.

The estimated cadmium-111 concentration detected in the field sample was only slightly above the detection limit. The method precision cannot be accurately assessed for this analyte.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The tetrachloroethene result of sample *MW-66:1.2-0112521* is considered estimated with a high analytical bias. This result is flagged JH* for reporting purposes.

The silver-107 result of sample *SB-2021-017:2-01252021* is considered estimated and flagged J* to identify the imprecision.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality was affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for PAHs, DRO, RRO, and PCBs analyses.

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ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for isotopic metals and mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The PAH analytes naphthalene, phenanthrene, fluoranthene, pyrene, and benzo(a)pyrene exhibited low recoveries in the MS and/or MSD samples associated with batch BJB0155.

The PAH analytes naphthalene, 2-methylnaphthalene, acenaphthylene, dibenzofuran, phenanthrene, fluoranthene, pyrene, and chrysene exhibited low recoveries in the MS and/or MSD samples associated with batch BJB0164.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

The method precision demonstrated by the MS and MSD samples were outside acceptance criteria for the PAH analyte benzo(a)pyrene associated with batch BJB0164.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The method SW8270E-SIM MS/MSD samples associated with batch BJB0155 were spiked from the field sample SB-2021-017:2-01252021. However, the analyte spiking concentrations added to the matrix were low relative to the native concentrations in the parent sample. The resulting uncertainty may render the MS/MSD results unrepresentative of actual method performance.

The method SW8270E-SIM MS/MSD samples associated with batch BJB0164 were spiked from the field sample SB-2021-011:1-01252021. With the exception of acenaphthylene, the analyte spiking concentrations added to the matrix were low relative to the native concentrations in the parent sample. The resulting uncertainty may render the MS/MSD results unrepresentative of actual method performance. The acenaphthylene result of the parent sample may be influenced by matrix effects causing low method recovery.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The acenaphthylene result of sample *SB-2021-011:1-01252021* is assumed to have a low analytical bias and is flagged JL* for reporting purposes.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is affected; see above for applies qualifiers.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The method SW8082A surrogate decachlorobiphenyl [2C] was not reported in samples *TSA-2021-004:1.2-01252021*, *Asphalt-001-01252021*, *TSA-2021-005:1.2-01252021*, *Asphalt-002-01252021* due to chromatographic interference. These surrogates were reported within acceptance limits in the primary column. Sample results are not affected.

The method SW8260D surrogate 4-bromofluorobenzene exhibited low recovery for the sample *MW-66:1.2-0112521*.

The method SW8260D surrogates 4-bromofluorobenzene and 1,2-dichloroethane-d4 exhibited low recoveries for the re-analysis of sample *MW-66:1.2-0112521*. The initial run is used for reporting.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The VOC surrogate 4-bromofluorobenzene is not correlated with the reported analytes. The sample results are not affected.

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iv. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐

Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐

Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐

Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank associated with this work order.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐

Comments:

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ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

The field duplicate pairs *TSA-2021-005:1.2-01252021 / TSA-2021-100:1.2-01252021*, *SB-2021-011:1-01252021 / SB-2021-101:1-01252021*, and *SB-2021-034:10.7-01252021 / SB-2021-102:10.7-01252021* were submitted with this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the detected results of the field duplicate samples *TSA-2021-005:1.2-01252021* and *TSA-2021-100:1.2-01252021* was within the recommended DQO of 50% for all analytes.

The relative precision demonstrated between the detected results of the field duplicate samples *SB-2021-011:1-01252021* and *SB-2021-101:1-01252021* was within the recommended DQO of 50% for all analytes except the following: copper-63, nickel-60, vanadium-51a, acenaphthene, benzo(a)pyrene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, and naphthalene.

The relative precision demonstrated between the detected results of the field duplicate samples *SB-2021-034:10.7-01252021* and *SB-2021-102:10.7-01252021* was within the recommended DQO of 50% for all analytes except the following: GRO, RRO, benzene, p&m-xylene, and toluene.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The above listed results of the field duplicate samples are considered estimated and flagged J* (unless already qualified) to identify the lack of precision.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

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i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the tetrachloroethane results of the samples due to the recovery failures in the associated ICV and/or CCV.

The laboratory applied the Q-flag to the Phenanthrene, dibenzofuran, and/or benzo(b)fluoranthene results of the samples included in batches BJB0164 and BJB0155 due to the recovery failures in the associated ICV and CCV.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Michael Jaramillo / Validated by: Adam Wyborny

Title:

Senior Chemist / Senior Engineer

Date:

September 20, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21A0376

Laboratory Report Date:

August 4, 2021

Report Name:

Lower Duwamish

Project Number

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21A0376

Laboratory Report Date:

August 4, 2021

Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Project samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☐ No ☒ N/A ☐ Comments:

Page 5 and 6 of the CoC did not clearly identify the sample collection date and matrix type. However, the laboratory reported the sample collection dates and matrix types from the sample containers. Sample results are not affected.

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates the samples were received in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that sample *MW-100:5.0-01262021* was incorrectly labeled on the sample container. The laboratory entered the sample name per the CoC and is not considered affected by this discrepancy.

e. Data quality or usability affected?

Comments:

The data quality/usability are not affected; see above

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

The SW8082A polychlorinated biphenyl (PCB) continuing calibration verification (CCV) had a low recovery for Aroclor 1260 in column zb-5. This analysis is reported by dual column to confirm detected results. The other column had passing CCV recoveries for Aroclor 1260 and the data were reported from the column with passing CCV recoveries. Sample results are not affected by the QC failure.

The SW8082A PCB initial calibration verification (ICV) had a low recovery for the internal standard hexachlorobiphenyl in column zb-5. The laboratory does not identify internal standard recovery failures for the associated project samples. Sample results are not affected by internal standard recovery failures in QC samples.

The SW8082A PCB surrogate decachlorobiphenyl had a high recovery failure in sample *SB-2021-025:5.5-01272021*. Refer to Section 6.d. for further assessment.

The SW8082 PCB surrogate decachlorobiphenyl had a low recovery failure in the ICV sample. The SW8082 PCB surrogate tetrachlorometaxylene had high recovery failures for, ICV1, ICV2, and CCV1, CCV2, and CCV3. Data are reported from the columns with passing QC. However, sample results are not affected by surrogate recovery failures in QC samples.

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The SW8082A PCB matrix spike (MS) associated with batch BJB0303 had a recovery failure for Aroclor 1260. The laboratory flagged this analyte within the QC section of the report. Refer to Section 6.c. for further assessment.

The SW8260D volatile organic carbon (VOC) analysis for sample *SB-2021-033:11-01262021* was reported at a 50-fold dilution due to high hydrocarbon background. Refer to Section 5.d. for further assessment.

The SW8260D VOC surrogate 1,2-dichloroethane-d4 had a high recovery for sample *MW-58:8.4-01272021*. Refer to Section 6.d. for further assessment.

The SW8270E-SIM polynuclear aromatic hydrocarbon (PAH) analysis for sample *MW-57:5-01272021* was analyzed at a 10-fold dilution due to matrix interference when analyzed at a 1-fold dilution. Refer to Section 5.d. for further assessment.

The SW8270E-SIM PAH ICV and/or CCV had low recoveries for dibenzofuran and phenanthrene in sequence SJB0418, a low recovery for phenanthrene in sequence SJC0072, low recoveries for benzo(j)fluoranthene and dibenzofuran in sequence SJC0052, and a low recovery for benzo(g,h,i) perylene in sequence SJC0019. All affected samples have been flagged “Q” by the laboratory.

The SW8270E-SIM PAH MS and matrix spike duplicate (MSD) associated with batch BJB0235 had recovery and RPD failures. The laboratory flagged affected analytes within the QC section of the report. Refer to Section 6.c. for further assessment.

The SM 3500-Cr B-09 hexavalent chromium MS associated with batch BJB0295 had a low recovery failure. A post-preparation spike was performed and was also recovered low. Deviations are flagged within the QC section of the report. Refer to Section 6.b. for further assessment.

The SW7471B mercury MS associated with batch BJB0287 had a high recovery failure. A post-preparation spike was performed and was also recovered high. Deviations are flagged within the QC section of the report. Refer to Section 6.b. for further assessment.

The laboratory report was revised to include the volatile organic compound (VOC) analyte trans-1,2-dichloroethene.

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c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

Corrective actions were not documented.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the benzo(g,h,i) perylene, benzo(j)fluoranthene, dibenzofuran, and phenanthrene results for associated samples due to the recovery failures in the associated ICV and/or CCV for PAH analysis.

Refer to subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☐ No ☒ N/A ☐ Comments:

The CoC requested that samples *SB-2021-018:8.2-01272021* and *SB-2021-018:11-01272021* be placed on hold for TPH-Dx analysis. However, the laboratory reported the TPH-Dx results for these samples. The additional analyses do not affect the overall data set.

The CoC requested samples *MW-76:1.5-01262021*, *MW-76:5.0-01262021*, *MW-100:5.0-01262021*, *MW-67:0.5-01262021*, *MW-67:5.5-01262021*, and *MW-67:9.0-01262021* be analyzed for full list SVOC analysis. However, the samples were reported for PAH analysis, which provides a subset of the analytes reported by full list SVOC analysis.

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☒ N/A ☐ Comments:

The hexavalent chromium and total organic carbon analyses were conducted on a wet weight basis per the reference method.

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d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

The PAH analyte dibenzo(a,h)anthracene in sample *MW-57:5-01272021* and several SVOC analytes in all samples for these requested analyses were not detected in these samples and were reported with reporting limits greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

In addition, samples *MW-76:1.5-01262021*, *MW-76:5.0-01262021*, *MW-100:5.0-01262021*, *MW-67:0.5-01262021*, *MW-67:5.5-01262021*, and *MW-67:9.0-01262021* only have PAH analytes reported instead of the full list SVOC analytes, as requested on the CoC.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Target analytes were not detected in the method blank samples reported for this work order.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; target analytes were not detected in the method blank samples reported for this work order.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

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v. Data quality or usability affected?

Comments:

The data quality is not affected; see above.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS/LCSDs were reported for VOCs and GRO analyses.

LCS/LCSDs were reported for DRO and RRO batch BJB0187. An LCS was reported for DRO and RRO batches BJB0238, BJB0239, and BJB0240. See MS/MSD for assessment of method precision for DRO/RRO batches BJB0238, BJB0239, and BJB0240.

An LCS was reported for PAH and PCB analyses. See MS/MSD for assessment of method precision for these analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

An LCS sample was reported for total organic carbon analysis. We have no measure of laboratory precision for this analysis.

An LCS and laboratory duplicate were reported for isotopic metals, mercury, and hexavalent chromium analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The isotopic metals laboratory duplicate sample associated with batch BJB0282 exhibited precision failures for selenium-78 and silver-107.

The isotopic metals laboratory duplicate sample associated with batch BJB0285 exhibited a precision failure for selenium-78.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Project samples *SB-2021-046:2-01262021* is associated with the laboratory duplicate sample for batch BJB0282. The selenium-78 and silver-107 results for this sample are considered estimated and flagged “J*” for reporting purposes.

The parent sample *MW-57:10-01272021* is associated with the laboratory duplicate sample for batch BJB0285. The selenium-78 result for this sample is considered estimated and flagged “J*” for reporting purposes.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality was affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for PAHs, DRO, RRO, and PCB analyses.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for isotopic metals, mercury, and hexavalent chromium analyses.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Several PAH analytes exhibited low recovery failures in the MS sample associated with batch BJB0235. The MSD sample for this batch had a low recovery failure for phenanthrene. With the exception of fluoranthene, benzo(a) anthracene, benzo(a) pyrene, benzo(b) fluoranthene, benzo(g,h,i) perylene, benzo(j) fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd) pyrene the native concentration of the analyte with recovery failures were greater than half the spiking concentration, which may contribute a significant uncertainty to the recovery calculations; the MS recovery may not be representative of actual method performance for the matrix. The benzo(a) anthracene, benzo(j) fluoranthene, and dibenzo(a,h) anthracene results for parent sample SB-2021-038:2-01262021 are considered affected by the MS recovery failures.

The PCB MS associated with batch BJB0303 had a high recovery failure for Aroclor-1260. The parent sample SB-2021-024:0.5-01272021 had an initial concentration of the analyte with recovery failures were greater than half the spiking concentration, which may contribute a significant uncertainty to the recovery calculations; the MS recovery may not be representative of actual method performance for the matrix. The sample result is not affected by the MS recovery failure for this analyte.

The mercury MS associated with batch BJB0287 had a high recovery failure for mercury. The parent sample MW-57:10-012720201 However, a post-digestion spike was analyzed and had recoveries within acceptance criteria. The sample result is not affected by the MS recovery failure for this analyte.

The hexavalent chromium MS associated with batch BJB0295 had no recovery for hexavalent chromium. However, hexavalent chromium was not detected in the parent sample MW-67:0.5-01262021 a pH adjusted post spike indicated possible matrix interference.

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

Several PAH analytes demonstrated relative precision failures in the MS and MSD samples associated with batch BJB0235. As mentioned above, with the exception of fluorene, anthracene, benzo(a)anthracene, benzo(a) pyrene, benzo(b) fluoranthene, benzo(g,h,i) perylene, benzo(j) fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd) pyrene the native concentration of the analyte with recovery failures were greater than half the spiking concentration, which may contribute a significant uncertainty to the recovery calculations; the MS recovery may not be representative of actual method performance for the matrix. The above listed results for parent sample *SB-2021-038:2-01262021* are considered affected by the precision failures.

The relative precision demonstrated between benzo(a)pyrene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, indeno(1,2,3-c,d)pyrene, phenanthrene, and pyrene recoveries of the MS and MSD samples associated with batch BJB0236 did not meet acceptance criteria. The parent sample *MW-58:1.5-01272021* is considered affected by the precision failures.

The PCB MS/MSD associated with batch BJB0303 exhibited a precision failure for Aroclor-1260. The parent sample *SB-2021-024:0.5-01272021* had a concentration of the analyte which was greater than half the spiking concentration, which may contribute a significant uncertainty to the recovery calculations; the MS/MSD recoveries may not be representative of actual method performance for the matrix. The sample result is not affected by the MS recovery failure for this analyte.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The fluoranthene, benzo(a) anthracene, benzo(a) pyrene, benzo(b) fluoranthene, benzo(g,h,i) perylene, benzo(j) fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd) pyrene results for parent sample *SB-2021-038:2-01262021* are considered affected by the recovery and precision failures for batch BJB0235. The sample results are considered estimated, biased low, and are flagged “JL*” for reporting purposes.

The fluorene and anthracene results for parent sample *MW-38:2-01272021* affected by the precision failures for batch BJB0235. The sample results are considered estimated and are flagged “J*” for reporting purposes.

The benzo(a)pyrene, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, indeno(1,2,3-c,d)pyrene, phenanthrene, and pyrene results for parent sample *MW-58:1.5-01272021* affected by the precision failures for batch BJB0236. The sample results are considered estimated and are flagged “J*” for reporting purposes.

The hexavalent chromium result for sample *MW-67:0.5-01262021* is considered unusable due to gross MS recovery failures and laboratory indication of possible matrix interference. The sample results is flagged “R*” for reporting purposes.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is affected; see above for applies qualifiers.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

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- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The method SW8082A surrogate decachlorobiphenyl was not reported in one of the two columns due to chromatographic interference for samples *SB-2021-018:7.2-01272021*, *SB-2021-038:2-01262021*, and *SB-2021-038:6.9-01262021*. However, the surrogate was recovered within acceptance criteria in the second column. Reported results are not affected by the surrogate recovery failure.

The method SW8082A surrogate decachlorobiphenyl had a high recovery for sample *SB-2021-019:0.8-01272021* in the primary column. However, the secondary column had decachlorobiphenyl within acceptance limits and the sample was analyzed at a dilution due to high concentrations of target analytes. Reported results are not affected by the surrogate recovery failure.

The method SW8082A surrogate decachlorobiphenyl and tetrachlorometaxylene were not recovered for sample *SB-2021-020:2.2-01272021* for both columns. However, the sample was analyzed at a 5,000-fold dilution due to high concentrations of target analytes. Reported results are not affected by the surrogate recovery failure.

The method SW8260D-MED surrogate 1,2-dichloroethane-d4 had a high recovery failure for sample *MW-58:8.4-01272021*. The surrogate is associated with the target analytes benzene, trichloroethene, 1,1-dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, and vinyl chloride. Of these associated analytes, only benzene was detected, and the result is considered estimated, biased high, and is flagged "JH*" in the analytical summary tables.

The method SW8270E-SIM surrogate 2-methylnaphthalene-d10 had no recovery for sample *MW-57:5-01272021*. However, the sample was analyzed at a 10-fold dilution due to high concentrations of target analytes. Reported results are not affected by the surrogate recovery failure.

The method SW8270E-SIM surrogate 2-methylnaphthalene-d10 had no recovery for sample *MW-57:5-01272021*. However, the sample was analyzed at a 10-fold dilution due to high concentrations of target analytes. The sample was re-analyzed at a 100-fold dilution and none of the SW8270E-SIM surrogates were recovered. Reported results are not affected by the surrogate recovery failure.

- iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above.

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iv. Data quality or usability affected?

Comments:

The data quality/usability is affected; see above for applies qualifiers.

e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐

Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☒ N/A ☐

Comments:

- iii. All results less than RL and project specified objectives?

Yes ☐ No ☒ N/A ☐

Comments:

Toluene and ethylbenzene were detected in the trip blank sample associated with work order.

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

The project samples *SB-2021-003:10.3-01262020*, *SB-2021-033:15-01262021*, and *SB-2021-035:13.8-01262021* had detections for toluene at estimated concentrations less than five times the trip blank detection. The samples results may be attributable to external or sample cross-contamination. The toluene results are considered non-detect at the LOQ and are flagged "B*" for reporting purposes.

The project sample *SB-2021-033:15-01262021* had a detection for ethylbenzene at a concentration less than five times the trip blank detection. The sample result may be attributable to external or sample cross-contamination. The ethylbenzene result is considered non-detect at the LOQ and is flagged "B*" for reporting purposes.

The remaining samples either did not have detections for these analytes or had detections at concentrations greater than ten times the trip blank detection; the remaining samples are therefore not affected.

v. Data quality or usability affected?

Comments:

The data quality/usability is affected; see above for applies qualifiers.

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

The following field duplicate pairs were submitted with this work order:

- MW-76:5.0-01262021 / MW-100:5.0-01262021; and
- SB-2021-021:2.5-01272021/ SB-2021-103:2.5-01272021

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the detected results of the field duplicate samples MW-76:5.0-01262021 and MW-100:5.0-01262021 were within the recommended DQO of 50% for all analytes, where calculable, except barium-135, lead-208, selenium-78, silver-107, arsenic-75a, cadmium-111, copper-63, nickel-60, zinc-66, mercury, acenaphthene, benzo(a)anthracene, fluorene, phenanthrene, and DRO.

The relative precision demonstrated between the detected results of the field duplicate samples SB-SB-2021-021:2.5-01272021 and SB-2021-103:2.5-01272021 were outside the recommended DQO of 50% for the detected analyte Aroclor 1260. In addition, the RRO result was detected in the field-duplicate sample above the RL but not detected in the primary sample. The results are considered a precision failure.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The above listed results of the field duplicate samples are considered estimated and flagged “J*” (unless already qualified) to identify the lack of precision.

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- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

- iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

- a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the benzo(g,h,i) perylene, benzo(j)fluoranthene, dibenzofuran, and phenanthrene results for associated samples due to the recovery failures in the associated ICV and/or CCV for PAH analysis.

The laboratory applied the E-flag to several PAH results for samples MW-57:5-01272021, MW-58:8.4-01272021, MW-67:0.5-01262021, MW-67:5.5-01262021, MW-76:5.0-01262021, and MW-100:5.0-01262021 because the analyte concentrations exceeded the upper limit of the calibration range of the instrument established by the initial calibration (ICAL). These analytes were re-extracted and within the method recognized hold time and within the laboratory ICAL, except for naphthalene in sample MW-58:8.4-01272021 which also had a result exceeding the ICAL. The re-extracted results for these PAH analytes are used for reporting purposes.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Michael Jaramillo / Validated by: Adam Wyborny

Title:

Senior Chemist / Senior Engineer

Date:

September 16, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21B0005

Laboratory Report Date:

August 3, 2021

Report Name:

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Project Number

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Project samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

Water samples for dissolved metals analysis were received unpreserved. The project samples were filtered by the laboratory and preserved with nitric acid. The sample results are not affected.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the trip blank sample *TB-3-01282021* was received with headspace and the laboratory was to determine the size of the bubble present in the VOA vial. However, the laboratory did not provide the size of the bubble. The trip blank sample is a QC sample used to assess cross contamination during sample transport. The analytical results are considered estimated, biased low. Non-detect results are flagged “UJ” in the analytical database and detected results are flagged “JL” due to the sample handling anomaly.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

See above.

e. Data quality or usability affected?

Comments:

The data quality/usability for the trip blank sample *TB-3-01282021* is affected; see above

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

The SW8082A polychlorinated biphenyl (PCB) matrix spike (MS) and matrix spike duplicate (MSD) associated with batch BJB0247 had a low recovery for Aroclor 1016. Refer to Section 6.c. for further assessment.

The SW8270E semivolatile organic compound (SVOC) initial calibration verification (ICV) and/or continuing calibration verification (CCV) associated batch BJB0248 had low recoveries for 4-nitrophenol, 4-chlorophenyl phenyl ether, and 4,6-dinitro-2-methylphenol. The laboratory flagged associated samples with a “Q” flag to identify the QC failure. Refer to Section 4.d. for further assessment.

The SW8270E SVOC surrogate recoveries were within acceptance criteria except where flagged. Refer to Section 6.d. for further assessment.

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The SW8270E SVOC method blank associated batch BJB0248 had a detection diethylphthalate. The laboratory flagged associated samples with a “B” flag if the analyte was detected. Refer to Section 6.a. for further assessment.

The SW8270E SVOC laboratory control sample (LCS) associated with batch BJB0248 had a low recovery for N-Nitroso-diphenylamine. Refer to Section 6.b. for further assessment.

The SW8270E SVOC MS and/or MSD associated with batch BJB0248 had some recovery failures that are flagged in the QC section of the report. Refer to Section 6.c. for further assessment.

The SW8270E-SIM polynuclear aromatic hydrocarbon (PAH) ICV and/or CCV had low recoveries for benzo(b)fluoranthene, benzo(j)fluoranthene, and the surrogate dibenzo(a,h)anthracene d-14. The laboratory flagged associated samples with a “Q” flag to identify the QC failure. Refer to Section 4.d. for further assessment.

The SW8270E-SIM PAH MS and MSD associated with batch BJB0335 had low recoveries for 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene. The laboratory flagged associated samples with a “Q” flag to identify the QC failure. Refer to Section 6.c. for further assessment.

The SW6020A metals laboratory duplicates associated with batches BJB0285, BJB0380, and BJB0438 had relative percent difference (RPD) failures for arsenic, zinc, and lead, respectively. Refer to Section 6.b. for further assessment.

The NW-TPHDx diesel range organics (DRO)/heavy oil range organics surrogate o-terphenyl was recovered low in sample SB-2021-006:10-01292021. Refer to Section 6.d. for further assessment.

The NW-TPHDx DRO/heavy oil MSD associated with batch BJB0329 had a high recovery. Refer to Section 6.c. for further assessment.

The laboratory report was revised to include the volatile organic compound (VOC) analyte trans-1,2-dichloroethene.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

Corrective actions were not documented.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the 4-nitrophenol, 4-chlorophenyl phenyl ether, and 4,6-dinitro-2-methylphenol results for associated samples due to the recovery failures in the associated ICV and/or CCV for SVOC analysis.

The laboratory applied the B-flag to the diethylphthalate results for associated with batch BJB0248.

The laboratory applied the Q-flag to the benzo(b)fluoranthene and benzo(j)fluoranthene results for associated samples due to the recovery failures in the associated ICV and/or CCV for PAH analysis.

The laboratory applied the Q-flag to the 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene results for associated samples due to the recovery failures in the associated MS/MSD in the PAH batch BJB0335.

Refer to subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☒ N/A ☐ Comments:

The hexavalent chromium analysis was conducted on a wet weight basis per the reference method.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

The PAH analyte dibenzo(a,h)anthracene in sample *SB-2021-006:10-01292021* and several SVOC analytes in samples *SB-2021-068:1.0-01262021* and *SB-2021-068:5.5-01262021* were not detected in these samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

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e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

The SVOC analyte diethylphthalate was detected above the RL in the method blank sample associated with batch BJB0248. In addition, the SVOC analytes 1,2,4-trichlorobenzene and di-n-butylphthalate were detected at estimated concentrations in the method blank.

The PAH analyte 2-methylnaphthalene was detected below the RL in the method blank sample associated with batch BJB0330.

The metals chromium-53 and vanadium-51b were detected below the RL in the method blank sample associated with batch BJB0438. However, these results were not reported for the field samples.

The dissolved metals iron-54 and magnesium-24 were detected below the RL in the method blank sample associated with batch BJB0246.

The dissolved metal mercury was detected below the RL in the method blank sample associated with batch BJB0297.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

The project samples associated with batch BJB0248 did not have detections for 1,2,4-trichlorobenzene, diethylphthalate, and di-n-butylphthalate. Sample results are not affected by the method blank detections.

The project samples associated with batch BJB0330 had detections for 2-methylnaphthalene. Samples *SB-2021-010:6-01282021* and *SB-2021-104:6-01282021* had detections less than ten-times the method blank detection. These sample results are considered estimated with a high analytical bias and flagged “JH*” in the analytical database. Samples *SB-2021-002:6-01282021*, *SB-2021-010:1.5-01282021*, *SB-2021-010:11-01282021*, *SB-2021-040:2-01282021*, *SB-2021-041:2-01282021*, *SB-2021-041:6-01282021*, and *SB-2021-105:6-01282021* had detections less than five-times method blank detection. These sample results are considered non-detect at the RL or sample concentration (whichever is greater) and are flagged “B*” in the analytical database. The remaining samples had detections greater than ten times the method blank detection and are not considered affected.

The project samples *AugerWater-01292021* and *ProbeWater-01292021* are associated with batch BJB0246.

- The sample *ProbeWater-01292021* had a detection for dissolved iron below the RL and less than five times the blank detection. The sample result is considered non-detect at the RL and is flagged “B*” in the analytical tables.
- The sample *AugerWater-01292021* did not have a detection for dissolved iron. The sample results are not affected by the method blank detection.
- Dissolved magnesium was detected in the associated project samples at concentrations greater than ten times the method blank detection and are not considered affected.

The project samples *AugerWater-01292021* and *ProbeWater-01292021* are associated with batch BJB0297.

- The samples *AugerWater-01292021* and *ProbeWater-01292021* had a detections for dissolved mercury below the RL and less than five times the blank detection. The sample result is considered non-detect at the RL and is flagged “B*” in the analytical tables.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above.

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v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS/LCSDs were reported for VOCs and GRO analyses.

LCS/LCSDs were reported for DRO and RRO batch BJB0188. An LCS was reported for DRO and RRO batches BJB0250 and BJB0329. See MS/MSD for assessment of method precision for DRO/RRO batches BJB0250 and BJB0329.

An LCS was reported for SVOC, PAH, and PCB analyses. See MS/MSD for assessment of method precision for these analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS/LCSDs were reported for hexavalent chromium analysis.

An LCS and laboratory duplicate were reported for isotopic metals and mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The SVOC LCS associated with preparation batch BJB0248 had a low recovery failure for N-nitrosodiphenylamine.

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The isotopic metals laboratory duplicate sample associated with batch BJB0285 exhibited a precision failure for arsenic-75, cadmium-111, and silver-107.

The method 7471B laboratory duplicate sample associated with batch BJB0287 exhibited a precision failure for mercury.

The isotopic metals laboratory duplicate sample associated with batch BJB0380 exhibited a precision failure for selenium-78, silver-107, and zinc-66.

The isotopic metals laboratory duplicate sample associated with batch BJB0438 exhibited a precision failure for cadmium-111 and lead-208.

The isotopic dissolved metals laboratory duplicate sample associated with batch BJB0246 exhibited a precision failure for dissolved nickel-60.

The dissolved method 7471B laboratory duplicate sample associated with batch BJB0297 exhibited a precision failure for dissolved mercury.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Project samples *SB-2021-068:1.0-01262021* and *SB-2021-068:5.5-01262021* are associated with batch BJB0248. N-Nitrosodiphenylamine was not detected in the project samples. The sample results are considered affected and are flagged “J*” in the analytical tables.

The parent sample *SB-2021-040:2-01282021* is associated with the laboratory duplicate sample for batch BJB0285. The arsenic-75, cadmium-111, and silver-107 results for this sample are considered estimated and flagged “J*” for reporting purposes.

The parent sample *SB-2021-040:2-01282021* is associated with the laboratory duplicate sample for batch BJB0287. The mercury result for this sample is considered estimated and flagged “J*” for reporting purposes.

The parent sample *SB-2021-002:6-01282021* is associated with the laboratory duplicate sample for batch BJB0380. The selenium-78, silver-107, and zinc-66 results for this sample are considered estimated and flagged “J*” for reporting purposes.

The parent sample *AugerWater-01292021* is associated with the laboratory duplicate sample for batch BJB0438. The cadmium-111 and lead-208 results for this sample are considered estimated and flagged “J*” for reporting purposes.

The parent sample *AugerWater-01292021* is associated with the laboratory duplicate sample for batch BJB0246. The dissolved nickel-60 result for this sample is considered estimated and flagged “J*” for reporting purposes.

The parent sample *ProbeWater-01292021* is associated with the laboratory duplicate sample for batch BJB0297. The dissolved mercury result for this sample is considered. However, this result was previously qualified for a method blank detection. Additional qualification is not required.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality was affected; see above for applied qualifiers.

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c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for SVOCs, PAHs, DRO, RRO, and PCB analyses.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for isotopic metals and mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Several SVOC analytes exhibited grossly low recovery failures in the MS and MSD sample associated with batch BJB0248. The MS and MSD samples were analyzed at a ten-fold dilution, which resulted in significant uncertainty in the recovery calculations. The project sample results are not affected by the MS and MSD recovery failures.

The PAH MS and MSD associated with batch BJB0335 had recovery low failures for 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene. The parent sample *SB-2021-006:6-01292021* is affected by the MS and MSD recovery failure for naphthalene. However, the 1-methylnaphthalene and 2-methylnaphthalene results were greater than the spiking concentration, which resulted in significant uncertainty in the recovery calculations. The project sample result is not affected by the MS and MSD recovery failures for 1-methylnaphthalene and 2-methylnaphthalene.

The DRO MS and MSD associated with batch BJB0250 had low recovery failures for DRO. The parent sample *SB-2021-068:1.0-01262021* had an initial concentration for DRO greater than the spiking concentration, which resulted in significant uncertainty in the recovery calculations. The project sample result is not affected by the MS and MSD recovery failures.

The DRO MSD associated with batch BJB0250 had a high recovery failure for DRO. The parent sample *MW-64-5.2-01282021* did not have a detection for DRO. The project sample result is not affected by the high MSD recovery failure.

The PCB MS and MSD associated with batch BJB0247 had low recovery failures for Aroclor-1016. The parent sample *Stain-001-01292021* is affected by the MS and MSD recovery failures.

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between 1-methylnaphthalene and 2-methylnaphthalene recoveries of the PAH MS and MSD samples associated with batch BJB0335 did not meet acceptance criteria. The parent sample *SB-2021-006:6-01292021* results for 1-methylnaphthalene and 2-methylnaphthalene were greater than the spiking concentration, which resulted in significant uncertainty in the recovery calculations. The project sample result is not affected by the precision failures for 1-methylnaphthalene and 2-methylnaphthalene.

The relative precision demonstrated between dissolved mercury recoveries of the MS and MSD samples associated with batch BJB0297 did not meet acceptance criteria. The parent sample *ProbeWater-01292021* is considered affected by the precision failure.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The parent sample *SB-2021-006:6-01292021* is affected by the MS and MSD (batch BJB0335) recovery failure for naphthalene. The sample result is considered estimated, biased low, and is flagged “JL*” for reporting purposes.

The parent sample *Stain-001-01292021* is affected by the MS and MSD (batch 0247) recovery failures for Aroclor-1016. The non-detect result is considered estimated and is flagged “J*” for reporting purposes.

The parent sample *ProbeWater-01292021* is considered affected by the MS/MSD precision failure (batch BJB0297) for dissolved mercury. The sample result is considered estimated, no direction of bias. However, the sample was previously qualified due to a method blank detection. Further qualification is not required.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is affected; see above for applies qualifiers.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The method SW8082A surrogate decachlorobiphenyl was not reported in one of the two columns due to chromatographic interference for samples *Stain-001-01292021*, *Stain-002-01292021*, *Asphalt-005-01292021*, and *SB-2021-068:5.5-01262021*. However, the surrogate was recovered within acceptance criteria in the second column. Sample results are not affected by the surrogate recovery failure.

The method SW8270E surrogates 2-fluorophenol and 2-chlorophenol-d4 exhibited high recovery while 2,4,6-tribromophenol exhibited low recovery for samples *SB-2021-068:1.0-01262021*, *SB-2021-068:5.5-01262021*, and the MS and MSD samples associated with batch BJB0248. However, these samples were analyzed at a ten-fold dilution, which resulted in significant uncertainty in the recovery calculations. Sample results are not affected by the surrogate recovery failures.

The method SW8270E-SIM surrogates were not calculable for sample *SB-2021-006:10-01292021*. However, the sample was analyzed at a dilution due to high concentrations of target analytes. Sample results are not affected by the surrogate recovery failures.

The method NWTPH-Dx surrogate o-terphenyl had a low recovery for sample *SB-2021-006:10-01292021*. The sample results for DRO and RRO are considered estimated, biased low, and are flagged “JL*” for reporting purposes.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above.

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iv. Data quality or usability affected?

Comments:

The data quality/usability is affected; see above for applies qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐

Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☒ N/A ☐

Comments:

iii. All results less than RL and project specified objectives?

Yes ☐ No ☒ N/A ☐

Comments:

Toluene and ethylbenzene were detected in the trip blank sample associated with work order.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

Ethylbenzene was not detected in the project samples associated with this work order and are not affected by the detection for this analyte.

The project samples *MW-75:8.5-01282021*, *SB-2021-041:10.5-01282021*, *SB-2021-068:1.0-01262021*, and *SB-2021-068:5.5-01262021* had detections for toluene at estimated concentrations less than five times the trip blank detection. The samples results may be attributable to external or sample cross-contamination. The toluene results are considered non-detect at the LOQ and are flagged "B*" for reporting purposes.

The project sample *MW-75:21.0-01282021* had a detection for toluene at a concentration less than ten times but greater than five times the trip blank detection. The sample result may be attributable to external or sample cross-contamination. The toluene result is considered estimated, biased high, and is flagged "JH*" for reporting purposes.

The remaining sample *MW-75:16.0-01282021* had a detection for toluene at a concentration greater than ten times the trip blank detection and is not affected.

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v. Data quality or usability affected?

Comments:

The data quality/usability is affected; see above for applies qualifiers.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐

Comments:

The following field duplicate pairs were submitted with this work order:

- SB-2021-010:6-01282021 / SB-2021-104:6-01282021;
- SB-2021-002:6-01282021 / SB-2021-105:6-01282021;
- SB-2021-041:2-01282021 / SB-2021-106:2-01282021; and
- SB-2021-042:11-01292021 / SB-2021-106:11-01292021.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the detected results of the field duplicate samples *SB-2021-010:6-01282021* and *SB-2021-104:6-01282021* were within the recommended DQO of 50% for all analytes, where calculable, except lead-208.

The relative precision demonstrated between the detected results of the field duplicate samples *SB-SB-2021-002:6-01282021* and *SB-2021-105:6-01282021* were within the recommended DQO of 50% for all analytes, where calculable, except selenium-78, silver-107, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, fluorene, and pyrene.

The relative precision demonstrated between the detected results of the field duplicate samples *SB-SB-2021-041:2-01282021* and *SB-2021-106:2-01282021* were within the recommended DQO of 50% for all analytes, where calculable, except cadmium-111, zinc, trichloroethene, and pyrene.

The relative precision demonstrated between the detected results of the field duplicate samples *SB-SB-2021-042:11-01292021* and *SB-2021-106:11-01292021* were within the recommended DQO of 50% for all analytes, where calculable, except 1-methylnaphthalene, 2-methylnaphthalene, benzo(b)fluoranthene, benzo(j)fluoranthene, benzo(k)fluoranthene, dibenzofuran, and naphthalene. In addition, DRO was detected in the primary sample above the RL but not detected in the duplicate sample. The results are considered a precision failure.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The above listed results of the field duplicate samples are considered estimated and flagged “J*” (unless already qualified) to identify the lack of precision.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

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i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the 4-nitrophenol, 4-chlorophenyl phenyl ether, and 4,6-dinitro-2-methylphenol results for associated samples due to the recovery failures in the associated ICV and/or CCV for SVOC analysis.

The laboratory applied the Q-flag to the benzo(b)fluoranthene and benzo(j)fluoranthene results for associated samples due to the recovery failures in the associated ICV and/or CCV for PAH analysis.

The laboratory applied the E-flag to the 1-methylnaphthalene, 2-methylnaphthalene, acenaphthene, fluorene, naphthalene, phenanthrene, and DRO results for sample *SB-2021-006:10-01292021* because the analyte concentrations exceeded the upper limit of the calibration range of the instrument established by the initial calibration (ICAL). These analytes were re-extracted and within the method recognized hold time and within the laboratory ICAL. The re-extracted results are used for reporting purposes.

The laboratory applied the E-flag on the DRO results for samples *SB-2021-068:1.0-01262021* and *SB-2021-068:5.5-01262021* and the RRO result for sample *SB-2021-068:1.0-01262021*. The results were E-flagged because the analyte concentrations exceeded the upper limit of the calibration range of the instrument established by the ICAL. These analytes were re-extracted and within the method recognized hold time and within the laboratory ICAL. The re-extracted results are used for reporting purposes.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 8, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

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Laboratory Report Date:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The grain size analysis was subcontracted to Materials Testing & Consulting, Inc. located in Tukwila, WA.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

Per the project managers instruction, the samples IDs beginning with the designation MW-65 were replaced with the designation SB-2021-065 to be consistent with the project naming convention.

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that custody seals were not present on the cooler. However, the CoC record implies that the samples were hand delivered to the laboratory.

The sample receipt form notes that the labels on the vials for the samples *SB-2021-047:10.5-02022021* and *MW-68:15.5-02022021* were smeared. However, the vials were grouped by sample, so the lab was able to positively match the vials with the correct sample on the CoC.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples with smeared labels were positively identified and processed within holding time.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

The PCB Aroclor 1260 was recovered below the lower control limit in the method SW8082A MSD sample associated with batch BJB0519.

The gasoline range organics analysis of sample *MW-73:11-02022021* had to be redone because the initial extract was overdiluted. The re-analysis occurred outside of the method required holding time due to a power outage that rendered the instrument inoperable for a couple days.

Dichloromethane and toluene were detected at concentrations above their method reporting limits in the trip blank submitted with this work order.

The method SW8260D surrogate 4-bromofluorobenzene exhibited low recovery for the sample *MW-73:7-02022021*.

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

Hexachlorocyclopentadiene, fluorene, and pentachlorophenol were recovered below their lower control limits in the initial and continuing calibration verifications (ICV and CCV). Similarly, 4,6-dinitro-2-methylphenol was recovered above its upper control limit in the ICV and CCV.

The SVOC analyte 3,3-dichlorobenzidine was recovered below the lower control limit in the method SW8270E MS sample associated with batch BJB0657.

The PAH analysis of sample *MW-70:4.3-02022021* was missed in the initial extraction batch. The sample was later extracted in batch BJB0690. The case narrative notes that the sample had been frozen and was extracted within the method required holding time for a frozen sample.

The PAH analyte benzo(j)fluoranthene exhibited low recovery in the ICV and CCV samples.

The method SW8270E-SIM surrogate 2-methylnaphthalene-d10 exhibited low recovery for sample *MW-73:11-02022021*.

1-Methylnaphthalene and 2-methylnaphthalene were detected at concentrations above their respective reporting limits in the method blank sample associated with batch BJB0656. Similarly, phenanthrene, fluoranthene, pyrene, benzo(a)anthracene, benzo(b)fluoranthene, and chrysene were detected at concentrations above their respective reporting limits in the method blank sample associated with batch BJB0690.

n-Decane was detected at a concentration greater than the reporting limit in the method blank sample associated with batch BJB0274.

The laboratory report was revised to add trans-1,2-dichloroethene to the VOC list and remove extra analyses reported for TOC.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The gasoline range organics were re-analyzed for sample *MW-73:11-02022021* following an over dilution of the initial extract.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the 4,6-dinitro-2-methylphenol, hexachlorocyclopentadiene, fluorene, and pentachlorophenol results of the samples due to the recovery failures in the associated ICV and/or CCV.

The laboratory applied the Q-flag to the benzo(j)fluoranthene results of the samples due to the recovery failures in the associated ICV and/or CCV.

The laboratory applied the B-flag to the 1-methylnaphthalene, 2-methylnaphthalene, phenanthrene, fluoranthene, pyrene, benzo(a)anthracene, benzo(b)fluoranthene, and chrysene results of the samples included in batches BJB0656 and/or BJB0690.

The laboratory applied the B-flag to the n-decane results of the samples included in batch BJB0274.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐

Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐

Comments:

The field samples were prepared via method SW8270E-SIM and/or SW8270E a little over 21 days after collection. This is outside the typical 14-day limit for extraction.

The SW8270E-SIM extraction and analysis of the sample *MW-70:4.3-02022021* was conducted over 50 days after collection. According to the laboratory this is still within holding time for a frozen sample. However, we were unable to find EPA documentation supporting this claim.

The gasoline range organics analysis of sample *MW-73:11-02022021* had to be redone because the initial extract was overdiluted. The re-analysis occurred outside of the method required holding time due to a power outage that rendered the instrument inoperable for a couple days.

c. All soils reported on a dry weight basis?

Yes ☐ No ☒ N/A ☐

Comments:

The hexavalent chromium and TOC analyses were conducted on a wet weight basis per the reference method.

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d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Several analytes had RLs that exceed the Ecology PCUL limits defined in the QAPP. Analytes with non-detect results that have RLs that exceed the Ecology PCUL are identified in bold in the analytical summary tables.

e. Data quality or usability affected?

The case narrative states that all analyses were conducted within the method required holding times for frozen samples. EPA guidance does not specifically contradict this, stating only that “*Selection of containers, preservation techniques and applicable holding times should be based on the stated project specific data quality objectives... Laboratories should consult data users and adhere to the sample storage and holding time requirements stipulated in the project QA plans to ensure generated data meets specific program and/or project needs.*” Since the holding time exceedance for most of the samples were minor, we will accept the laboratory’s assertion that the project DQO was met, with one exception. Sample MW-70:4.3-02022021 was missing during the initial extraction and its subsequent analysis was grossly outside of the method required holding time. We assume a low analytical bias for the PAH results of this sample and have qualified the data JL* for reporting purposes.

The GRO result of sample MW-73:11-02022021 is assumed to have a low analytical bias due to the holding time exceedance. This result is flagged JL* for reporting purposes.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, several analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

1-Methylnaphthalene and 2-methylnaphthalene were detected in the method blank sample associated with batch BJB0656.

Benzo(a)anthracene, benzo(b)fluoranthene, chrysene, fluoranthene, phenanthrene, and pyrene were detected in the method blank sample associated with batch BJB0690. Anthracene, benzo(a)pyrene, benzo[g,h,i]perylene, benzo(k)fluoranthene, benzo(j)fluoranthene, fluorene, and indeno[1,2,3-cd]pyrene were also detected in this method blank at estimated concentrations below the RL.

n-Decane was detected in the method blank sample associated with batch BJB0274.

Mercury was detected at an estimated concentration in the method blank sample associated with batch BJB0434.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples *MW-73:17.7-02022021*, *MW-56:1.0-02022021*, and *MW-56:8.0-02022021* contained 1-methylnaphthalene and 2-methylnaphthalene concentrations within 5X those of the concentrations detected in the associated method blank.

Batch BJB0690 includes only sample *MW-70:4.3-02022021*. Two sets of results are provided for this sample as dilution was necessary following the initial run. Most PAH concentrations were greater than 10X those of the concentrations detected in the method blank, with the following exceptions. Benzo(a)anthracene and chrysene were detected in the diluted extract at concentrations within 10X those of the concentrations detected in the method blank. Benzo(k)fluoranthene and benzo(j)fluoranthene were detected in both extracts at concentrations within 10X those of the concentrations detected in the method blank.

n-Decane was not a target analyte for the field samples. The reported results are therefore unaffected.

Samples *MW-72:1-02022021*, *MW-72:5-02022021*, *MW-72:10.9-02022021*, *MW-70:0-02022021*, *MW-70:4.3-02022021*, *MW-70:8-02022021*, *MW-68:8.5-02022021*, *MW-56:1.0-02022021*, *MW-56:8.0-02022021*, *MW-101:8.0-02022021*, and *SB-2021-065:13-02022021* contained mercury concentrations within 5X that of the concentration detected in the associated method blank.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 1-methylnaphthalene and 2-methylnaphthalene results of samples *MW-73:17.7-02022021*, *MW-56:1.0-02022021*, and *MW-56:8.0-02022021* are assumed to be artifacts of laboratory contamination and are flagged B* for reporting purposes.

The Benzo(a)anthracene and chrysene results are reported from the undiluted extract because they did not exceed the instrument's calibration limit and the results are higher. The benzo(k)fluoranthene and benzo(j)fluoranthene results of sample *MW-70:4.3-02022021* may be affected by external analyte contributions. However, these results were also affected by a serious holding time exceedance. Due to the conflicting directions of bias, these results are considered estimated and flagged J* for reporting purposes.

The mercury results of samples *MW-72:1-02022021*, *MW-72:5-02022021*, *MW-72:10.9-02022021*, *MW-70:0-02022021*, *MW-70:4.3-02022021*, *MW-70:8-02022021*, *MW-68:8.5-02022021*, *MW-56:1.0-02022021*, *MW-56:8.0-02022021*, *MW-101:8.0-02022021*, and *SB-2021-065:13-02022021* are assumed to be artifacts of laboratory contamination and are flagged B* at the LOQ or reported concentration (whichever is greater).

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS/LCSDs were reported for VOCs (both standard and purge-and-trap), GRO, and PCBs analyses.

An LCS was reported for SVOCs, PAHs, DRO, and C8-C10 aliphatics analyses. See MS/MSD for assessment of method precision.

An LCS was reported for TOC analysis. No measure of method precision was provided.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

An LCS was reported for hexavalent chromium analysis. No measure of method precision was provided.

An LCS and laboratory duplicate were reported for isotopic metals and mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The isotopic metals laboratory duplicate sample associated with batch BJB0429 exhibited a precision failure for selenium-78.

The method 7471B laboratory duplicate sample associated with batch BJB0433 exhibited a precision failure for mercury.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

All field samples included in batch BJB0429 may be affected by a lack of precision in how the selenium-78 result was quantified.

All field samples included in batch BJB0433 may be affected by a lack of precision in how the mercury result was quantified.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The selenium-78 and mercury results of samples *MW-60:1.5-02012021*, *MW-60:5-02012021*, *MW-60:9-02012021*, *MW-61:1.5-02012021*, *MW-61:6-02012021*, *MW-61:11-02012021*, *MW-74:3-02022021*, *MW-74:6-02022021*, *MW-74:10.3-02022021*, *MW-101:10.3-02022021*, *MW-73:3.2-02022021*, *MW-73:7-02022021*, *MW-73:11-02022021*, *MW-73:15-02022021*, *MW-73:17.7-02022021*, *SB-2021-047:1.5-02022021*, and *SB-2021-047:7.1-02022021* are considered estimated and flagged J* for reporting purposes.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality was affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for SVOCs, PAHs, DRO, PCBs, and C8-C10 aliphatics analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for isotopic metals and mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The SVOC analyte 3,3'-dichlorobenzidine exhibited grossly low recovery in the MS sample associated with batch BJB0657.

The PAH analytes 1-methylnaphthalene, 2-methylnaphthalene, chrysene, dibenzofuran, and naphthalene exhibited low recoveries in the MS and MSD samples associated with batch BJB0656.

C8-C10 aliphatics were unrecoverable in the MSD sample associated with batch BJB0328.

The PCB Aroclor 1260 exhibited low recovery in the MS and MSD samples associated with batch BJB0519.

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the 3,3'-dichlorobenzidine recoveries of the MS and MSD samples associated with batch BJB0657 did not meet acceptance criteria.

The relative precision demonstrated between the C8-C10 aliphatics recoveries of the MS and MSD samples associated with batch BJB0328 could not be assessed.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The method SW8270E MS/MSD samples associated with batch BJB0657 were spiked from the field sample *MW-72:10.9-02022021*. 3,3'-Dichlorobenzidine was not detected in the parent sample. The gross recovery failures in the MS/MSD samples imply that matrix effects may be impacting method recovery.

The method SW8270E-SIM MS/MSD samples associated with batch BJB0656 were spiked from the field sample *MW-70:0-02022021*. However, the analyte spiking concentrations added to the matrix were low relative to the native concentrations in the parent sample. The resulting uncertainty may render the MS/MSD results unrepresentative of actual method performance.

The method 3546 (Microwave) MS/MSD samples associated with batch BJB0328 were spiked from the field sample *MW-73:11-02022021*. C8-C10 aliphatics were not detected in the parent sample. The gross recovery failure in the MSD sample implies that matrix effects may be impacting method recovery.

The method 8082A MS/MSD samples associated with batch BJB0519 were spiked from the field sample *MW-60:1.5-02012021*. PCB Aroclor 1260 was not detected in the parent sample. The recovery failures in the MS/MSD samples imply that matrix effects may be impacting method recovery.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect 3,3'-dichlorobenzidine result of sample *MW-72:10.9-02022021* is rejected due to the gross recovery failure. This result is flagged R* for reporting purposes.

The non-detect C8-C10 aliphatics result of sample *MW-73:11-02022021* is rejected due to the gross recovery failure. This result is flagged R* for reporting purposes.

The non-detect PCB Aroclor 1260 result of sample *MW-60:1.5-02012021* is assumed to have a low analytical bias and is therefore considered estimated. This result is flagged J* for reporting purposes.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is affected; see above for applies qualifiers.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The method SW8260D surrogate 4-bromofluorobenzene exhibited low recovery for the sample *MW-73:7-02022021*.

The method SW8270E-SIM surrogates 2-methylnaphthalene-d10 and fluoranthene-d10 were not recoverable in sample *MW-73:7-02022021*. The sample was diluted by a factor of 10X.

The method SW8270E-SIM surrogates 2-methylnaphthalene-d10, dibenzo[a,h]anthracene-d10, and fluoranthene-d10 were not recoverable in the re-extraction of sample *MW-73:7-02022021*. The sample was diluted by a factor of 200X.

The method SW8270E-SIM surrogate 2-methylnaphthalene-d10 exhibited low recovery in sample *MW-73:11-02022021*. The sample was diluted by a factor of 10X.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The VOC surrogate 4-bromofluorobenzene is not correlated with the reported analytes. The sample results are not affected.

Surrogate recovery failures attributable to sample dilution do not affect data quality. The surrogate spike is often unrecoverable in a heavily diluted extract.

iv. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Toluene was detected in the trip blank sample submitted with this work order.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

Toluene was detected in samples *MW-60:1.5-02012021*, *MW-60:9-02012021*, *SB-2021-047:7.1-02022021*, *MW-73:7-02022021*, *MW-73:11-02022021*, *MW-73:15-02022021*, *MW-70:0-02022021*, *MW-70:8-02022021*, and *MW-68:8.5-02022021* at concentrations roughly equivalent to that of the concentration detected in the trip blank.

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v. Data quality or usability affected?

Comments:

The toluene results of samples *MW-60:1.5-02012021*, *MW-60:9-02012021*, *SB-2021-047:7.1-02022021*, *MW-73:7-02022021*, *MW-73:11-02022021*, *MW-73:15-02022021*, *MW-70:0-02022021*, *MW-70:8-02022021*, and *MW-68:8.5-02022021* may be attributable to external or sample cross-contamination. These results are flagged B* for reporting purposes.

f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐

Comments:

- ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐

Comments:

The field duplicate pairs *MW-56:8.0-02022021* / *MW-101:8.0-02022021* and *MW-74:10.3-02022021* / *MW-101:10.3-02022021* were submitted with this work order.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☒ N/A ☐

Comments:

The relative precision demonstrated between the detected results of the field duplicate samples *MW-56:8.0-02022021* and *MW-101:8.0-02022021* was within the recommended DQO of 50% for all analytes except the following: silver-107, copper-63, RRO, and all PAH analytes.

The relative precision demonstrated between the detected results of the field duplicate samples *MW-74:10.3-02022021* and *MW-101:10.3-02022021* was within the recommended DQO of 50% for all analytes except the following: all PAH analytes except dibenzo(a,h)anthracene.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The above listed results of the field duplicate samples are considered estimated and flagged J* (unless already qualified) to identify the lack of precision.

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- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

- iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

- a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the 4,6-dinitro-2-methylphenol, hexachlorocyclopentadiene, fluorene, and pentachlorophenol results of the samples due to the recovery failures in the associated ICV and/or CCV.

The laboratory applied the Q-flag to the benzo(j)fluoranthene results of the samples due to the recovery failures in the associated ICV and/or CCV

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 7, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The grain size analysis was subcontracted to Materials Testing & Consulting, Inc. located in Tukwila, WA.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that custody seals were not present on the cooler. However, the CoC record implies that the samples were hand delivered to the laboratory.

The sample receipt form notes that the label for the jar containing volume for metals analysis associated with sample *MW-55:5.5-02032021* was left partially blank. However, the sample was unambiguous due to it being grouped in a baggie with the other containers for the sample.

The sample receipt form notes that the labels for the sample *MW-55:15.5-02032021* were left partially blank. However, the sample was able to be matched to the CoC through process of elimination.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The partially labeled samples were positively identified and processed within holding time.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The PCB Aroclor 1260 was recovered below the lower control limit in the method SW8082A closing continuing calibration verification (CCV) on column zb-5. The laboratory reported data from the passing column zb-35.

Benzo(b)fluoranthene and benzo(j)fluoranthene were recovered below their lower control limits in the initial and continuing calibration verifications.

The internal standard area counts for phenanthracene-d10 and perylene-d12 were below their respective control limits for the sample *MW-22R:15.5-02032021*. Similarly, chrysene exhibited high recovery in the samples *MW-59:9.5-02032021* and *MW-55:5.5-02032021*.

The DRO surrogate o-terphenyl exhibited elevated recovery for the sample *MW-22R:5.5-02032021*. The case narrative notes that the sample may have been erroneously spiked twice.

The laboratory report was revised to add trans-1,2-dichloroethene to the VOC list.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The samples *MW-22R:15.5-02032021*, *MW-59:9.5-02032021*, and *MW-55:5.5-02032021* were re-extracted via method SW8270E-SIM due to internal standard recovery failures in the initial run. The laboratory reports passing internal standard area counts in the re-extracted batch. Both sets of data are reported.

Sample specific QC was performed on the field samples used for laboratory duplicates and MS/MSD analyses.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the benzo(b)fluoranthene and benzo(j)fluoranthene results of the samples due to the recovery failures in the associated ICV and/or CCV.

The o-terphenyl recovery of sample *MW-22R:5.5-02032021* was flagged as a deviation due to the high recovery.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☒ N/A ☐ Comments:

The hexavalent chromium and TOC analyses were conducted on a wet weight basis per the reference method.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Benzene, dibenzo(a,h)anthracene, trichloroethene and vinyl chloride were not detected in one or more field samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

1-Methylnaphthalene and 2-methylnaphthalene were detected at estimated concentrations in the method blank sample associated with batch BJB0470.

Mercury was detected at an estimated concentration in the method blank sample associated with batch BJB0434.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples *MW-59:9.5-02032021*, *MW-55:1.5-02032021*, and *MW-54:1-02032021* contained 1-methylnaphthalene concentrations within 10X that of the concentration detected in the associated method blank. Similarly, the samples *MW-22R:1.0-02032021*, *MW-22R:20.5-02032021*, and *MW-54:9-02032021* contained 1-methylnaphthalene concentrations within 5X that of the concentration detected in the associated method blank.

Sample *MW-54:1-02032021* contained 2-methylnaphthalene at a concentration within 10X that of the concentration detected in the associated method blank. Similarly, the samples *MW-59:9.5-02032021*, *MW-22R:1.0-02032021*, *MW-22R:20.5-02032021*, *MW-55:1.5-02032021*, and *MW-54:9-02032021* contained 2-methylnaphthalene concentrations within 5X that of the concentration detected in the associated method blank.

Sample *MW-59:9.5-02032021* contained mercury at a concentration within 10X that of the concentration detected in the associated method blank. Similarly, the samples *MW-59:1.0-02032021* and *MW-59:6.5-02032021* contained mercury concentrations within 5X that of the concentration detected in the associated method blank.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 1-methylnaphthalene results of samples *MW-59:9.5-02032021*, *MW-55:1.5-02032021*, and *MW-54:1-02032021* are assumed to have a high analytical bias attributable to external analyte contributions. These results are flagged JH* for reporting purposes.

The 1-methylnaphthalene results of samples *MW-22R:1.0-02032021*, *MW-22R:20.5-02032021*, and *MW-54:9-02032021* are assumed to be artifacts of laboratory contamination and are flagged B* at the LOQ or reported concentration (whichever is greater).

The 2-methylnaphthalene result of sample *MW-54:1-02032021* is assumed to have a high analytical bias attributable to external analyte contributions. This result is flagged JH* for reporting purposes.

The 2-methylnaphthalene results of samples *MW-59:9.5-02032021*, *MW-22R:1.0-02032021*, *MW-22R:20.5-02032021*, *MW-55:1.5-02032021*, and *MW-54:9-02032021* are assumed to be artifacts of laboratory contamination and are flagged B* at the LOQ or reported concentration (whichever is greater).

The mercury result of sample *MW-59:9.5-02032021* is assumed to have a high analytical bias attributable to external analyte contributions. This result is flagged JH* for reporting purposes.

The mercury results of samples *MW-59:1.0-02032021* and *MW-59:6.5-02032021* are assumed to be artifacts of laboratory contamination and are flagged B* at the LOQ or reported concentration (whichever is greater).

v. Data quality or usability affected?

Comments:

The data quality was affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS/LCSDs were reported for VOCs and PCBs analyses.

An LCS was reported for PAHs and DRO analyses. See MS/MSD for assessment of method precision.

An LCS was reported for TOC analysis. No measure of method precision was provided.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

An LCS was reported for total metals and hexavalent chromium analyses. No measure of method precision was provided.

An LCS and laboratory duplicate were reported for isotopic metals and mercury.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

We note that mercury was not detected in the field sample *MW-22R:1.0-02032021* but it was detected at an estimated concentration in the laboratory duplicate analysis of that sample.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and, where applicable, precision were demonstrated to be within acceptable limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification was not required; see above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability was not affected; see above.

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c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for PAHs and DRO analyses.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for isotopic metals and mercury.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and precision were demonstrated to be within acceptable limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification was not required; see above.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The DRO/RRO surrogate o-terphenyl exhibited elevated recovery for the sample *MW-22R:5.5-02032021*.The method SW8082A surrogate recovery information for samples *MW-54:1-02032021* and *MW-102:5.5-02032021* was not provided. These samples were diluted by factors of 1,000X and 50X respectively, so the surrogates were unrecoverable.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

The DRO and RRO results of sample *MW-22R:5.5-02032021* may be affected by elevated method recovery. The laboratory notes that the high surrogate recovery is likely due to an erroneous double spike rather than an actual recovery failure but is unable to make a definitive conclusion. We have applied a JH* flag to these results out of an abundance of caution.

Surrogate recovery failures attributable to sample dilution do not affect data quality. The surrogate spike is often unrecoverable in a heavily diluted extract.

iv. Data quality or usability affected?

Comments:

The data quality may be affected but is somewhat inconclusive.

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e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

No samples are affected. Target analytes were not detected in the trip blank.

- v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

The field-duplicate samples were not submitted with this work order. However, field duplicates are collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

The field-duplicate samples were not submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

The field-duplicate samples were not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

- iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the benzo(b)fluoranthene and benzo(j)fluoranthene results of the samples due to the recovery failures in the associated ICV and/or CCV.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 7, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21B0101

Laboratory Report Date:

August 3, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21B0101

Laboratory Report Date:

August 3, 2021

Report Name:

Lower Duwamish

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that custody seals were not present on the cooler. However, the CoC record implies that the samples were hand delivered to the laboratory.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The sample *MW-71:20.5-02042021* was re-extracted via method SW8260D outside of the required holding time due to elevated surrogate recovery in the initial run.

The recovery of the method SW8260D surrogate 1,2-dichloromethane-d4 was outside of laboratory control limits in the sample *MW-71:20.5-02042021*.

The laboratory report was revised to add trans-1,2-dichloroethene to the VOC list.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The sample *MW-71:20.5-02042021* was re-extracted via method SW8260D outside of the required holding time due to elevated surrogate recovery in the initial run.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory flagged several SVOC analytes in the SW8270E MS/MSD samples due to their RPDs being outside of laboratory control limits.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

The sample *MW-71:20.5-02042021* was re-extracted via method SW8260D outside of the required holding time due to low surrogate recovery in the initial run. Only cis-1,2-dichloroethene and vinyl chloride reported higher concentrations compared to the initial run. All other results are reported from the within-hold data.

c. All soils reported on a dry weight basis?

Yes ☒ No ☐ N/A ☐ Comments:

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Benzo(a)anthracene, benzo(a)pyrene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, pentachlorophenol, and vinyl chloride were not detected in one or more of the field samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

The cis-1,2-dichloroethene and vinyl chloride results of sample *MW-71:20.5-02042021* are assumed to have a low analytical bias due to the holding time exceedance. These results are flagged JL* for reporting purposes.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

1,2,3-Trichlorobenzene, 1,2,4-trichlorobenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, hexachloro-1,3-butadiene, naphthalene, and n-butylbenzene were detected at estimated concentrations in the method blank sample associated with batch BJB0418.

1,2,4-Trichlorobenzene, methylene chloride, and naphthalene were detected at estimated concentrations in the method blank sample associated with batch BJB0495.

- iii. If above RL or project specified objectives, what samples are affected?

Comments:

The VOCs detected in the method blank sample associated with batch BJB0418 were not target analytes for the included field samples. The results are therefore unaffected.

Batch BJB0495 represents the re-extraction of sample *MW-71:20.5-02042021*. The 1,2,4-trichlorobenzene, methylene chloride, and naphthalene concentrations were not reported from the re-extracted results.

- iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The reported results were not affected by laboratory contamination; see above.

- v. Data quality or usability affected?

Comments:

The data quality/usability was not affected; see above.

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b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for VOCs analysis.

An LCS was reported for SVOCs and DRO analyses. See MS/MSD for assessment of method precision.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

An LCS was reported for total metals and mercury analyses. No measure of method precision was provided.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Acrolein exhibited elevated recovery in the EPA Method 5035 LCSD associated with batch BJB0418.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

Method precision could only be assessed for VOCs.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Acrolein was not one of the target VOCs for the field samples. The samples are not affected by the recovery failure for this analyte.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Acrolein was not reported in the field samples.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability was not affected; see above.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for SVOCs and DRO analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were not reported for metals/inorganics.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Benzoic acid exhibited grossly low recovery in the EPA Method 3546 MS/MSD samples associated with batch BJB0517.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the pentachlorophenol recoveries of the EPA Method 3546 MS and MSD samples associated with batch BJB0517 was outside of acceptance criteria.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The MS and MSD samples associated with batch BJB0517 were spiked from the field sample MW-71:1.5-02042021. The benzoic acid concentration reported for the parent sample may be influenced by matrix effects resulting in grossly low method recovery. However, only the PAH list of analytes was reported. Benzoic acid was not a target analyte for the field samples.

The pentachlorophenol concentration reported for sample MW-71:1.5-02042021 may be influenced by matrix effects resulting low method precision.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect pentachlorophenol result of the sample *MW-71:1.5-02042021* is considered estimated due to the method precision failure. This result is flagged J* for reporting purposes.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is affected; see above for applied qualifiers.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☒ N/A ☐ Comments:

The method SW8260D surrogate 1,2-dichloromethane-d4 exhibited low recovery in the sample *MW-71:20.5-02042021*.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☒ Comments:

The analytes 1,1-dichloroethene, benzene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride are associated with the surrogate 1,2-dichloromethane-d4. The vinyl chloride and cis-1,2-dichloroethene results of the affected sample are reported from the re-extracted batch. The remaining results are assumed to have a low analytical bias and are flagged JL* for detected concentrations and J* for concentrations that were not detected.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see applied qualifiers above.

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e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

The trip blank sample *TB-5-02052021* was submitted with this work order.

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

No samples are affected. Target analytes were not detected in the trip blank.

- v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

The field-duplicate samples were not submitted with this work order. However, field duplicates are collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

The field-duplicate samples were not submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

The field-duplicate samples were not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

- iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒ Comments:

No additional data flags/qualifiers were required.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 3, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21B0126

Laboratory Report Date:

August 4, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21B0126

Laboratory Report Date:

August 4, 2021

Report Name:

Lower Duwamish

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that custody seals were not present on the cooler. However, the CoC record implies that the samples were hand delivered to the laboratory.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The PCB Aroclor 1260 was recovered below the lower control limit in the method SW8082A closing continuing calibration verification (CCV) on column zb-5. The laboratory reported data from the passing column zb-35.

The samples *MW-10R:9-02052021* and *MW-104:9-02052021* were re-extracted via method SW8260D outside of the required holding time due to elevated surrogate recovery in the initial run. Both sets of data are reported but the laboratory advises using the re-extracted batch. However, the lab also notes that the sample volume used for the re-extraction was sourced from unpreserved containers due to an instrument malfunction ruining the sodium bisulfate preserved containers.

The method SW8260D surrogate 1,2-dichloromethane-d4 exhibited elevated recovery in the initial calibration verification (ICV) sample.

The method SW8260D internal standard area counts were outside of laboratory control limits for samples *MW-10R:9-02052021* and *MW-104:9-02052021*.

Benzo(j)fluoranthene exhibited low recovery in the SW8270E-SIM initial and CCV samples.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

Sample specific QC was performed on those samples used for MS/MSD analysis.

The samples *MW-10R:9-02052021* and *MW-104:9-02052021* were re-extracted via method SW8260D outside of the required holding time due to elevated surrogate recovery in the initial run.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the 1,2-dichloromethane-d4 surrogate recoveries of all samples due to the recovery failure in the ICV.

The laboratory applied the Q-flag to the benzo(j)fluoranthene results of all samples due to the recovery failures in the ICV and CCV.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

The samples *MW-10R:9-02052021* and *MW-104:9-02052021* were re-extracted via method SW8260D outside of the required holding time due to elevated surrogate recovery in the initial run. However, the re-extracted batch was affected by serious laboratory errors and will not be used. The within-hold results of the initial run are reported.

c. All soils reported on a dry weight basis?

Yes ☒ No ☐ N/A ☐ Comments:

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Trichloroethene and vinyl chloride were not detected in the field samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Mercury was detected at an estimated concentration in the method blank sample associated with batch BJB0434.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples *MW-10R:2-02052021*, *MW-10R:5.4-02052021*, *MW-10R:9-02052021*, *MW-104:9-02052021*, and *MW-65:20-02052021* contained mercury concentrations within 5X that of the concentration detected in the associated method blank.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:The mercury results of samples *MW-10R:2-02052021*, *MW-10R:5.4-02052021*, *MW-10R:9-02052021*, *MW-104:9-02052021*, and *MW-65:20-02052021* may be artifacts of laboratory contamination and are flagged B* at the LOQ or sample concentration (whichever is greater).

v. Data quality or usability affected?

Comments:

The data quality was affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS/LCSDs were reported for VOCs and PCBs analyses.

An LCS was reported for PAHs analysis. See MS/MSD for assessment of method precision.

An LCS was reported for DRO analyses. No measure of method precision was provided, and no measure of method accuracy or precision was provided for the RRO analysis.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

An LCS was reported for total metals, mercury, and hexavalent chromium analyses. No measure of method precision was provided.

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- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Trans-1,2-dichloroethene was unrecoverable in the LCS associated with batch BJB0637 and the LCS/LCSD associated with batch BJB0694.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Trans-1,2-dichloroethene was not detected in the field samples. Due to the laboratory's inability to recover this analyte in the LCS and/or LCSDs, we consider the non-detect results included in batches BJB0637 and BJB0694 to be unusable.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect trans-1,2-dichloroethene results of the samples *MW-10R:2-02052021*, *MW-10R:5.4-02052021*, and *MW-65:20-02052021* are rejected and flagged R* for reporting purposes.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability was affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for PAHs analysis.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were not reported for metals/inorganics.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

Only PAHs were analyzed.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

Only PAHs were analyzed.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

No samples are affected. Accuracy and precision for method SW8270E-SIM was demonstrated to be within acceptable limits.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification was not required; see above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

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- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The method SW8260D surrogate 1,2-dichloromethane-d4 exhibited elevated recovery in the ICV sample. We note that the field samples and batch QC samples associated with this ICV exhibited passing surrogate recovery.

- iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Field sample surrogate recoveries were within acceptable limits.

- iv. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

The trip blank sample *TB-5-02052021* was submitted with this work order.

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

No samples are affected. Target analytes were not detected in the trip blank.

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v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐

Comments:

The field-duplicate samples *MW-10R:9-02052021* and *MW-104:9-02052021* were submitted with this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration

R_2 = Field Duplicate Concentration

Yes ☐ No ☒ N/A ☐

Comments:

The relative precision demonstrated between the detected results of the field duplicate samples *MW-10R:9-02052021* and *MW-104:9-02052021* was within the recommended DQO of 50% for all analytes except cadmium-111, benzene, and all PAH analytes.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The cadmium-111, benzene, and all PAH results of the field duplicate samples *MW-10R:9-02052021* and *MW-104:9-02052021* are considered estimated and flagged J* to identify the imprecision.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒

Comments:

Equipment blank samples were not submitted with this work order.

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i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the benzo(j)fluoranthene results of all samples due to the recovery failures in the ICV and CCV.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 2, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

Two 500-mL HDPE containers (jars A and B) for sample MW-66-20211002 were received under-preserved at the laboratory with pHs >2.

One 500-mL HDPE container (jars A) for sample MW-76-20211002 was received under-preserved at the laboratory with a pH >2.

One 500-mL HDPE container (jars A) for sample MW-100-20211002 was received under-preserved at the laboratory with a pH >2.

Two 500-mL HDPE containers (jars A and B) for sample MW-56-20211002 were received under-preserved at the laboratory with pHs >2.

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that custody seals were not present on the cooler. However, the CoC record implies that the samples were hand delivered to the laboratory.

- e. Data quality or usability affected?

Comments:

The sample containers exhibiting insufficient preservation were filtered at 0.45 um and had their pH adjusted with 0.75 mL of concentrated HNO₃ upon receipt at the laboratory. The samples were collected and submitted to the laboratory on 2/10/2021. The pHs of the containers were adjusted on 2/11/2021. We do not consider the results be meaningfully affected by this preservation failure. The under-preserved jars contain sample volume for total dissolved metals analyses. Metals are typically stable in the sample matrix and are unlikely to be affected by being under-preserved for a period of less than 24 hours.

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4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The EPA method SW8082A surrogate tetrachlorometaxylene exhibited low recovery for the sample MW-51-2021002.

The PCB Aroclor 1260 was recovered below the lower control limit in the method SW8082A MSD sample associated with batch BJB0451.

1,1-Dichloroethene and vinyl chloride were recovered above their upper control limits in the method SW8260D MS and MSD samples associated with batch BJB0615.

The SVOCs 4,6-dinitro-2-methylphenol and 2-nitrophenol exhibited elevated recoveries while 1,2,4-trichlorobenzene and hexachlorobutadiene exhibited low recoveries in the method SW8270E initial calibration verification (ICV).

The recoveries of hexachlorobutadiene and 4-chloroaniline were below their lower control limits in the method SW8270E LCS and LCSD.

Manganese was detected in the SW6020B method blank sample.

Total iron was recovered below the lower control limit in the method SW6020B MS sample associated with batch BJB0603.

The sulfite analyses took place outside of the method required holding time.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

Sample specific QC was performed on those samples used for MS/MSD analysis.

The laboratory report was revised to add trans-1,2-dichloroethene to the list of reported VOCs.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to detected 4,6-dinitro-2-methylphenol, 2-nitrophenol, 1,2,4-trichlorobenzene, and hexachlorobutadiene results of the field samples due to the recovery failures exhibited by the method SW8270E ICV.

The laboratory applied the B-flag to the detected manganese results of the field samples due to the method blank detection.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐

Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐

Comments:

The method required holding time for sulfite analysis is 15 minutes. Meeting this holding time is not practical for most field sites. The samples were analyzed within 24 hours of collection, but the sulfite results are assumed to have a low analytical bias.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒

Comments:

Soil samples were not submitted with this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐

Comments:

Several SVOCs and PAHs were not detected in the field samples and reported at limits of detection (LODs) which were greater than their associated regulatory limits.

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e. Data quality or usability affected?

The sulfite results of all field samples reported in this work order are assumed to have a low analytical bias. Detected sulfite concentrations are flagged JL* while non-detect results are flagged J* for reporting purposes.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

1-Methylnaphthalene, 2-methylnaphthalene, and naphthalene were detected at estimated concentrations in the method blank sample associated with batch BJB0449.

Mercury was detected at an estimated concentration in the method blank sample associated with batch BJB0399.

Iron isotope 57, chromium isotope 53, and vanadium isotope 51b were detected at estimated concentrations in the method blank sample associated with batch BJB0514.

Total dissolved manganese-55 was detected at a concentration above the LOQ in the method blank sample associated with batch BJB0603. Total dissolved chromium-52, chromium-53, iron-54, and vanadium-51b were detected at estimated concentrations.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples *MW-56-20211002*, *MW-66-20211002*, *MW-76-20211002*, and *MW-100-20211002* contained 1-methylnaphthalene and naphthalene concentrations roughly equivalent to those of the concentrations detected in the associated method blank.

No field samples are included in batch BJB0399. The sample results are not affected by the mercury detection.

Iron isotope 57, chromium isotope 53, and vanadium isotope 51b were not reported for the field samples.

Samples *MW-56-20211002*, *MW-66-20211002*, *MW-76-20211002*, and *MW-100-20211002* contained total dissolved chromium-52 concentrations roughly equivalent to those of the concentrations detected in the associated method blank. All samples contained iron-54 and manganese-55 at concentrations greater than 10X those of the concentrations detected in the method blank. Vanadium-51b was not reported for the field samples.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 1-methylnaphthalene and naphthalene results of samples *MW-56-20211002*, *MW-66-20211002*, *MW-76-20211002*, and *MW-100-20211002* may be artifacts of laboratory contamination and are flagged B* at the LOQ.

The total dissolved chromium-52 results of samples *MW-56-20211002*, *MW-66-20211002*, *MW-76-20211002*, and *MW-100-20211002* may be artifacts of laboratory contamination and are flagged B* at the LOQ.

v. Data quality or usability affected?

Comments:

The data quality was affected; see above for applied qualifiers.

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b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, volatile gases, and SVOCs analyses.

An LCS was reported for PAHs, DRO, and PCB analyses. See MS/MSD for assessment of method precision.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for total metals, total dissolved metals, mercury, sulfite, ferrous iron analyses.

An LCS was reported for chloride, nitrate, nitrite, and sulfate analyses. No measure of method precision was provided.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

4-Chloroaniline exhibited low recovery in the LCS and LCSD associated with batch BJB0460.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the hexachlorobutadiene results of the LCS and LCSD reported in batch BJB0460 did not meet acceptance criteria.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Samples *MW-56-20211002*, *MW-76-20211002*, and *MW-100-20211002* are included in batch BJB0460. 4-Chloroaniline and hexachlorobutadiene were not detected in these samples.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect 4-chloroaniline results of samples *MW-56-20211002*, *MW-76-20211002*, and *MW-100-20211002* may be affected by low method recovery. These results are flagged J* for reporting purposes.

The non-detect hexachlorobutadiene results of samples *MW-56-20211002*, *MW-76-20211002*, and *MW-100-20211002* may lack sufficient precision. These results are flagged J* for reporting purposes.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality was affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for VOCs, PAHs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for total metals, total dissolved metals, and mercury analyses.

An MS was reported for ferrous iron analysis. See laboratory duplicate for assessment of method precision.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

1,1-Dichloroethene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, and vinyl chloride exhibited elevated recoveries in the MS/MSD samples associated with batch BJB0615.

The PCB Aroclor 1260 exhibited low recovery in the MSD sample associated with batch BJB0451.

Iron isotope 54 and manganese isotope 55 exhibited low recoveries in the MSD samples associated with batch BJB0514.

Total dissolved manganese isotope 55 exhibited high recovery in the MS sample associated with batch BJB0603.

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The MS/MSD samples reported for batch BJB0615 were spiked from the field sample MW-66-20211002. Of the analytes exhibiting elevated recovery, only trans-1,2-dichloroethene was detected in the parent sample.

The MS/MSD samples reported for batch BJB0451 were spiked from the field sample MW-66-20211002. Aroclor 1260 was not detected in the parent sample.

The MS/MSD samples reported for batch BJB0514 were spiked from the field sample MW-66-20211002. However, the iron and manganese spikes added to the sample matrix were low relative to the native concentrations in the parent sample. The resulting uncertainty may render the results unrepresentative of actual method performance.

The MS/MSD samples reported for batch BJB0603 were spiked from the field sample MW-66-20211002. However, the dissolved manganese spike added to the sample matrix was low relative to the native concentration in the parent sample. The resulting uncertainty may render the result unrepresentative of actual method performance.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The trans-1,2-dichloroethene result of sample MW-66-20211002 may be influenced by matrix effects that result in high method recovery. This result is flagged JH* for reporting purposes.

The non-detect Aroclor 1260 result of sample MW-66-20211002 may be influenced by matrix effects that result in low method recovery. This non-detect result is flagged J* for reporting purposes.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see applied qualifiers above.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The PCB surrogate tetrachlorometaxylene exhibited low recovery for the sample *MW-51-2021002*.

The SVOC surrogate phenol-d5 exhibited low recovery in the laboratory blank sample reported with batch BJB0460.

The PCB surrogate tetrachlorometaxylene exhibited low recovery in the laboratory blank sample reported with batch BJB0451.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

The non-detect PCB results of sample *MW-51-2021002* are considered estimated due to the low surrogate recovery. These results are flagged J* for reporting purposes.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see applied qualifiers above.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☐ No ☐ N/A ☐

Comments:

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ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

No samples are affected. Target analytes were not detected in the trip blank.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

The field-duplicate samples *MW-76-20211002*, and *MW-100-20211002* were submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the detected results of the field duplicate samples *MW-76-20211002*, and *MW-100-20211002* was within the recommended DQO of 30% for all analytes except 2-methylnaphthalene and diethyl phthalate.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The 2-methylnaphthalene and diethyl phthalate results of the field duplicate samples *MW-76-20211002*, and *MW-100-20211002* are considered estimated and flagged J* to identify the imprecision.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

- iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒ Comments:

Additional data flags and qualifiers were not required for this work order.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 9, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21B0174

Laboratory Report Date:

August 4, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21B0174

Laboratory Report Date:

August 4, 2021

Report Name:

Lower Duwamish

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

One 500-mL HDPE container for samples MW-55-20211002, MW-25-20211002, MW-70-20211002, MW-69-20211002, MW-24-20211002, and EB-2-20211002 were received under-preserved at the laboratory with pH >2.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that custody seals were not present on the cooler. However, the CoC record implies that the samples were hand delivered to the laboratory.

The sample receipt form notes that the container labels for the total metals and dissolved metals jars associated with the equipment blank sample *EB-2-20211102* were blank. As these were the only labels missing identifying information, the laboratory was able to match the containers to the CoC by process of elimination.

e. Data quality or usability affected?

Comments:

The sample containers exhibiting insufficient preservation were filtered at 0.45 um and had their pH adjusted with 0.75 mL of concentrated HNO₃ upon receipt at the laboratory. The samples were collected and submitted to the laboratory on 2/11/2021. The pHs of the containers were adjusted on 2/12/2021. We do not consider the results be meaningfully affected by this preservation failure. The under-preserved jars contain sample volume for total dissolved metals analyses. Metals are typically stable in the sample matrix and are unlikely to be affected by being under-preserved for a period of less than 24 hours.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

1,1-Dichloroethene exhibited elevated recovery in the initial calibration verification (ICV) sample designated SJB0357-ICV1 and the continuing calibration verification (CCV) sample designated SJB0357-CCV1.

The EPA method SW8270E surrogate phenol-d5 exhibited low recovery in one or more unspecified samples.

Dibenzo(a,h)anthracene exhibited low recovery in the second source calibration check designated SIH03040SCV1.

The EPA method SW8082A surrogate tetrachloro-m-xylene (TCMX) exhibited low recovery on the second column for an unspecified sample. The laboratory states that the recovery of TCMX is an indication of blow-down efficiencies and does not require corrective action.

The recovery of hexavalent chromium was below the lower control limit in the MS sample. A post-digestion spike was performed to confirm matrix interference. The laboratory notes that the post-digestion spike recovery was also low.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory performed a post-digestion bench spike following the recovery failure for hexavalent chromium in the MS sample.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to detected 1,1-dichloroethene results of the field samples due to the recovery failures exhibited by the batch ICV and CCV.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

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b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Soil samples were not submitted with this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium, 1,2,4-trichlorobenzene, bis (2-chloroethylhexyl) phthalate, butylbenzylphthalate, pentachlorophenol, and several PAHs were not detected in the field samples and reported at limits of detection (LODs) which were greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

1-Methylnaphthalene, 2-methylnaphthalene, and naphthalene were detected at estimated concentrations in the method blank sample associated with batch BJB0449.

Chromium isotopes 52 and 53 were detected at estimated concentrations in the method blank sample associated with batch BJB0618.

Total dissolved chromium-52, chromium-53, iron-54, zinc-66, and zinc-67 were detected at estimated concentrations in the method blank sample associated with batch BJB0662.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

Sample *MW-70-20211102* contained 1-methylnaphthalene and 2-methylnaphthalene concentrations within 10X those of the concentrations detected in the associated method blank. Similarly, samples *MW-24-20211002*, *EB-2-20211002*, and *MW-25-20211002* contained 1-methylnaphthalene and 2-methylnaphthalene concentrations roughly equivalent to those of the concentrations detected in the associated method blank.

Sample *MW-70-20211102* contained a naphthalene concentration within 10X that of the concentration detected in the associated method blank. Similarly, samples *MW-55-20211002*, *MW-24-20211002*, *EB-2-20211002*, and *MW-25-20211002* contained naphthalene concentrations roughly equivalent to that of the concentration detected in the associated method blank.

Sample *MW-69-20211102* contained a total chromium-52 concentration within 10X that of the concentration detected in the associated method blank. Similarly, samples *MW-55-20211002* and *EB-2-20211002* contained chromium-52 concentrations roughly equivalent to that of the concentration detected in the associated method blank. Chromium-53 was not reported for the samples included in batches BJB0618 and BJB0662.

Sample *MW-69-20211102* contained a dissolved chromium-52 concentration within 5X that of the concentration detected in the associated method blank.

Sample *EB-2-20211102* contained iron-54 at a concentration roughly equivalent to that of the concentration detected in the associated method blank.

Sample *MW-69-20211102* contained a zinc-66 concentration within 5X that of the concentration detected in the associated method blank. Zinc-67 was not reported for the samples included in batch BJB0662.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene results of sample *MW-70-20211102* may be affected by external analyte contributions. These results are flagged JH* for reporting purposes.

The 1-methylnaphthalene and 2-methylnaphthalene results of samples *MW-24-20211002*, *EB-2-20211002*, and *MW-25-20211002* may be artifacts of laboratory contamination and are flagged B* at the LOQ.

The naphthalene results of samples *MW-55-20211002*, *MW-24-20211002*, *EB-2-20211002*, and *MW-25-20211002* may be artifacts of laboratory contamination and are flagged B* at the LOQ.

The total chromium-52 result of sample *MW-69-20211102* may be affected by external analyte contributions. This result is flagged JH* for reporting purposes. The dissolved chromium-52 result of this sample may be attributable to residual equipment contamination and is flagged B* for reporting purposes.

The chromium-52 results of samples *MW-55-20211002* and *EB-2-20211002* may be artifacts of laboratory contamination and are flagged B* at the LOQ or sample concentration (whichever is greater).

The iron-54 result of sample *EB-2-20211002* may be an artifact of laboratory contamination and is flagged B* at the LOQ.

The dissolved zinc-66 result of sample *MW-69-20211002* may be an artifact of laboratory contamination and is flagged B* at the LOQ or sample concentration (whichever is greater).

v. Data quality or usability affected?

Comments:

The data quality was affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, and DRO analyses.

An LCS was reported for PAHs and PCB analyses. No measure of method precision was provided.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for isotopic metals (total and dissolved), mercury (total and dissolved), and hexavalent chromium analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and, where applicable, precision were demonstrated to be within acceptable limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification was not required; see above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☐ Comments:

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ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for isotopic metals (total and dissolved) and mercury (total and dissolved) analyses.

An MS and post-digestion bench spike were reported for hexavalent chromium analysis. See laboratory duplicate for assessment of method precision.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Manganese-55 exhibited elevated recovery in the MSD sample associated with batch BJB0618.

Dissolved manganese-55 exhibited low recovery in the MS and high recovery in the MSD samples associated with batch BJB0662.

Hexavalent chromium was unrecoverable in the MS sample and exhibited low recovery in the post-spike sample associated with batch BJB0396.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The MS/MSD samples reported for batch BJB0618 were spiked from the field sample *MW-55-20211002*. However, the manganese spike added to the sample matrix was low relative to the native concentration in the parent sample. The resulting uncertainty may render the MSD result unrepresentative of actual method performance.

The MS/MSD samples reported for batch BJB0662 were spiked from the field sample *MW-69-20211002*. However, the manganese spike added to the sample matrix was low relative to the native concentration in the parent sample. The resulting uncertainty may render the MSD result unrepresentative of actual method performance.

The MS/MSD samples reported for batch BJB0396 were spiked from the field sample *MW-55-20211002*. The recovery failures in the associated MS/MSD samples may imply that the sample matrix is adversely affecting method performance.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect hexavalent chromium result of sample *MW55-20211002* may be influenced by matrix effects that result in low method recovery. This non-detect result is rejected and flagged R* for reporting purposes.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is affected; see applied qualifiers above.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

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- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The SVOC surrogate phenol-d5 exhibited low recovery in the laboratory blank sample reported with batch BJB0460.

The PCB surrogate tetrachlorometaxylene exhibited low recovery in the laboratory blank sample reported with batch BJB0451.

- iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The field samples were not affected by surrogate recovery failures.

- iv. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☐ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

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iv. If above RL or project specified objectives, what samples are affected?

Comments:

No samples are affected. Target analytes were not detected in the trip blank.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒

Comments:

A field duplicate sample was not submitted with this work order. However, field duplicates have been collected at the required frequency for the overall project.

iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☐ N/A ☒

Comments:

Field duplicates were not submitted with this work order.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

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- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

The equipment blank sample *EB-2-20211102* was submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Iron-54 was detected at a concentration above the RL. Similarly, barium-135, chromium-52, manganese-55, arsenic-75a, nickel-60, 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene were detected at estimated concentrations.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

1-Methylnaphthalene, 2-methylnaphthalene, naphthalene, chromium-52, and iron-54 were detected in the associated method blank. These results in the equipment blank are likely artifacts of laboratory contamination. The sample results were previously qualified for the method blank detections so additional qualification is not required.

Sample *MW-55-20211102* contains total arsenic-75a at a concentration within 5X that of the concentration detected in the equipment blank and dissolved arsenic-75a at a concentration within 10X that of the concentration detected in the equipment blank.

Samples *MW-55-20211102* and *MW-69-20211102* contained total nickel-60 concentrations within 10X that of the concentration detected in the equipment blank. Samples *MW-55-20211102*, *MW-69-20211102*, and *MW-70-20211102* contained dissolved nickel-60 at concentrations within 5X that of the concentration detected in the equipment blank.

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iii. Data quality or usability affected?

Comments:

The total arsenic-75a concentration in sample *MW-55-20211102* may be an artifact of equipment contamination and is flagged B* at the LOQ or sample concentration (whichever is greater).

The dissolved arsenic-75a concentration in sample *MW-55-20211102* may be affected by external analyte contributions. This result is flagged JH* for reporting purposes.

The total nickel-60 concentrations of samples *MW-55-20211102* and *MW-69-20211102* may be affected by external analyte contributions. These results are flagged JH* for reporting purposes.

The dissolved nickel-60 concentrations in samples *MW-55-20211102*, *MW-69-20211102*, and *MW-70-20211102* may be artifacts of equipment contamination and are flagged B* at the LOQ or sample concentration (whichever is greater).

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory applied the Q-flag to detected 1,1-dichloroethene results of the field samples due to the recovery failures exhibited by the batch ICV and CCV.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 10, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21B0192

Laboratory Report Date:

July 21, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

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Laboratory Report Date:

July 21, 2021

Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

One 500-mL HDPE container for samples MW-49-20211002, MW-59-20211002, MW-50-20211002, MW-52-20211002, and MW-23-20211002 were received under-preserved at the laboratory with pH >2.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that custody seals were not present on the cooler. However, the CoC record implies that the samples were hand delivered to the laboratory.

The sample receipt form notes that the trip blank listed on the CoC was not present in the cooler.

e. Data quality or usability affected?

Comments:

The sample containers exhibiting insufficient preservation were filtered at 0.45 um and had their pH adjusted with 0.75 mL of concentrated HNO₃ upon receipt at the laboratory. The samples were collected and submitted to the laboratory on 2/12/2021. The pHs of the containers were adjusted on 2/15/2021. We do not consider the results be meaningfully affected by this preservation failure. The under-preserved jars contain sample volume for total dissolved metals analyses. Metals are typically stable in the sample matrix and are unlikely to be affected by a short-term under-preservation.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The EPA method SW8082A surrogate tetrachlorometaxylene exhibited low recovery on column zb-35. Data was reported from the passing column.

The method required holding time of 15 minutes for sulfite analysis was exceeded at the time the samples were received at the laboratory.

The recovery of total mercury exceeded the upper control limit in the EPA method 7470 MSD sample associated with batch BJB0704. A post-digestion spike was performed, and the total mercury recovery met method requirements.

The report was revised to include 1,2-dichloroethene, correct the target analyte list for MW-23, and make minor corrections to the case narrative.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

Sample-specific QC was performed on samples used for MS/MSD analyses.

The laboratory performed a post-digestion bench spike following the recovery failure for total mercury in the MSD sample.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory flagged the sulfite results due to the holding time exceedance.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The sulfite analysis of sample MW-23-20211202 occurred outside the method required holding time of 15 minutes.

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c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Soil samples were not submitted with this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several PAHs were not detected in the field samples and reported at limits of detection (LODs) which were greater than their associated regulatory limits.

e. Data quality or usability affected?

The non-detect sulfite result of sample *MW-23-20211202* is assumed to have a low analytical bias. We consider it an estimated non-detection and have applied the J* qualifier.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

2-Methylnaphthalene, and naphthalene were detected at estimated concentrations in the method blank sample associated with batch BJB0509.

Barium isotopes 135 and 137 were detected at estimated concentrations in the method blank sample associated with batch BJB0680.

Dissolved manganese-55 was detected at an estimated concentration in the method blank sample associated with batch BJB0675.

Dissolved iron-54 was detected at an estimated concentration in the method blank sample associated with batch BJB0675.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples *MW-52-20211002* and *MW-59-20211002* contained 2-methylnaphthalene and naphthalene concentrations roughly equivalent to those of the concentrations detected in the associated method blank.

All other samples contained the target analytes at concentrations greater than 10X those found in the respective method blanks.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 2-methylnaphthalene and naphthalene results of samples *MW-52-20211002* and *MW-59-20211002* are likely artifacts of laboratory contamination. These results are flagged B* at the LOQ.

v. Data quality or usability affected?

Comments:

The data quality was affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, dissolved gases, PAHs, DRO, and PCBs analyses.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for isotopic metals (total and dissolved), mercury (total and dissolved), sulfite, and ferrous iron analyses.

An LCS was reported for chloride, nitrate, nitrite, sulfate, and hexavalent chromium analyses. No measure of method precision was provided.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

Zinc-66 was detected at an estimated concentration in the field sample but not detected in the laboratory duplicate sample analyzed from it in batch BJB0680. However, the detected concentration in the field sample was only slightly above the method detection limit (MDL). Assessment of method precision therefore holds no value for this analyte.

Zinc-66 was detected at an estimated concentration in the laboratory duplicate sample reported in batch BJB0675 but not detected in the field sample from which it was analyzed. However, the detected concentration in the laboratory duplicate sample was only slightly above the MDL. Assessment of method precision therefore holds no value for this analyte.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and, where applicable, precision were demonstrated to be within acceptable limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification was not required; see above.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organics analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for isotopic metals (total and dissolved) and mercury (total and dissolved) analyses.

An MS was reported for ferrous iron analysis. See laboratory duplicate sample for assessment of method precision.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Mercury exhibited elevated recovery in the MSD sample associated with batch BJB0736.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The MS/MSD samples reported for batch BJB0736 were spiked from the field sample MW-49-20211002. However, the mercury spike added to the matrix was too low to properly quantify. Additionally, a post-digestion bench spike was analyzed which demonstrated passing recovery.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification was not required; see above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The PCB surrogate tetrachlorometaxylene exhibited low recovery in the laboratory blank sample reported with batch BJB0536.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The field samples were not affected by surrogate recovery failures.

iv. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☐ No ☒ N/A ☐ Comments:

The trip blank listed on the CoC was omitted from the cooler containing the samples.

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ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☐ N/A ☒ Comments:

The trip blank was not present with the samples.

iii. All results less than RL and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

A trip blank was not analyzed with this work order.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; see above.

v. Data quality or usability affected?

Comments:

We cannot assess whether the volatile sample results were affected by external or sample cross-contamination.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order. However, field duplicates have been collected at the required frequency for the overall project.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

Field duplicates were not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank sample was not submitted with this work order. An equipment blank was submitted from the previous days sampling event with work order 21B0174.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank sample was not included with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank sample was not included with this work order.

- iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒ Comments:

No additional flags/qualifiers were required.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 14, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21B0227

Laboratory Report Date:

July 21, 2021

Report Name:

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Project Number

21-1-12596-035

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☐ No ☒ N/A ☐ Comments:

Several samples on the CoC lacked dates. However, it is implied that all samples were collected on 2/16/2021.

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

One 500-mL HDPE container for samples MW-8-20211602, MW-72-20211602, MS/MSD-MW-72-20211602, MW-64-20211602, and MW-68-20211602 were received under-preserved at the laboratory with pH >2.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that custody seals were not present on the cooler. However, the CoC record implies that the samples were hand delivered to the laboratory.

e. Data quality or usability affected?

Comments:

The sample containers exhibiting insufficient preservation were filtered at 0.45 um and had their pH adjusted with 0.75 mL of concentrated HNO₃ upon receipt at the laboratory. The samples were collected and submitted to the laboratory on 2/16/2021. The pHs of the containers were adjusted on 2/19/2021. We do not consider the results be meaningfully affected by this preservation failure. The under-preserved jars contain sample volume for total dissolved metals analyses. Metals are typically stable in the sample matrix and are unlikely to be affected by a short-term under-preservation.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

2,4-Dinitrophenol and hexachlorocyclopentadiene exhibited elevated recoveries in the second source calibration verification (SCV) designated SJB0096-SCV1.

Hexachlorocyclopentadiene, 4-nitrophenol, fluorene, and pentachlorophenol exhibited low recoveries in the initial calibration verification (ICV) designated SJC0182-ICV1.

The EPA method SW8270E surrogate phenol-d5 was recovered below the lower control limit in the samples MW-72-20211602, MW-68-20211602, and the method blank BJB0600-BLK1.

4-Chloroaniline and 3,3'-dichlorobenzidine exhibited low recoveries in the LCS reported in batch BJB0600. The relative precision demonstrated between the 3-nitroaniline and 3,3'-dichlorobenzidine recoveries of the LCS and LCSD did not meet acceptance criteria.

The report was revised to correct the list of VOC analytes reported for locations MW-72 and MW-8.

c. Were all corrective actions documented?

Yes ☐ No ☒ N/A ☐ Comments:

No corrective actions were detailed in the case narrative.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The detected 2,4-dinitrophenol, hexachlorocyclopentadiene, 4-nitrophenol, fluorene, and pentachlorophenol results of the field samples were assigned the Q-flag due to the SCV and ICV recovery failures.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

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c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Soil samples were not submitted with this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOCs and PAHs were not detected in the field samples and reported at limits of detection (LODs) which were greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Chromium isotopes 52 and 53 and iron isotopes 54 and 57 were detected at estimated concentrations in the method blank sample associated with batch BJB0786.

Dissolved chromium-53 and iron-54 were detected at estimated concentrations in the method blank sample associated with batch BJB0738.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples *MW-72-20211602* and *MS/MSD-MW-72-20211602* contained chromium-52 concentrations roughly equivalent to that of the concentration detected in the associated method blank.

The field QC sample *MS/MSD-MW-72-20211602* contains iron-54 at a concentration within 10X that of the concentration detected in the associated method blank.

The samples *MW-72-20211602* and *MW-68-20211602* contained dissolved iron-54 concentrations within 5X that of the concentration detected in the associated method blank.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The chromium-52 results of samples *MW-72-20211602* and *MS/MSD-MW-72-20211602* are likely artifacts of laboratory contamination. These results are flagged B* at the LOQ.

The iron-54 result of the field QC sample *MS/MSD-MW-72-20211602* is considered estimated with a high analytical bias. This result is flagged JH* for reporting purposes.

The dissolved iron-54 results of samples *MW-72-20211602* and *MW-68-20211602* are likely artifacts of laboratory contamination. These results are flagged B* at the LOQ.

v. Data quality or usability affected?

Comments:

The data quality was affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

A laboratory duplicate was reported for vinyl chloride in addition to the LCS/LCSD.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for isotopic metals (total and dissolved) and mercury (total and dissolved) analyses.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

3,3'-dichlorobenzidine, and phenol exhibited low recoveries and 4-chloroaniline exhibited grossly low recovery in the method SW8270E LCS and/or LCSD reported in batch BJB0600.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the 3,3'-dichlorobenzidine, 3-nitroaniline, and 4-chloroaniline recoveries of the LCS and LCSD reported in batch BJB0600 did not meet acceptance criteria.

Cadmium-111 was detected at an estimated concentration in the laboratory duplicate sample reported in batch BJB0786 but not detected in the field sample from which it was analyzed. However, the detected concentration in the laboratory duplicate sample was only slightly above the method detection limit (MDL). Assessment of method precision therefore holds no value for this analyte.

Zinc-66 was detected at an estimated concentration in the field sample but not detected in the laboratory duplicate sample analyzed from it in batch BJB0786. However, the detected concentration in the field sample was only slightly above the MDL. Assessment of method precision therefore holds no value for this analyte.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Batch BJB0600 includes project samples *MW-72-20211602* and *MW-68-20211602* and the field QC sample *MS/MSD-MW-72-20211602*. The non-detect 4-chloroaniline, 3,3'-dichlorobenzidine, and phenol results of these samples are assumed to have a low analytical bias. The non-detect 3-nitroaniline result may lack precision.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect 3,3'-dichlorobenzidine, 3-nitroaniline, and phenol results of samples *MW-72-20211602*, *MW-68-20211602*, and *MS/MSD-MW-72-20211602* are considered estimated and flagged J* for reporting purposes. The non-detect 4-chloroaniline results of these samples are rejected due to the gross recovery failure and flagged R* for reporting purposes.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for DRO analysis.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for isotopic metals (total and dissolved) and mercury (total and dissolved) analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and precision were not adversely affected by the sample matrix.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification was not required; see above.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:The EPA method SW8270E surrogate phenol-d5 was recovered below the lower control limit in the samples *MW-72-20211602*, *MS/MSD-MW-72-20211602*, *MW-68-20211602*, and the method blank *BJB0600-BLK1*.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:The surrogate phenol-d5 is associated with the SVOC analytes 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-chlorophenol, 2-methylphenol, 4-methylphenol, benzyl alcohol, bis(2-chloroethyl)ether, hexachloroethane, N-nitrosodimethylamine, N-nitroso-di-n-propylamine, and phenol. These results are assumed to have a low analytical bias in samples *MW-72-20211602*, *MS/MSD-MW-72-20211602*, and *MW-68-20211602*. Detected concentrations are flagged JL* while non-detect results are flagged J* for reporting purposes.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

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ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank submitted with this sample batch.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order. However, field duplicates have been collected at the required frequency for the overall project.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

Field duplicates were not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank sample was not submitted with this work order. An equipment blank was submitted from the previous days sampling event with work order 21B0174.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank sample was not included with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank sample was not included with this work order.

- iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The detected 2,4-dinitrophenol, hexachlorocyclopentadiene, 4-nitrophenol, fluorene, and pentachlorophenol results of the field samples were assigned the Q-flag by the laboratory due to the SCV and ICV recovery failures.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 16, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

One 500-mL HDPE container for samples MW-63-20211702, MW-103-20211702, MW-60-20211702, MW-71-20211702, and MW-43-20211702 were received under-preserved at the laboratory with pH >2.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that custody seals were not present on the cooler. However, the CoC record implies that the samples were hand delivered to the laboratory.

The case narrative notes that only one vial was received for the trip blank.

e. Data quality or usability affected?

Comments:

The sample containers exhibiting insufficient preservation were filtered at 0.45 um and had their pH adjusted with 0.75 mL of concentrated HNO₃ upon receipt at the laboratory. The samples were collected and submitted to the laboratory on 2/17/2021. The pHs of the containers were adjusted on the same day. We do not consider the results be meaningfully affected by this preservation failure. The under-preserved jars contain sample volume for total dissolved metals analyses. Metals are typically stable in the sample matrix and are unlikely to be affected by a short-term under-preservation.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

Hexachlorocyclopentadiene, 4-nitrophenol, fluorene, and pentachlorophenol exhibited low recoveries in the EPA method SW8270E initial and continuing calibration verifications (ICV and CCV).

The EPA method SW8270D surrogate phenol-d5 was recovered below the lower control limit in samples MW-63-20211702, MW-103-20211702, the batch method blank and LCS.

3,3'-Dichlorobenzidine, 3-nitroaniline, 4-chloroaniline, and phenol exhibited low recoveries in the EPA method SW8270E LCS and LCSD reported in batch BJB0600.

The method required holding time of 15 minutes for sulfite analysis was exceeded at the time the samples were received at the laboratory.

Sulfate exhibited low recovery in the MS sample reported with batch BJB0486.

The report was revised to add trans-1,2-dichloroethene to the target VOC list.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

Sample-specific QC was performed on samples used for MS/MSD analyses.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the detected hexachlorocyclopentadiene, 4-nitrophenol, fluorene, and pentachlorophenol results of the field samples due to the recovery failures exhibited by the associated ICV and CCV.

The laboratory flagged the sulfite results due to the holding time exceedance.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

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b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The sulfite analysis occurred outside the method required holding time of 15 minutes.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Soil samples were not submitted with this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several PAHs/SVOCs were not detected in one or more field samples and reported at limits of detection (LODs) which were greater than their associated regulatory limits.

e. Data quality or usability affected?

The non-detect sulfite result of sample *MW-60-20211702* is assumed to have a low analytical bias. This result is considered an estimated non-detection and is flagged J* for reporting purposes.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Chromium isotope 53, iron isotope 54, manganese isotope 55, and nickel isotope 60 were detected at estimated concentrations in the method blank sample associated with batch BJB0758.

Dissolved chromium isotope 53 and iron isotope 54 were detected at estimated concentrations in the method blank sample associated with batch BJB0738.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

Sample *MW-71-20211702* contains nickel-60 at a concentration within 10X that of the concentration detected in the method blank reported in batch BJB0758.

Sample *MW-63-20211702* contains dissolved iron-54 at a concentration within 10X that of the concentration detected in the method blank reported in batch BJB0738.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The nickel-60 result of sample *MW-71-20211702* may be influenced by laboratory contamination. This result is considered estimated with a high analytical bias and flagged JH* for reporting purposes.

The dissolved iron-54 result of sample *MW-63-20211702* may be influenced by laboratory contamination. This result is considered estimated with a high analytical bias and flagged JH* for reporting purposes.

v. Data quality or usability affected?

Comments:

The data quality was affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for isotopic metals (total and dissolved), mercury (total and dissolved), sulfite, chloride, nitrate, nitrite, sulfate, and ferrous iron analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Phenol and 3,3'-dichlorobenzidine exhibited low recovery and 4-chloroaniline exhibited grossly low recovery in the method SW8270E LCS and/or LCSD associated with batch BJB0600.

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the 3,3'-dichlorobenzidine, 3-nitroaniline, and 4-chloroaniline recoveries of the SW8270E LCS/LCSD reported with batch BJB0600 did not meet acceptance criteria.

The method SW6020B laboratory duplicate sample reported with batch BJB0758 exhibited analytical precision failures for cadmium-111, selenium-78, and zinc-66.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The method SW6020B laboratory duplicate sample reported in batch BJB0758 was performed on the field sample MW-63-20211702. The cadmium-111, selenium-78, and zinc-66 results of the field sample may lack precision.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The cadmium-111, selenium-78, and zinc-66 results of the sample MW-63-20211702 are considered estimated due to the precision failure and flagged J* for reporting purposes.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organics analyses.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for isotopic metals (total and dissolved) and mercury (total and dissolved) analyses.

An MS was reported for chloride, nitrate, nitrite, sulfate, and ferrous iron analyses. See laboratory duplicate sample for assessment of method precision.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The MS reported with batch BJB0486 exhibited low sulfate recovery.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The MS sample reported for batch BJB0486 was spiked from the field sample MW-60-20211702. The sulfate spike was low compared to the native concentration in the parent sample. The sulfate recovery may not be representative of actual method performance.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The results did not require qualification; see above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

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- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The SVOC surrogate phenol-d5 was recovered below the lower control limit in samples *MW-63-20211702*, *MW-103-20211702*, the batch method blank and LCS.

- iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

1,2-Dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-chlorophenol, 2-methylphenol, 4-methylphenol, benzyl alcohol, bis(2-chloroethyl) ether, hexachloroethane, N-nitrosodimethylamine, N-nitroso-di-n-propylamine, and phenol are associated with the surrogate phenol-d5. Results for these analytes are assumed to have a low analytical bias in the samples *MW-63-20211702* and *MW-103-20211702*. These non-detect results are flagged J* for reporting purposes.

- iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

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iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank submitted with this work order.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐

Comments:

The field duplicate samples MW-63-20211702 and MW-103-20211702 were submitted with this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☒ N/A ☐

Comments:

The relative precision demonstrated between the detected results of the field duplicate samples was within the DQO of 30% for all analytes except the following: arsenic-75a, barium-135, cadmium-111, chromium-52, cobalt-59, copper-63, iron-54, lead-208, manganese-55, nickel-60, vanadium-51a, zinc-66, dissolved cadmium-111, and dissolved iron-54.

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iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The arsenic-75a, barium-135, cadmium-111, chromium-52, cobalt-59, copper-63, iron-54, lead-208, manganese-55, nickel-60, vanadium-51a, zinc-66, dissolved cadmium-111, and dissolved iron-54 results of the field duplicate samples *MW-63-20211702*, and *MW-103-20211702* are considered estimated and flagged J* to identify the imprecision.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank sample was not submitted with this work order.

i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank sample was not included with this work order.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank sample was not included with this work order.

iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the detected hexachlorocyclopentadiene, 4-nitrophenol, fluorene, and pentachlorophenol results of the field samples due to the recovery failures exhibited by the associated ICV and CCV.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 16, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

One 500-mL HDPE container for samples MW-9-20211802, MW-58-20211802, MW-57-20211802, MW-30-20211802, and MW-75-20211802 were received under-preserved at the laboratory with pH >2.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that custody seals were not present on the cooler. However, the CoC record implies that the samples were hand delivered to the laboratory.

The case narrative notes that only one vial was received for the trip blank. The provided volume was used to analyze the requested VOC list.

e. Data quality or usability affected?

Comments:

The sample containers exhibiting insufficient preservation were filtered at 0.45 um and had their pH adjusted with 0.75 mL of concentrated HNO₃ upon receipt at the laboratory. The samples were collected and submitted to the laboratory on 2/18/2021. The pHs of the containers were adjusted on 2/19/2021. We do not consider the results be meaningfully affected by this preservation failure. The under-preserved jars contain sample volume for total dissolved metals analyses. Metals are typically stable in the sample matrix and are unlikely to be affected by a short-term under-preservation.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

One or more VOCs exhibited low recovery in the EPA method SW8260D LCSD reported in batch BJB0793. The laboratory flagged the recovery failures in the QC section of the report.

Hexachlorocyclopentadiene, 4-nitrophenol, fluorene, pentachlorophenol, and 4-chlorophenylphenyl ether exhibited low recoveries in the EPA method SW8270E initial and continuing calibration verifications (ICV and CCV). The case narrative notes that the samples were run in two sequences. The sequence run with the LCS had passing recovery for 4-chlorophenylphenyl ether.

The EPA method SW8270D surrogate phenol-d5 was recovered below the lower control limit in sample *MW-54-20211802* and the batch method blank.

3,3'-Dichlorobenzidine, 4-chloroaniline, and phenol exhibited low recoveries in the EPA method SW8270E LCS and LCSD reported in batch BJB0600. Additionally, the relative precision demonstrated between the 3-nitroaniline recoveries of the LCS/LCSD did not meet acceptance criteria.

The EPA method SW8270D-SIM surrogate phenol-d5 was recovered below the lower control limit in sample *MW-75-20211802*.

The EPA method SW6020B laboratory duplicate sample associated with batch BJC047 exhibited an analytical precision failure for nickel.

The EPA method SW6020B MS sample reported in batch BJC0047 exhibited low recovery for vanadium. The associated MSD exhibited low recoveries for vanadium and chromium. The laboratory flagged the recovery failures in the QC section of the report.

The method required holding time of 15 minutes for sulfite analysis was exceeded at the time the samples were received at the laboratory.

The report was revised to correct the target VOC list.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

Sample-specific QC was performed on samples used for MS/MSD analyses.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the detected hexachlorocyclopentadiene, 4-nitrophenol, fluorene, pentachlorophenol, and 4-chlorophenylphenyl ether results of the field samples due to the recovery failures exhibited by the associated ICV and CCV.

The laboratory flagged the sulfite results due to the holding time exceedance.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The sulfite analyses occurred outside the method required holding time of 15 minutes.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Soil samples were not submitted with this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOCs/PAHs were not detected in one or more field samples and reported at limits of detection (LODs) which were greater than their associated regulatory limits.

e. Data quality or usability affected?

The non-detect sulfite results of samples *MW-30-20211802* and *MW-58-20211802* are assumed to have a low analytical bias. These results are considered estimated non-detections and are flagged J* for reporting purposes.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Dissolved chromium isotopes 52 and 53, iron isotope 54, and manganese isotope 55 were detected at estimated concentrations in the method blank sample associated with batch BJC0054.

- iii. If above RL or project specified objectives, what samples are affected?

Comments:

Sample *MW-54-20211802* contains dissolved chromium-52 at a concentration within 10X that of the concentration detected in the associated method blank. Sample *MW-62-20211802* contains dissolved chromium-52 at a concentration within 5X that of the concentration detected in the associated method blank.

Sample *MW-75-20211802* contains dissolved iron-54 at a concentration within 10X that of the concentration detected in the associated method blank. Sample *MW-58-20211802* contains dissolved iron-54 at a concentration within 5X that of the concentration detected in the associated method blank.

- iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The dissolved chromium-52 result of sample *MW-54-20211802* may be influenced by laboratory contamination. This result is considered estimated with a high analytical bias and flagged JH* for reporting purposes.

The dissolved chromium-52 result of sample *MW-62-20211802* is likely an artifact of laboratory contamination. This result is flagged B* at the LOQ.

The dissolved iron-54 result of sample *MW-75-20211802* may be influenced by laboratory contamination. This result is considered estimated with a high analytical bias and flagged JH* for reporting purposes.

The dissolved iron-54 result of sample *MW-58-20211802* is likely an artifact of laboratory contamination. This result is flagged B* for reporting purposes.

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v. Data quality or usability affected?

Comments:

The data quality was affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for isotopic metals (total and dissolved), mercury (total and dissolved), sulfite, chloride, nitrate, nitrite, sulfate, and ferrous iron analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Benzene, cis-1,2-dichloroethene, ethylbenzene, p&m-xylene, o-xylene, toluene, and trichloroethene exhibited low recovery in the LCSD associated with batch BJB0793.

Phenol and 3,3'-dichlorobenzidine exhibited low recovery and 4-chloroaniline exhibited grossly low recovery in the method SW8270E LCS and/or LCSD associated with batch BJB0600.

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the 3,3'-dichlorobenzidine and 3-nitroaniline recoveries of the SW8270E LCS/LCSD reported with batch BJB0600 did not meet acceptance criteria.

The method SW6020B laboratory duplicate sample reported with batch BJC0047 exhibited an analytical precision failure for nickel-60.

The method SW6020B laboratory duplicate sample reported with batch BJC0054 exhibited an analytical precision failure for dissolved zinc-66.

Dissolved chromium-52 was detected at an estimated concentration in the laboratory duplicate sample reported in batch BJC0054 but not detected in the field sample from which it was analyzed. However, the detected concentration in the laboratory duplicate sample was below the LOQ. Assessment of method precision therefore holds no value for this analyte.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Samples *MW-9-20211802*, *MW-54-20211802*, *MW-57-20211802*, *MW-58-20211802*, *MW-62-20211802*, *MW-75-20211802*, and the trip blank are included in batch BJB0793. The benzene, cis-1,2-dichloroethene, ethylbenzene, p&m-xylene, o-xylene, toluene, and trichloroethene results may be affected by low method recovery.

Samples *MW-54-20211802* and *MW-75-20211802* are included in batch BJB0600. The phenol and 3,3'-dichlorobenzidine results may be affected by low method recovery while the 4-chloroaniline results may be affected by a gross recovery failure. The 3-nitroaniline result may lack precision. However, these analytes were only reported in sample *MW-75-20211802*.

The method SW6020B laboratory duplicate sample reported in batch BJC0047 was performed on the field sample *MW-9-20211802*. The nickel-60 result of the field sample may lack precision. However, this analyte was not reported for this sample.

The method SW6020B laboratory duplicate sample reported in batch BJC0054 was performed on the field sample *MW-75-20211802*. The zinc-66 result of the field sample may lack precision.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The benzene, cis-1,2-dichloroethene, ethylbenzene, p&m-xylene, o-xylene, toluene, and trichloroethene results of samples *MW-9-20211802*, *MW-54-20211802*, *MW-57-20211802*, *MW-58-20211802*, *MW-62-20211802*, *MW-75-20211802*, and the trip blank are assumed to have a low analytical bias. Detected concentrations are flagged JL* while non-detect results are flagged J* for reporting purposes.

The non-detect phenol, 3,3'-dichlorobenzidine, and 3-nitroaniline results of sample *MW-75-20211802* may be affected by low method recovery or lacking precision. These results are considered estimated and flagged J* for reporting purposes. The 4-chloroaniline result of this sample is rejected due to the gross recovery failure and flagged R* for reporting purposes.

The zinc-66 result of the sample *MW-75-20211802* is considered estimated due to the precision failure and flagged J* for reporting purposes.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organics analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for isotopic metals (total and dissolved) and mercury (total and dissolved) analyses.

An MS was reported for chloride, nitrate, nitrite, sulfate, and ferrous iron analyses. See laboratory duplicate sample for assessment of method precision.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The method SW6020B MS sample reported with batch BJC0047 exhibited low recovery for vanadium-51a and high recovery for manganese-55. The associated MSD exhibited low recovery for chromium-52 and vanadium-51a.

The method SW6020B MS and MSD samples reported with batch BJC0054 exhibited low recovery for dissolved manganese-55.

The MS reported with batch BJB0549 exhibited low sulfate recovery.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The MS/MSD samples reported for batch BJB0600 were spiked from the field sample *MW-9-20211802*. The manganese-55 spike was grossly low compared to the native concentration in the parent sample. However, the chromium-52 and vanadium-51a spikes were appropriate. The low recovery of these analytes may imply that the matrix is adversely affecting method performance.

The MS/MSD samples reported for batch BJB0054 were spiked from the field sample *MW-75-20211802*. The manganese-55 spike was grossly low compared to the native concentration in the parent sample. The manganese-55 recoveries may not be representative of actual method performance.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The chromium-52 and vanadium-51a were not reported for sample *MW-9-20211802*.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The SVOC surrogate phenol-d5 was recovered below the lower control limit in samples MW-75-20211802 and MW-54-20211802 and the method blank reported in batch BJB0600.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

1,2-Dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-chlorophenol, 2-methylphenol, 4-methylphenol, benzyl alcohol, bis(2-chloroethyl)ether, hexachloroethane, N-nitrosodimethylamine, N-nitroso-di-n-propylamine, and phenol are associated with the surrogate phenol-d5. Results for these analytes are assumed to have a low analytical bias in the samples MW-75-20211802 and MW-54-20211802. These non-detect results are flagged J* for reporting purposes.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

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ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank submitted with this work order.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order. However, field duplicates have been collected at the required frequency for the overall project.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration

R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

Field duplicates were not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank sample was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank sample was not included with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank sample was not included with this work order.

- iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the detected hexachlorocyclopentadiene, 4-nitrophenol, fluorene, pentachlorophenol, and 4-chlorophenylphenyl ether results of the field samples due to the recovery failures exhibited by the associated ICV and CCV.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 17, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21B0272

Laboratory Report Date:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

One 500-mL HDPE container for samples MW-3-20211902, MW-4-20211902, MW-11-20211902, MW-14-20211902, MW-10R-20211902, and MW-15-20211902 were received under-preserved at the laboratory with pH >2.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that custody seals were not present on the cooler. However, the CoC record implies that the samples were hand delivered to the laboratory.

The case narrative notes that only one vial was received for the trip blank. The provided volume was used to analyze the requested VOC list.

e. Data quality or usability affected?

Comments:

The sample containers exhibiting insufficient preservation were filtered at 0.45 um and had their pH adjusted with 0.75 mL of concentrated HNO₃ upon receipt at the laboratory. The samples were collected and submitted to the laboratory on 2/19/2021. The pHs of the containers were adjusted on 2/22/2021. We do not consider the results be meaningfully affected by this preservation failure. The under-preserved jars contain sample volume for total dissolved metals analyses. Metals are typically stable in the sample matrix and are unlikely to be affected by a short-term under-preservation.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

One or more VOCs exhibited low recovery in the EPA method SW8260D LCSD reported in batch BJB0793. The laboratory attributes these failures to poor injection and notes that an LCSD is not required by the method.

The EPA method SW8270D surrogate phenol-d5 was recovered below the lower control limit in the batch method blank.

The EPA method SW6020B MS/MSD sample associated with batch BJC0112 exhibited an analytical precision failure for total mercury.

The method required holding time of 15 minutes for sulfite analysis was exceeded at the time the samples were received at the laboratory.

c. Were all corrective actions documented?

Yes ☐ No ☒ N/A ☐ Comments:

No corrective actions were detailed in the case narrative.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory flagged the sulfite results due to the holding time exceedance.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The sulfite analyses occurred outside the method required holding time of 15 minutes.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Soil samples were not submitted with this work order.

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d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOCs/PAHs were not detected in one or more field samples and reported at limits of detection (LODs) which were greater than their associated regulatory limits.

e. Data quality or usability affected?

The non-detect sulfite results of samples *MW-14-20211902* and *MW-15-20211902* are assumed to have a low analytical bias. These results are considered estimated non-detections and are flagged J* for reporting purposes.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Total chromium isotope 53, vanadium isotope 51b, and zinc isotopes 66 and 67 were detected at estimated concentrations in the method blank sample associated with batch BJC0081.

Dissolved iron-54 was detected at an estimated concentration in the method blank sample associated with batch BJC0088.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples *MW-4-20211902*, *MW-14-20211902*, and *MW-10R-20211902* contain zinc-66 at concentrations within 5X that of the concentration detected in the associated method blank.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The total zinc-66 results of samples *MW-4-20211902*, *MW-14-20211902*, and *MW-10R-20211902* are likely artifacts of laboratory contamination. These results are flagged B* at the LOQ.

v. Data quality or usability affected?

Comments:

The data quality was affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for isotopic metals (total and dissolved), mercury (total and dissolved), sulfite, chloride, nitrate, nitrite, sulfate, and ferrous iron analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Benzene, cis-1,2-dichloroethene, ethylbenzene, p&m-xylene, o-xylene, toluene, and trichloroethene exhibited low recovery in the LCSD associated with batch BJB0793.

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

Total chromium-52 was detected at an estimated concentration in the laboratory duplicate sample reported in batch BJC0081 but not detected in the field sample from which it was analyzed. However, the detected concentration in the laboratory duplicate sample was below the LOQ. Assessment of method precision therefore holds no value for this analyte.

The method SW6020B laboratory duplicate sample reported with batch BJC0081 exhibited an analytical precision failure for iron-54.

Total mercury was detected at an estimated concentration in the laboratory duplicate sample reported in batch BJC0112 but not detected in the field sample from which it was analyzed. However, the detected concentration in the laboratory duplicate sample was below the LOQ. Assessment of method precision therefore holds no value for this analyte.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The method SW6020B laboratory duplicate sample reported in batch BJC0081 was performed on the field sample *MW-15-20211902*. However, iron-54 was not reported for this sample.

Samples *MW-3-20211902*, *MW-4-20211902*, *MW-11-20211902*, *MW-14-20211902*, and the trip blank are included in batch BJB0793. The benzene, cis-1,2-dichloroethene, ethylbenzene, p&m-xylene, o-xylene, toluene, and trichloroethene results may be affected by low method recovery.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The benzene, cis-1,2-dichloroethene, ethylbenzene, p&m-xylene, o-xylene, toluene, and trichloroethene results of samples *MW-3-20211902*, *MW-4-20211902*, and *MW-14-20211902* are assumed to have a low analytical bias. Detected concentrations are flagged JL* while non-detect results are flagged J* for reporting purposes.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

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c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organics analyses.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for isotopic metals (total and dissolved) and mercury (total and dissolved) analyses.

An MS was reported for chloride, nitrate, nitrite, sulfate, and ferrous iron analyses. See laboratory duplicate sample for assessment of method precision.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The EPA method SW6020B MS/MSD sample associated with batch BJC0112 exhibited an analytical precision failure for total mercury.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The MS/MSD samples reported for batch BJC0112 were spiked from the field sample *MW-10R-20211902*. The mercury result of the parent sample may lack precision.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:The non-detect total mercury result of sample *MW-10R-20211902* is considered estimated due to the MS/MSD precision failure and flagged J* for reporting purposes.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:The SVOC surrogate phenol-d5 was recovered below the lower control limit in sample *MW-14-20211902* and the method blank reported in batch BJB0763.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:1,2-Dichlorobenzene, 1,4-dichlorobenzene, and N-nitrosodimethylamine are associated with the surrogate phenol-d5. Results for these analytes are assumed to have a low analytical bias in the sample *MW-14-20211902*. These non-detect results are flagged J* for reporting purposes.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

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ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank submitted with this work order.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order. However, field duplicates have been collected at the required frequency for the overall project.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

Field duplicates were not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank sample was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank sample was not included with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank sample was not included with this work order.

- iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒ Comments:

No additional data flags/qualifiers were required.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 17, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

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Laboratory Report Date:

July 31, 2021

Report Name:

Lower Duwamish

Project Number

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Laboratory Report Date:

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Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

One 500-mL HDPE container for samples MW-53-20212202, MW-73-20212202, MW-74-20212202, MW-61-20212202, MW-36-20212202, and MW-32-20212202 were received under-preserved at the laboratory with pH >2.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Samples were received in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that custody seals were not present on the cooler. However, the CoC record implies that the samples were hand delivered to the laboratory.

e. Data quality or usability affected?

Comments:

The sample containers exhibiting insufficient preservation were filtered at 0.45 um and had their pH adjusted with 0.75 mL of concentrated HNO₃ upon receipt at the laboratory. The samples were collected and submitted to the laboratory on 2/22/2021. The pHs of the containers were adjusted on 2/23/2021. We do not consider the results be meaningfully affected by this preservation failure. The under-preserved jars contain sample volume for total dissolved metals analyses. Metals are typically stable in the sample matrix and are unlikely to be affected by a short-term under-preservation.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

Pentachlorophenol exhibited low recovery in the EPA method SW8270E initial calibration verification (ICV).

The EPA method SW8270E surrogate phenol-d5 was recovered below the lower control limit in samples *MW-101-20212202*, *MW-32-20212202*, and the batch method blank.

The method required holding time of 15 minutes for sulfite analysis was exceeded at the time the samples were received at the laboratory.

The EPA method 7471 MS/MSD samples reported with batch BJC0112 exhibited an analytical precision failure for total mercury.

The report was revised to correct the VOC list.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

Sample-specific QC was performed on field samples used for MS/MSD and laboratory duplicate analyses.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the pentachlorophenol results of the field samples due to the ICV recovery failure.

The laboratory flagged the sulfite results due to the holding time exceedance.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The sulfite analyses occurred outside the method required holding time of 15 minutes.

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c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Soil samples were not submitted with this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOCs/PAHs were not detected in one or more field samples and reported at limits of detection (LODs) which were greater than their associated regulatory limits.

e. Data quality or usability affected?

The non-detect sulfite results of sample *MW-36-20212202* is assumed to have a low analytical bias. This result is considered an estimated non-detection and is flagged J* for reporting purposes.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Total arsenic isotope 75a, calcium isotope 44, magnesium isotope 24, manganese 55, and vanadium isotope 51b were detected at estimated concentrations in the method blank sample associated with batch BJC0110.

Dissolved chromium isotopes 52 and 53, iron isotopes 54 and 57, and manganese isotope 55 were detected at estimated concentrations in the method blank sample associated with batch BJC0116.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

Sample *MW-74-20212202* contains dissolved chromium-52 at a concentration within 10X that of the concentration detected in the associated method blank.

Samples *MW-36-20212202*, *MW-53-20212202*, *MW-71-20212202*, *MW-73-20212202*, and *MW-101-20212202* contain dissolved chromium-52 at concentrations within 5X that of the concentration detected in the associated method blank.

Samples *MW-61-20212202* and *MW-101-20212202* contain dissolved iron-54 at concentrations within 10X that of the concentration detected in the associated method blank.

Sample *MW-53-20212202* contains dissolved iron-54 at a concentration within 5X that of the concentration detected in the associated method blank.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

The dissolved chromium-52 result of sample *MW-74-20212202* may be influenced by laboratory analyte contributions. This result is considered estimated with a high analytical bias and is flagged JH* for reporting purposes.

The dissolved chromium-52 results of samples *MW-36-20212202*, *MW-53-20212202*, *MW-61-20212202*, *MW-71-20212202*, *MW-73-20212202*, and *MW-101-20212202* are likely artifacts of laboratory contamination. These results are flagged B* at the LOQ or sample result (whichever is greater).

The dissolved iron-54 results of samples *MW-61-20212202* and *MW-101-20212202* may be influenced by laboratory analyte contributions. These results are considered estimated with a high analytical bias and are flagged JH* for reporting purposes.

The dissolved iron-54 result of sample *MW-53-20212202* is likely an artifact of laboratory contamination. This result is flagged B* at the LOQ.

v. Data quality or usability affected?

Comments:

The data quality was affected; see above for applied qualifiers.

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b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for isotopic metals (total and dissolved), mercury (total and dissolved), sulfite, chloride, nitrate, nitrite, sulfate, and ferrous iron analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

Total cadmium-111 was not detected in the laboratory duplicate sample reported in batch BJC0110 but detected at an estimated concentration in the field sample from which it was analyzed. However, the detected concentration was below the LOQ. Assessment of method precision therefore holds no value for this analyte.

Total mercury was detected at an estimated concentration in the laboratory duplicate sample reported in batch BJC0112 but not detected in the field sample from which it was analyzed. However, the detected concentration in the laboratory duplicate sample was below the LOQ. Assessment of method precision therefore holds no value for this analyte.

Dissolved cadmium-111 was detected at an estimated concentration in the laboratory duplicate sample reported in batch BJC0116 but not detected in the field sample from which it was analyzed. However, the detected concentration in the laboratory duplicate sample was below the LOQ. Assessment of method precision therefore holds no value for this analyte.

Dissolved zinc-66 was not detected in the laboratory duplicate sample reported in batch BJC0116 but detected at an estimated concentration in the field sample from which it was analyzed. However, the detected concentration was below the LOQ. Assessment of method precision therefore holds no value for this analyte.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and, where calculable, precision were demonstrated to be within acceptable limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification was not required; see above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

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c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)**i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?**Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organics analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for isotopic metals (total and dissolved) and mercury (total and dissolved) analyses.

An MS was reported for chloride, nitrate, nitrite, sulfate, and ferrous iron analyses. See laboratory duplicate sample for assessment of method precision.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?Yes ☒ No ☐ N/A ☐ Comments:**iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.**Yes ☐ No ☒ N/A ☐ Comments:

The EPA method SW6020B MS/MSD sample associated with batch BJC0112 exhibited an analytical precision failure for total mercury.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The method SW6020B MS/MSD samples reported in batch BJC0112 were spiked from the field sample MW-61-20212202. Matrix affects may be adversely impacting method precision for total mercury of the parent sample.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?Yes ☒ No ☐ N/A ☐ Comments:

The total mercury result of sample MW-61-20212202 is considered estimated due to the MS/MSD precision failure and flagged J* for reporting purposes.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The SVOC surrogate phenol-d5 was recovered below the lower control limit in sample MW-53-20212202, MW-101-20212202, MW-32-20212202, and the method blank reported in batch BJB0763.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

1,2-Dichlorobenzene, 1,4-dichlorobenzene, and N-nitrosodimethylamine are associated with the surrogate phenol-d5. Results for these analytes are assumed to have a low analytical bias in the samples MW-53-20212202, MW-101-20212202, and MW-32-20212202. These non-detect results are flagged J* for reporting purposes.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

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ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank submitted with this work order.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

The field duplicate samples *MW-53-20212202* and *MW-101-20212202* were submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☐ Comments:

The relative precision demonstrated between the detected results of the field duplicate samples met the DQO of 30% for all analytes except: dissolved chromium-52 and total zinc-66.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The dissolved chromium-52 and total zinc-66 results of the field duplicate samples are considered estimated and flagged J* to identify the imprecision (unless already qualified).

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank sample was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank sample was not included with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank sample was not included with this work order.

- iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the pentachlorophenol results of the field samples due to the ICV recovery failure

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 19, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21B0309

Laboratory Report Date:

August 2, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21B0309

Laboratory Report Date:

August 2, 2021

Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

One 500-mL HDPE container for samples MW-44-20212302, MW-42-20212302, MW-67-20212302, MW-38-20212302, MW-37-20212302, MW-7-20212302, and MW-102-20212302 were received under-preserved at the laboratory with pH >2.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes the presence of bubbles in vials H and I of sample MW-44-20212302. The size of the bubbles was not detailed and the laboratory did not identify the headspace as an issue.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that custody seals were not present on the cooler. However, the CoC record implies that the samples were hand delivered to the laboratory.

e. Data quality or usability affected?

Comments:

The sample containers exhibiting insufficient preservation were filtered at 0.45 um and had their pH adjusted with 0.75 mL of concentrated HNO₃ upon receipt at the laboratory. The samples were collected and submitted to the laboratory on 2/23/2021. The pHs of the containers were adjusted on 2/24/2021. We do not consider the results be meaningfully affected by this preservation failure. The under-preserved jars contain sample volume for total dissolved metals analyses. Metals are typically stable in the sample matrix and are unlikely to be affected by a short-term under-preservation.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The PCB Aroclor 1242 exhibited a recovery failure in the continuing calibration verification (CCV) on column zb-5. The data is reported from passing column zb-35 and the samples did not contain detectable concentrations of this Aroclor.

4-Nitrophenol, fluorine, hexachlorocyclopentadiene, and pentachlorophenol exhibited low recovery in the EPA method SW8270E initial calibration verification (ICV).

The EPA method SW8270E surrogate phenol-d5 was recovered below the lower control limit in sample MW-67-20212302 and the method blank reported in batch BJB0763.

The EPA method SW8270E LCS/LCSD reported in batch BJB0763 exhibited low recovery and a precision failure for 4-chloroaniline.

The EPA method SW6020B method blank sample reported in batch BJC0224 exhibited detections for nickel.

The EPA method SW6020B laboratory duplicate sample reported with batch BJC0235 exhibited an analytical precision failure for dissolved zinc.

The report was revised to correct add trans-1,2-dichloroethene VOC list.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The samples run in batch BJC0224 were re-digested following the LCS recovery failure for nickel. The laboratory reports passing QC in the re-digested batch.

Sample-specific QC was performed on field samples used for MS/MSD and laboratory duplicate analyses.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the 4-nitrophenol, fluorine, hexachlorocyclopentadiene, and pentachlorophenol results of the field samples due to the ICV recovery failure.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Soil samples were not submitted with this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOCs/PAHs were not detected in one or more field samples and reported at limits of detection (LODs) which were greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Total nickel isotopes 60 and 62 were detected in the method blank sample associated with batch BJC0224. Additionally, chromium isotopes 52 and 53 were detected at estimated concentrations in this method blank. However, the samples included in batch BJC0224 were re-digested and re-extracted for analysis of nickel. Nickel was not detected in the method blank for the re-extracted batch and these results are reported.

Dissolved mercury was detected at an estimated concentration in the method blank sample associated with batch BJC0221.

Dissolved chromium isotope 53 and iron isotopes 54 and 57 were detected at estimated concentrations in the method blank sample associated with batch BJC0235.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

Sample MW-7-20212302 contains total chromium-52 at a concentration within 5X that of the concentration detected in the associated method blank.

Sample MW-67-20212302 contains dissolved iron-54 at a concentration roughly equivalent to that of the concentration detected in the associated method blank.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The total chromium-52 result of sample MW-7-20212302 is likely an artifact of laboratory contamination. This result is flagged B* for reporting purposes.

The dissolved iron-54 result of sample MW-67-20212302 is likely an artifact of laboratory contamination. This result is flagged B* for reporting purposes.

v. Data quality or usability affected?

Comments:

The data quality was affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for isotopic metals (total and dissolved), mercury (total and dissolved) and hexavalent chromium analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The EPA method SW8270E LCS/LCSD reported in batch BJB0763 exhibited low recovery for 4-chloroaniline.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

The EPA method SW8270E LCS/LCSD reported in batch BJB0763 exhibited a precision failure for 4-chloroaniline.

The method SW6020B laboratory duplicate samples reported with batch BJC0224 exhibited analytical precision failures for cobalt-59 and iron-54.

Total lead-208 was not detected in the laboratory duplicate sample reported in batch BJC0224 but detected at an estimated concentration in the field sample from which it was analyzed. However, the detected concentration was below the LOQ. Assessment of method precision therefore holds no value for this analyte.

The method SW6020B laboratory duplicate samples reported with batch BJC0235 exhibited an analytical precision failure for dissolved zinc-66.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Only sample *MW-67-20212302* is included in batch BJB0763. The 4-chloroaniline result of this sample is affected by a gross recovery failure and a method precision failure.

The method SW6020B laboratory duplicate sample reported with batch BJC0224 was performed on sample *MW-7-20212302*. The cobalt-59 and iron-54 results of this sample may lack precision. However, these analytes were not reported for this sample.

The method SW6020B laboratory duplicate sample reported with batch BJC0235 was performed on sample *MW-7-20212302*. The dissolved zinc-66 result of this sample may lack precision. However, this analyte was not reported for this sample.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

The 4-chloroaniline result of sample *MW-67-20212302* is rejected and flagged R* for reporting purposes.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒

Comments:

MS/MSD samples were not reported for organics analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐

Comments:

MS/MSD samples were reported for isotopic metals (total and dissolved) and mercury (total and dissolved) analyses.

An MS was reported for hexavalent chromium analysis. See laboratory duplicate sample for assessment of method precision.

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- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and, where applicable, precision do not appear to have been compromised by matrix effects.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification was not required; see above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The SVOC surrogate phenol-d5 was recovered below the lower control limit in sample MW-67-20212302 and the method blank reported in batch BJB0763.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The surrogate phenol-d5 is associated with the SVOC analytes 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-chlorophenol, 2-methylphenol, 4-methylphenol, benzyl alcohol, bis(2-chloroethyl)ether, hexachloroethane, N-nitrosodimethylamine, N-nitroso-di-n-propylamine, and phenol. Results for these analytes are assumed to have a low analytical bias in the sample MW-67-20212302. These non-detect results are flagged J* for reporting purposes.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank submitted with this work order.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

The field duplicate samples *MW-37-20212302* and *MW-102-20212302* were submitted with this work order.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☐ Comments:

The relative precision demonstrated between the detected results of the field duplicate samples met the DQO of 30% for all analytes except: manganese-55 (total and dissolved) and dissolved zinc-66.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The manganese-55 (total and dissolved) and dissolved zinc-66 results of the field duplicate samples are considered estimated and flagged J* to identify the imprecision.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank sample was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank sample was not included with this work order.

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank sample was not included with this work order.

iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory applied the Q-flag to the 4-nitrophenol, fluorine, hexachlorocyclopentadiene, and pentachlorophenol results of the field samples due to the ICV recovery failure.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 20, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21B0322

Laboratory Report Date:

August 2, 2021

Report Name:

Lower Duwamish

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

One 500-mL HDPE container for samples MW-39-20212402, MW-47-20212402, MW-46-20212402, and MW-45-20212402 were received under-preserved at the laboratory with pH >2.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that custody seals were not present on the cooler. However, the CoC record implies that the samples were hand delivered to the laboratory.

e. Data quality or usability affected?

Comments:

The sample containers exhibiting insufficient preservation were filtered at 0.45 um and had their pH adjusted with 0.75 mL of concentrated HNO₃ upon receipt at the laboratory. The samples were collected and submitted to the laboratory on 2/24/2021. The pHs of the containers were adjusted on 2/25/2021. We do not consider the results be meaningfully affected by this preservation failure. The under-preserved jars contain sample volume for total dissolved metals analyses. Metals are typically stable in the sample matrix and are unlikely to be affected by a short-term under-preservation.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The PCB Aroclor 1242 exhibited a recovery failure in the continuing calibration verification (CCV) on column zb-5. The data is reported from passing column zb-35 and the samples did not contain detectable concentrations of this Aroclor.

Following the method NWTPH-g analysis of sample *MW-46-20212402*, the analyst noted that the gas detection was almost entirely naphthalene.

2,4-Dinitrophenol, 4-nitrophenol, fluorine, hexachlorocyclopentadiene, and pentachlorophenol exhibited high recovery in the EPA method SW8270E initial calibration verification (ICV).

The EPA method SW8270E surrogate phenol-d5 was recovered below the lower control limit in samples *MW-47-20212402*, *MW-46-20212402*, and *MW-31-20212402*.

The EPA method SW8270E LCS/LCSD reported in batch BJB0058 exhibited low recovery and precision failures for 4-chloroaniline and 4-nitrophenol.

2-Chloronaphthalene and dibenzofuran exhibited low recovery in the EPA method SW8270E-SIM ICV.

The EPA method SW8270E-SIM method blank sample reported in batch BJC0057 exhibited a detection for naphthalene.

The MS sample analyzed for hexavalent chromium in batch BJB0712 exhibited elevated recovery. The subsequently analyzed post-preparation spike exhibited low recovery. The laboratory attributes these recovery failures to matrix interference.

The report was revised to correct add trans-1,2-dichloroethene VOC list and to correct the SVOC and PAH lists.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

A post-preparation spike was analyzed following the recovery failure for hexavalent chromium in the associated MS sample.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the 2,4-dinitrophenol, 4-nitrophenol, fluorine, hexachlorocyclopentadiene, and pentachlorophenol results of the field samples due to the ICV recovery failures.

The laboratory applied the Q-flag to the 2-chloronaphthalene and dibenzofuran results of the field samples due to the ICV recovery failures.

The laboratory applied the B-flag to the naphthalene results of all samples included in batch BJC0057.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Soil samples were not submitted with this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOCs/PAHs were not detected in one or more field samples and reported at limits of detection (LODs) which were greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Naphthalene was detected in the EPA method SW8270E-SIM method blank reported with batch BJC0057.

Dissolved chromium isotopes 52 and 53 were detected at estimated concentrations in the method blank sample associated with batch BJC0138.

- iii. If above RL or project specified objectives, what samples are affected?

Comments:

Sample *MW-31-20212402* contains naphthalene at a concentration within 5X that of the concentration detected in the associated method blank.

Sample *MW-46-20212402* contains dissolved chromium-52 at a concentration roughly equivalent to that of the concentration detected in the associated method blank.

- iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The naphthalene result of sample *MW-31-20212402* is likely an artifact of laboratory contamination. This result is flagged B* for reporting purposes.

The dissolved chromium-52 result of sample *MW-46-20212402* is likely an artifact of laboratory contamination. This result is flagged B* for reporting purposes.

- v. Data quality or usability affected?

Comments:

The data quality was affected; see above for applied qualifiers.

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b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for isotopic metals (total and dissolved), dissolved mercury, and hexavalent chromium analyses.

An LCS was reported for total mercury analysis. No measure of method precision was provided.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The EPA method SW8270E LCS/LCSD reported in batch BJC0058 exhibited low recovery for 4-chloroaniline and 4-nitrophenol.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

The EPA method SW8270E LCS/LCSD reported in batch BJB0763 exhibited a precision failure for 4-nitrophenol.

Total zinc-66 was not detected in the laboratory duplicate sample reported in batch BJC0127 but detected at an estimated concentration in the field sample from which it was analyzed. However, the detected concentration was below the LOQ. Assessment of method precision therefore holds no value for this analyte.

The method SW6020B laboratory duplicate samples reported with batch BJC0138 exhibited an analytical precision failure for dissolved chromium-52.

Dissolved zinc-66 was not detected in the laboratory duplicate sample reported in batch BJC0138 but detected at an estimated concentration in the field sample from which it was analyzed. However, the detected concentration was below the LOQ. Assessment of method precision therefore holds no value for this analyte.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Only sample *MW-47-20212402* is included in batch BJC0058. The non-detect 4-chloroaniline and 4-nitrophenol results of this sample are affected by gross recovery failures and a method precision failure for 4-nitrophenol.

The method SW6020B laboratory duplicate sample reported with batch BJC0138 was performed on sample *MW-45-20212402*. The dissolved chromium-52 results of this sample may lack precision. However, dissolved chromium-52 was not reported for this sample.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 4-chloroaniline and 4-nitrophenol results of sample *MW-47-20212402* are rejected and flagged R* for reporting purposes.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organics analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for isotopic metals (total and dissolved) and dissolved mercury analyses.

An MS and post spike were reported for hexavalent chromium analysis. See laboratory duplicate sample for assessment of method precision.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Total manganese-55 exhibited low recovery in the method SW6020B MSD sample reported with batch BJC0127.

Dissolved manganese-55 exhibited high recovery in the method SW6020B MS and MSD samples reported with batch BJC0138.

Hexavalent chromium exhibited high recovery in the MS sample reported with batch BJB0712 but low recovery in the subsequent post spike.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The method SW6020B MS/MSD samples were spiked from the field sample *MW-45-20212402*. The manganese-55 spike added to the matrix was grossly low compared to the native concentration in the parent sample. The MS/MSD recovery may not be representative of actual method performance.

The method SW6020B MS/MSD samples were spiked from the re-analysis of sample *MW-45-20212402*. The dissolved manganese-55 spike added to the matrix was grossly low compared to the native concentration in the parent sample. The MS/MSD recovery may not be representative of actual method performance.

The MS and post spike reported with batch BJB0712 were spiked from the field sample *MW-39-20212402*. The conflicting directions of bias imply that the matrix may be adversely affecting method performance.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect hexavalent chromium result of sample *MW-39-20212402* is considered estimated and flagged J* for reporting purposes.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The EPA method SW8270E surrogate phenol-d5 was recovered below the lower control limit in samples *MW-47-20212402*, *MW-46-20212402*, *MW-31-20212402*, and the method blank sample reported in batch BJC0058.

The EPA method SW8270D-SIM surrogates were diluted and unrecoverable for the re-analysis of sample *MW-46-20212402*.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

The surrogate phenol-d5 is associated with the SVOC analytes 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-chlorophenol, 2-methylphenol, 4-methylphenol, benzyl alcohol, bis(2-chloroethyl) ether, hexachloroethane, N-nitrosodimethylamine, N-nitroso-di-n-propylamine, and phenol. Results for these analytes are assumed to have a low analytical bias in the samples *MW-47-20212402*, *MW-46-20212402*, and *MW-31-20212402*. These non-detect results are flagged J* for reporting purposes.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

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e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank submitted with this work order.

- v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate was not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank sample was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank sample was not included with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank sample was not included with this work order.

- iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the 2,4-dinitrophenol, 4-nitrophenol, fluorine, hexachlorocyclopentadiene, and pentachlorophenol results of the field samples due to the ICV recovery failures.

The laboratory applied the Q-flag to the 2-chloronaphthalene and dibenzofuran results of the field samples due to the ICV recovery failures.

The laboratory applied the B-flag to the naphthalene results of all samples included in batch BJC0057.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 20, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21B0344

Laboratory Report Date:

August 2, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The porosity analyses of the included soil samples were subcontracted to Materials Testing & Consulting, Inc. in Tukwila, WA.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

One 500-mL HDPE container for samples MW-6-20212502, MW-65-20212502, MW-46-20212402, MW-40-20212502, and MW-41-20212502 were received under-preserved at the laboratory with pH >2.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no discrepancies documented by the laboratory.

e. Data quality or usability affected?

Comments:

The sample containers exhibiting insufficient preservation were filtered at 0.45 um and had their pH adjusted with 0.75 mL of concentrated HNO₃ upon receipt at the laboratory. The samples were collected and submitted to the laboratory on 2/25/2021. The pHs of the containers were adjusted on 2/26/2021. We do not consider the results be meaningfully affected by this preservation failure. The under-preserved jars contain sample volume for total dissolved metals analyses. Metals are typically stable in the sample matrix and are unlikely to be affected by a short-term under-preservation.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The PCB Aroclor 1242 exhibited a recovery failure in the continuing calibration verification (CCV) on column zb-5. The data is reported from passing column zb-35 and the samples did not contain detectable concentrations of this Aroclor.

Pentachlorophenol exhibited high recovery in the EPA method SW8270E initial calibration verification (ICV).

The EPA method SW8270E surrogate phenol-d5 was recovered below the lower control limit in samples *MW-65-20212502*, *MW-40-20212502*, *MW-41-20212502*, and the associated method blank.

2-Chloronaphthalene and dibenzofuran exhibited low recovery in the EPA method SW8270E-SIM ICV.

The EPA method SW8270E-SIM method blank sample reported in batch BJC0057 exhibited a detection for naphthalene.

The report was revised to correct add trans-1,2-dichloroethene VOC list.

c. Were all corrective actions documented?

Yes ☐ No ☒ N/A ☐ Comments:

No corrective actions were detailed in the case narrative.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the pentachlorophenol results of the field samples due to the ICV recovery failures.

The laboratory applied the Q-flag to the 2-chloronaphthalene and dibenzofuran results of the field samples due to the ICV recovery failures.

The laboratory applied the B-flag to the naphthalene results of all samples included in batch BJC0057.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Soil samples were not submitted with this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOCs/PAHs were not detected in one or more field samples and reported at limits of detection (LODs) which were greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Naphthalene was detected in the SW8270E-SIM method blank reported with batch BJC0057.

Total chromium isotopes 52 and 53 and magnesium isotope 24 were detected at estimated concentrations in the SW6020B method blank sample associated with batch BJC0224.

Total nickel isotopes 60 and 62 were detected in the SW6020B method blank sample associated with batch BJC0224.

Dissolved iron isotopes 54 and 57 were detected in the SW6020B method blank sample associated with batch BJC0290.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples *MW-40-20212502*, *MW-41-20212502*, and *MW-65-20212502* contain naphthalene at concentrations within 5X that of the concentration detected in the associated method blank.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:The naphthalene results of samples *MW-40-20212502*, *MW-41-20212502*, and *MW-65-20212502* are likely artifacts of laboratory contamination. These results are flagged B* for reporting purposes.

v. Data quality or usability affected?

Comments:

The data quality was affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for isotopic metals (total and dissolved), mercury (total and dissolved), and antimony analyses.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

Dissolved zinc-66 was not detected in the laboratory duplicate sample reported in batch BJC0290 but detected at an estimated concentration in the field sample from which it was analyzed. However, the detected concentration was below the LOQ. Assessment of method precision therefore holds no value for this analyte.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; the method accuracy and, where calculable, precision were within acceptable limits.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification was not required; see above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organics analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for isotopic metals (total and dissolved), mercury (total and dissolved), and antimony analyses.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Dissolved manganese-55 exhibited low recovery in the method SW6020B MS sample reported with batch BJC0290.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The method SW6020B MS/MSD samples were spiked from the field sample *MW-40-20212502*. The dissolved manganese-55 spike added to the matrix was grossly low compared to the native concentration in the parent sample. The MS/MSD recovery may not be representative of actual method performance.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification was not required; see above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

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- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The EPA method SW8270E surrogate phenol-d5 was recovered below the lower control limit in samples *MW-65-20212502*, *MW-40-20212502*, *MW-41-20212502*, and the method blank sample reported in batch BJC0058.

- iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

1,2-Dichlorobenzene, 1,4-dichlorobenzene, and N-nitrosodimethylamine are associated with the surrogate phenol-d5. Results for these analytes are assumed to have a low analytical bias in the samples *MW-65-20212502*, *MW-40-20212502*, and *MW-41-20212502*. These non-detect results are flagged J* for reporting purposes.

- iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

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iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank submitted with this work order.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒

Comments:

A field duplicate sample was not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☐ N/A ☒

Comments:

A field duplicate was not submitted with this work order.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality is not affected.

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- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank sample was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank sample was not included with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank sample was not included with this work order.

- iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

- a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the pentachlorophenol results of the field samples due to the ICV recovery failures.

The laboratory applied the Q-flag to the 2-chloronaphthalene and dibenzofuran results of the field samples due to the ICV recovery failures.

The laboratory applied the B-flag to the naphthalene results of all samples included in batch BJC0057.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Michael Jaramillo / Validated by: Adam Wyborny, P.E.

Title:

Senior Chemist / Senior Environmental Engineer

Date:

May 5, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21D0061

Laboratory Report Date:

August 2, 2021

Report Name:

Lower Duwamish

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The porosity analyses of the included soil samples were subcontracted to Materials Testing & Consulting, Inc. in Tukwila, WA.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

The samples reported in this work order were initially submitted to the laboratory between January 25 through February 5, 2021 and placed on hold. On March 29, 2021, Shannon & Wilson requested several samples from various work orders be analyzed for metals, polynuclear aromatic hydrocarbons (PAHs), and polychlorinated biphenyls (PCBs).

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no discrepancies documented by the laboratory.

- e. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

Sample analysis list received April 6, 2021. For details regarding sample receipt, please refer to the Cooler Receipt Form. Refer to Section 5.b for further assessment of hold time exceedances.

The PCB analyte Aroclor-1260 exhibited a low recovery failure in the continuing calibration verification (CCV) on column zb-5. The data is reported from passing column zb-. Sample results are not affected by the CCV failures.

The surrogate percent recoveries were within control limits except decachlorobiphenyl on both columns and tetrachlorometaxylene on column zb-5 in sample *TSA-2021-004:1.7-01252021*. Refer to Section 6.d for further assessment.

The PAH analytes acenaphthylene, dibenzofuran, and benzo(b)fluoranthene exhibited low recovery failures in the initial calibration verification (ICV). All samples associated with this analytical batch are considered estimated and detections are flagged "JL*" and non-detect results are flagged "J*" in the analytical reporting tables.

The PAH method blank samples did not have detections at the reporting limits (RLs), except for fluoranthene. All samples which contain analyte have been flagged with a "B" qualifier. Refer to Section 6.a for further assessment.

c. Were all corrective actions documented?

Yes ☐ No ☒ N/A ☐ Comments:

No corrective actions were detailed in the case narrative.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory flagged the data associated with the surrogate recovery failures for PCB analysis in sample *TSA-2021-004:1.7-01252021*.

The laboratory applied the Q-flag to the acenaphthalene, dibenzofuran, and benzo(b) fluoranthene results of the field samples due to the ICV recovery failures.

The laboratory applied the B-flag to the fluoranthene results of all samples included in batch BJC0249.

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5. Samples Results

- a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

- b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

The hold time for PAHs is 14-days from collection. The samples were submitted to the laboratory between January 26 through February 5, 2021 and were kept frozen to extend the hold time for this analysis. Upon receipt of results for other project samples, Shannon & Wilson requested for the analysis of these samples 70 days past collection. Based on recommendations from the laboratory, the analytical results do not require qualification due to the hold time exceedances for these samples.

We also note the holding time listed in the QAPP for PCB analysis (14 days) was exceeded. However, in our professional opinion the hold time is not representative of the stability of these compounds and we do not consider the results affected. The EPA method does not list a required hold time for these analytes, noting "PCBs are very stable in a variety of matrices, and holding times under the conditions listed above may be as long as a year." The conditions they are referring to are storing the samples under refrigeration and out of direct light. These samples were stored in a freezer out of direct sunlight, therefore we do not consider analysis 70 days past collection to affect the results.

- c. All soils reported on a dry weight basis?

Yes ☒ No ☐ N/A ☐ Comments:

- d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Several PAHs were not detected in one or more field samples and reported at RLs which were greater than their associated regulatory limits.

- e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Fluoranthene was detected in the SW8270E-SIM method blank reported with batch BJC0249 at a concentration greater than the RL. In addition, the analytes chrysene and pyrene were detected at estimated concentrations below the RL for this method blank sample.

- iii. If above RL or project specified objectives, what samples are affected?

Comments:

The following samples had detections for chrysene, fluoranthene, or pyrene at concentrations less than five times that of the concentration detected in the method blank. The sample results are considered non-detect due to laboratory contamination and are flagged "B*" in the analytical summary tables at the detected result or the RL, whichever value is greater.

- Chrysene: SB-2021-006:20-01292021, SB-2021-038:12.9-1262021, and SB-2021-047:10.5-02022021.
- Fluoranthene: MW-10R:15-02052021, MW-57:15.3-01272021, MW-58:15-01272021, MW-62:15-01272021, MW-68:15.5-02022021, MW-70:15-02022021, MW-71:15.5-02042021, SB-2021-006:20-01292021, SB-2021-038:12.9-1262021, SB-2021-040:13.7-01282021, SB-2021-041:13.3-01282021, SB-2021-046:13.9-1262021, and SB-2021-047:10.5-02022021.
- Pyrene: MW-10R:15-02052021, MW-58:15-01272021, MW-68:15.5-02022021, MW-71:15.5-02042021, SB-2021-006:20-01292021, SB-2021-038:12.9-1262021, SB-2021-040:13.7-01282021, SB-2021-041:13.3-01282021, SB-2021-046:13.9-1262021, and SB-2021-047:10.5-02022021.

The following samples had detections for chrysene or pyrene at concentrations less than ten but greater than five times that of the concentration detected in the method blank. The sample results are considered estimated, biased high, and are flagged "JH*" in the analytical summary tables.

- Chrysene: MW-10R:15-02052021, MW-58:15-01272021, MW-70:15-02022021, MW-71:15.5-02042021, SB-2021-040:13.7-01282021, SB-2021-041:13.3-01282021, and SB-2021-046:13.9-1262021.
- Pyrene: MW-57:15.3-01272021, MW-62:15-01272021, and MW-70:15-02022021.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Refer to Section 6.a.iii for applied qualifiers.

v. Data quality or usability affected?

Comments:

The data quality was affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS samples were reported for PAH analysis. Refer to Section 6.c for assessment of laboratory precision for this analysis.

LCS/LCSDs were reported for PCB analysis.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for isotopic metals analysis.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

Cadmium-111 and selenium-78 had laboratory duplicate RPD failures reported in batch BJD0279. The cadmium and selenium results for the parent sample SB-2021-009:13.3-01252021 are considered estimated due to the laboratory imprecision and are flagged “J*” in the analytical summary tables.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Refer to Section 6.b.iv for affected samples.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Refer to Section 6.b.iv for applied qualifications.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for PAH and PCB analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for isotopic metals analysis.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; laboratory precision and accuracy requirements were met for MS and MSD samples.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification was not required; see above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The EPA method SW8082A surrogate decachlorobiphenyl was recovered above the upper control limit in sample *TSA-2021-004:1.7-01252021*. In addition, surrogate tetrachlorometaxylene was recovered below the lower control limit in this sample.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The sample *TSA-2021-004:1.7-01252021* was diluted and the low surrogate recovery failure can be attributable to the sample dilution. The sample results are not affected by the low surrogate recovery failure for tetrachlorometaxylene. However, the detected results are considered estimated, biased high, and are flagged “JH*” in the analytical summary tables.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

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e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☐ No ☐ N/A ☒ Comments:

Volatile analyses were not request with this work order. A trip blank was not required.

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☐ N/A ☒ Comments:

A trip blank was not required for this work order.

- iii. All results less than RL and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

A trip blank was not required for this work order.

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; a trip blank was not required for this work order.

- v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate was not submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate was not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank sample was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank sample was not included with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank sample was not included with this work order.

- iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the P1-flag to the Aroclor-1254 result for sample *SB-2021-025:10-1272021* due to the reported value having a difference greater than 40% RPD to the confirmation column. The sample result is considered estimated and is flagged "J*" in the analytical summary table.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, P.E. / Validated by: Michael Jaramillo

Title:

Senior Engineer / Senior Chemist

Date:

September 20, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21G0121

Laboratory Report Date:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The samples were not transferred to a “network” laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

Note that this work order reports analyses that were missed in the original laboratory deliverables. COCs from numerous work orders are included but only select samples and analyses are detailed in this report.

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no discrepancies documented by the laboratory.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

Analyses were run from frozen samples stored from previous work orders. The laboratory states that holding times were extended based on the storage conditions.

Isophorone exhibited high recovery while benzoic acid and pentachlorophenol exhibited low recoveries in the EPA method SW8270E initial calibration verification (ICV) designated SJG0329-ICV.

Pentachlorophenol exhibited low recovery while 2,4-dichlorophenol exhibited high recovery in the ICV designated SJG0343-ICV.

2,4-Dichlorophenol and hexachlorocyclopentadiene exhibited low recoveries in the continuing calibration verification (CCV) designated SJG0329-CCV.

The EPA method SW8270E LCS associated with batch BJJ0492 exhibited low recovery for n-nitrosodiphenylamine.

The EPA method SW8270E-SIM MS and MSD samples reported in batch BJJ0493 exhibited low recoveries for naphthalene.

c. Were all corrective actions documented?

Yes ☐ No ☒ N/A ☐ Comments:

No corrective actions were detailed in the case narrative.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the 2,4-dichlorophenol, benzoic acid, hexachlorocyclopentadiene, isophorone, and pentachlorophenol results of the field samples due to the ICV and CCV recovery failures.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

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b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The analyses run for this work order represent analyses that were missed in prior work orders. As such, the samples were pulled from storage where they had been frozen. We note that these analyses were conducted months outside of their method required holding times. According to the laboratory, this is acceptable for frozen samples. Per the project DQOs, we have not qualified these results for the gross holding time exceedances.

c. All soils reported on a dry weight basis?

Yes ☒ No ☐ N/A ☐ Comments:

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Several PAHs and SVOCs were not detected in one or more field samples and reported at limits of detection (LODs) which were greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Phenanthrene was detected at an estimated concentration in the SW8270E-SIM method blank reported with batch BJG0493.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

The field samples reported in batch BJG0493 all contained phenanthrene concentrations greater than 10X that of the concentration detected in the method blank. The results are not meaningfully affected.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The field sample results were not meaningfully affected by laboratory contamination.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

An LCS/LCSD pair was reported for method SW8082A.

An LCS was reported for Methods SW8270E and SW8270E-SIM.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

An LCS and laboratory duplicate sample were reported method EPA 3010A.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

N-Nitrosodiphenylamine exhibited low recovery in the EPA method SW8270E LCS reported with batch BJG0492.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N-Nitrosodiphenylamine was not detected in the field samples reported in batch BJJ0492. These non-detect results may be affected by low method recovery.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect n-nitrosodiphenylamine results of samples MW-67:0.5-01262021, MW-67:5.5-01262021, MW-67:9.0-01262021, MW-67:16.0-01262021, MW-67:20.5-01262021, MW-76:1.5-01262021, MW-76:5.0-01262021, and MW-100:5.0-01262021 are considered estimated and flagged J* for reporting purposes.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were reported for methods SW8270E and SW8270E-SIM.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for method EPA 3010A.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Naphthalene exhibited low recovery in the EPA method SW8270E-SIM MS and MSD samples reported with batch BJJ0493.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The method SW8270E-SIM MS/MSD samples were spiked from the field sample *MW-71:5.0-02042021*. The naphthalene spike added to the matrix was low compared to the native concentration in the parent sample. The MS/MSD recovery may not be representative of actual method performance.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification was not required; see above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☒ Comments:

There were no surrogate recovery failures for the samples included in this work order.

iv. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☐ No ☐ N/A ☒ Comments:

Volatile analyses were not requested for this work order. A trip blank was not required.

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☐ N/A ☒ Comments:

A trip blank was not analyzed for this work order.

- iii. All results less than RL and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

A trip blank was not analyzed for this work order.

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; a trip blank was not analyzed for this work order.

- v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

The field duplicate samples *MW-76:5.0-01262021* and *MW-100:5.0-01262021* were submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the detected results of the field duplicate samples was within the recommended DQO of 50% for all analytes except the following: anthracene, dibenzofuran, diethyl phthalate, fluoranthene, fluorene, naphthalene, and phenanthrene.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The diethyl phthalate results of the field duplicate samples are considered estimated and flagged J* to identify the imprecision. The remaining analytes were reported with the initial analyses of these samples. Wherever possible, the results of the initial analyses are used and the results of the re-analyses detailed in this work order were removed.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank sample was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank sample was not included with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank sample was not included with this work order.

- iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory applied the Q-flag to the 2,4-dichlorophenol, benzoic acid, hexachlorocyclopentadiene, isophorone, and pentachlorophenol results of the field samples due to the ICV and CCV recovery failures.

Laboratory Data Review Checklist

Completed By:

Reviewed/Validated by: Michael Jaramillo

Title:

Senior Chemist

Date:

November 7, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Eurofins TestAmerica, Inc. (TestAmerica)

Laboratory Report Number:

320-70313-1

Laboratory Report Date:

February 25, 2021

Report Name:

Lower Duwamish

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to TestAmerica of Sacramento, California, a WA State Department of Ecology approved laboratory for per- and polyfluorinated alkyl substances (PFAS) analysis.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Project samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates the samples were received in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no discrepancies identified by the laboratory.

e. Data quality or usability affected?

Comments:

The data quality/usability are not affected; see above

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The "I" qualifier means the transition mass ratio for the indicated analyte was outside of the established ratio limits. The qualitative identification of the analyte has some degree of uncertainty, and the reported value may have some high bias. However, analyst judgement was used to positively identify the analyte. The perfluorooctanesulfonic acid (PFOS) result for sample *MW-68-20211602* was identified as having a transition mass ratio outside laboratory limits.

Results for samples *MW-60-20211602*, *MW-43-20211602*, and *MW-64-20211602* were reported from the analysis of a diluted extract due to high concentration of the target analyte in the analysis of the undiluted extract. The dilution factor was applied to the labeled internal standard area counts and these area counts were within acceptance limits.

Insufficient sample volume was available to perform a matrix spike/matrix spike duplicate (MS/MSD) associated with preparation batches 320-464133 and 320-464133.

Samples *MW-60-20211602*, *MW-43-20211602*, *MW-68-20211602*, *MW-64-20211602*, and *MW-71-20211602* were beige prior to extraction.

The following Sample *MW-64-20211602* contained sediments which clogged the cartridge during extraction.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

See above.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The PFOS result for sample *MW-68-20211602* is considered estimated, biased high, and is flagged "JH" in the analytical tables.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

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b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Soil samples were not reported with this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☒ No ☐ N/A ☐ Comments:

However, several samples were analyzed at a dilution due to high concentrations of target analytes. These samples had elevated RLs but had detections for these analytes.

e. Data quality or usability affected?

The data quality and usability were not affected; see above.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Target analytes were not detected in the method blank samples reported for this work order.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; target analytes were not detected in the method blank samples reported for this work order.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

v. Data quality or usability affected?

Comments:

The data quality is not affected; see above.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for PFAS analysis.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals/inorganic analyses were not requested with this work order.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Laboratory accuracy and precision were within laboratory acceptance criteria.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality and usability were not affected; see above.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Insufficient sample volume was available to perform a MS/MSD associated with preparation batches 320-464133 and 320-464133. Refer to Section 6.b for assessment of laboratory accuracy and precision.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

See above.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; see above.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality and usability were not affected; see above.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

IDA recoveries are within laboratory acceptance criteria.

iv. Data quality or usability affected?

Comments:

The data quality and usability were not affected; see above.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☐ No ☐ N/A ☒ Comments:

PFAS analytes are not volatile organic compounds and a trip blank is not required.

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ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

iii. All results less than RL and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; see above.

v. Data quality or usability affected?

Comments:

The data quality and usability were not affected; see above.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

Sample MW-103-20211602 is a field duplicate of sample MW-63-20211602.

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iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☒ No ☐ N/A ☐ Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality and usability were not affected; see above.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

Sample *EB-1-20211602* is an equipment blank and sample *FB-1-20211602* is a field blank collected in association with this work order.

i. All results less than RLs and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; project analytes were not detected in the equipment blank and field blank samples.

iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

Refer to Section 4.d for applied qualifiers due to transition mass ratio failures.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

January 18, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21E0174

Laboratory Report Date:

December 13, 2021

Report Name:

Lower Duwamish

Project Number

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The project samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

We note that a date was only listed for the first sample on the COC. The intent was for this date to apply to all samples on the COC. Sample custody is not considered affected.

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples MW-66-20211305, MW-76-20211305, MW-65-20211305, and MW-6-20211305. These samples were filtered at 0.45 um and preserved with 0.75 mL of HNO₃ by the laboratory.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

One of the VOA vials provided for each of the samples *MW-76-20211305* and *MW-65-20211305* contained bubbles.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples were delivered to the laboratory on the same day as they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt. The VOA vials containing headspace were not used for analysis.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8082A continuing calibration verification (CCV) samples 5 and 6 exhibited elevated recoveries of the internal standard hexabromobiphenyl on column zb-35. This internal standard exhibited passing recovery on column zb-5 and all associated field samples were non-detects. Samples results are not affected.

The Method SW8270E initial calibration verification (ICV) exhibited low recoveries for 4-chlorophenyl phenyl ether and carbazole and high recoveries for 2-nitroaniline and the surrogate 2,4,6-tribromophenol. The laboratory flagged associated samples with a Q-flag to identify the QC failure. Refer to Section 4.d. for further assessment of the surrogate recovery failure.

The Method SW8270E semi-volatile organic compounds (SVOC) surrogate 2,4,6-tribromophenol exhibited elevated recovery in the ICV, blank spike, and samples MW-76-20211305 and MW-65-20211305. Refer to Section 6.d. for further assessment.

The Method SW8270E blank spike exhibited elevated recovery for 4-nitroaniline and low recovery for 4-chloroaniline. Refer to Section 6.b. for further assessment.

The Method SW8270E-SIM polynuclear aromatic hydrocarbon (PAH) ICV exhibited high recoveries for benzo(g,h,i)perylene and the surrogate dibenzo(a,h)anthracene-d14. The laboratory flagged associated samples with a "Q" flag to identify the QC failure. Refer to Section 4.d. for further assessment.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The report was revised to correct the reported list of volatile organic compounds (VOCs).

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the 4-chlorophenyl phenyl ether, carbozole, and 2-nitroaniline results for associated samples due to the recovery failures in the associated ICV for SVOC analysis.

The laboratory applied the Q-flag to the surrogate 2,4,6-tribromophenol recoveries for samples MW-76-20211305 and MW-65-20211305.

The laboratory applied the Q-flag to the 4-nitroaniline and 4-chloroaniline results of the blank spike.

The laboratory applied the Q-flag to the benzo(g,h,i)perylene results for associated samples due to the recovery failures in the associated ICV for PAH analysis.

Refer to subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐

Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐

Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒

Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐

Comments:

Chromium and several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

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e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

The PAH analytes naphthalene and pyrene were detected below the RL in the method blank sample associated with batch BJE0432.

Dissolved iron-57 was detected in the method blank sample associated with batch BJE0722.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

The samples *MW-66-20211305* and *MW-76-20211305* contain naphthalene concentrations within 5X that of the concentration detected in the method blank. Similarly, the sample *MW-65-20211305* contains a naphthalene concentration within 10X that of the concentration detected in the method blank.

The sample *MW-76-20211305* contains a pyrene concentration within 10X that of the concentration detected in the method blank. Similarly, the sample *MW-65-20211305* contains a pyrene concentration within 5X that of the concentration detected in the method blank.

Dissolved iron-57 is not a target analyte for this project.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The naphthalene results of samples *MW-66-20211305* and *MW-76-20211305* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged 'B*' to identify the external analyte contributions.

The naphthalene result of sample *MW-65-20211305* may have a high analytical bias due to external analyte contributions. This result is flagged JH* to identify the bias.

The pyrene result of sample *MW-76-20211305* may have a high analytical bias due to external analyte contributions. This result is flagged JH* to identify the bias.

The pyrene result of sample *MW-65-20211305* is assumed to be an artifact of laboratory contamination and is considered a false positive. This result is flagged 'B*' to identify the external analyte contribution.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, DRO, and PCBs analyses.

An LCS was reported for PAHs analysis. No measure of method precision was provided for this batch.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

An LCS and laboratory duplicate were reported for both total and dissolved isotopic metals and mercury analyses.

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- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E LCS and LCSD associated with preparation batch BJE0412 exhibited low recovery for 4-chloroaniline. The LCSD also exhibited elevated recovery for 2-nitroaniline.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Project sample *MW-76-20211305* is associated with batch BJE0412. 4-Chloroaniline and 2-nitroaniline were not detected in the project sample. The non-detect 4-chloroaniline result may be affected by low method recovery.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect 4-chloroaniline result of sample *MW-76-20211305* may be affected by low method recovery and is flagged 'J*' in the summary table.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality was affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for both total and dissolved isotopic metals and mercury analyses.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The EPA Method 600 MSD reported with batch BJE0678 exhibited low recovery for manganese-55.

The EPA Method 600 MSD reported with batch BJE0680 exhibited low recovery for dissolved manganese-55.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The parent sample *MW-66-20211305* is not affected by the MSD (batch BJE0678) recovery failure for manganese-55. The manganese-55 spike added to the matrix was grossly low compared to the native concentration in the parent sample. The discrepancy in concentrations renders the spike recovery unquantifiable.

The parent sample *MW-6-20211305* is not affected by the MSD (batch BJE0680) recovery failure for dissolved manganese-55. The dissolved manganese-55 spike added to the matrix was grossly low compared to the native concentration in the parent sample. The discrepancy in concentrations renders the spike recovery unquantifiable.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The results did not require qualification; see above.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The Method SW8270E ICV exhibited low recovery for the surrogate 2,4,6-tribromophenol.

The Method SW8270E surrogate 2,4,6-tribromophenol exhibited elevated recovery in the ICV, blank spike, and samples *MW-76-20211305* and *MW-65-20211305*.

The Method SW8270E-SIM ICV exhibited high recovery for the surrogate dibenzo(a,h)anthracene-d14.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

4,6-Dinitro-2-methylphenol, 4-bromophenyl phenyl ether, anthracene, di-n-butylphthalate, fluoranthene, hexachlorobenzene, N-nitrosodiphenylamine, pentachlorophenol, and phenanthrene are associated with the surrogate 2,4,6-tribromophenol. Detected concentrations of these analytes in the SVOC results of samples *MW-76-20211305* and *MW-65-20211305* are considered estimated with a high analytical bias. Affected results are flagged JH* in the summary table.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applies qualifiers.

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e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

- v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

- iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the 4-chlorophenyl phenyl ether, carbozole, and 2-nitroaniline results for associated samples due to the recovery failures in the associated ICV for SVOC analysis.

The laboratory applied the Q-flag to the surrogate 2,4,6-tribromophenol recoveries for samples MW-76-20211305 and MW-65-20211305.

The laboratory applied the Q-flag to the 4-nitroaniline and 4-chloroaniline results of the blank spike.

The laboratory applied the Q-flag to the benzo(g,h,i)perylene results for associated samples due to the recovery failures in the associated ICV for PAH analysis.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Dana Fjare / Validated by: Adam Wyborny, PE

Title:

Environmental Scientist / Senior Environmental Engineer

Date:

January 19, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21E0190

Laboratory Report Date:

December 13, 2021

Report Name:

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Project Number

21-1-12596-035

21E0190

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The project samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The project was built with sulfite analysis, but sulfide containers (without preservative) were provided. Sulfide was cancelled, and sulfite analysis also needed to be cancelled because without preservative the analyte dissipates rapidly.

The volume provided for dissolved metals analysis arrived under-preserved for samples *MW-15-20211405*, *MW-14-20211405*, *MW-23-20211405*, *MW-46-20211405*, and *MW-55-20211405*.

The volume provided for attenuation indicators arrived under-preserved for samples *MW-23-20211405*, *MW-14-20211405*, and *MW-15-20211405*.

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Two of the VOA vials provided for sample *MW-14-20211405* and one of the VOA vials provided for sample *MW-15-20211405* contained bubbles.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

- e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt. Sulfite analysis was not performed because the analyte dissipates rapidly without proper preservation. The VOA vials containing headspace were not used for analysis. Data quality and usability were not affected.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8082A continuing calibration verification (CCV) samples 5 and 6 exhibited elevated recoveries of the internal standard hexabromobiphenyl on column zb-35. All associated field samples were non-detects.

The Method SW8270E semi-volatile organic compounds (SVOC) surrogate 2,4,6-tribromophenol exhibited elevated recovery in the initial calibration verification (ICV), laboratory control sample (LCS), laboratory control sample duplicate (LCSD), and samples *MW-46-20211405* and *MW-14-2-211405*. The laboratory flagged associated samples with a “Q” flag to identify the QC failure. Refer to Section 6.d. for further assessment.

The Method SW8270E-SIM polynuclear aromatic hydrocarbon (PAH) ICV exhibited high recoveries for benzo(g,h,i)perylene and the surrogate dibenzo(a,h)anthracene-d14. The laboratory flagged associated samples with a “Q” flag to identify the QC failure. Refer to Section 4.d. for further assessment.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The report was revised to correct volatile organic compounds (VOC) and RSK-175 lists of reported analytes.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the surrogate 2,4,6-tribromophenol recoveries for samples *MW-46-20211405* and *MW-14-2-211405*.

The laboratory applied the Q-flag to the 2,4,6-tribromophenol surrogate recovery of the blank, LCS, and LCS duplicate.

The laboratory applied the Q-flag to the dibenzo(a,h)anthracene-d14 surrogate recovery of the blank and LCS.

The laboratory applied the Q-flag to the benzo(g,h,i)perylene results for the LCS.

Refer to subsequent sections for further assessment.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Dissolved chromium, total chromium, and various SVOC and PAH analytes were not detected in the included samples and were reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project-specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

The PAH analytes naphthalene and pyrene were detected below the RL in the method blank sample associated with batch BJE0432.

Dissolved mercury was detected below the RL in the method blank sample associated with batch BJE0682.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

The sample *MW-46-20211405* is associated with batch BJE0432.

The samples *MW-46-20211405*, *MW-55-20211405*, and *MW-14-20211405* are associated with batch BJE0682.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The naphthalene and pyrene concentrations in sample *MW-46-20211405* are greater than 10 times the concentrations detected in the method blank. Consequently, the results of sample *MW-46-20211405* are not affected by the method blank detections and qualification of the data was not required.

The mercury (dissolved) concentrations detected in the project samples *MW-46-20211405*, *MW-55-20211405*, and *MW-14-20211405* are less than the LOQ and within five times the concentration detected in the method blank. As a result, the mercury results are considered false positives and are flagged B* at the LOQ in the analytical database.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, dissolved gases, SVOCs, DRO, and PCBs analyses.

An LCS was reported for Attenuation Indicators and PAHs analyses. No measure of method precision was provided for this batch.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

A LCS and laboratory duplicate samples were reported for total mercury, total metals, dissolved mercury, dissolved metals, ferrous iron, chloride, sulfate, nitrate/nitrite, and hexavalent chromium analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The Method 7470A laboratory duplicate sample reported with batch BJE0682 exhibited a precision failure for mercury (dissolved).

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The Method 7470A laboratory duplicate sample reported with batch BJE0682 was analyzed from the field sample *MW-55-20211405*. The mercury (dissolved) result of this sample may lack precision.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The mercury (dissolved) result of sample *MW-55-20211405* was previously identified as an artifact of laboratory contamination and qualified for a blank detection. See section 6.a for details.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality and usability were not affected; see above.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were reported for GRO.

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ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for both total mercury, total metals, dissolved mercury, and dissolved metals analyses.

A MS sample was reported for ferrous iron, chloride, sulfate, nitrate/nitrite, and hexavalent chromium analyses. Refer to section 6.b for assessment of method precision.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

An MSD was not reported for ferrous iron, chloride, sulfate, nitrate/nitrite, and hexavalent chromium analyses. Refer to section 6.b for assessment of method precision.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; MS and MSD accuracy and, where applicable, precision were within laboratory control limits.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

No samples are affected; see above.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality and usability are not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The Method SW8270E surrogate 2,4,6-tribromophenol exhibited elevated recovery in the ICV, LCS, LCSD, and samples MW-46-20211405 and MW-14-2-211405.

The Method SW8270E-SIM ICV exhibited high recovery for the surrogate dibenzo(a,h)anthracene-d14.

The Method SW8270E surrogates 2-methylnaphthalene-d10, dibenzo(a,h)anthracene-d14, and fluoranthene-d10 were not recovered due to 100-times sample dilution in the re-analysis of sample MW-46-20211405.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

Di-n-butylphthalate, pentachlorophenol, and n-nitrosodiphenylamine are associated with the surrogate 2,4,6-tribromophenol in SVOC method SW8270E. These analytes were not detected in the SVOC results of samples MW-46-20211405 and MW-14-2-211405. Consequently, data qualification is not required for the high surrogate recovery failure.

Surrogate recovery failures due to dilution are not considered to affect the project samples.

iv. Data quality or usability affected?

Comments:

The data quality and usability is not affected; see above.

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e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☒ N/A ☐ Comments:

The cooler used to transport the trip blank and samples for volatile analysis is not marked on the COC; however, the trip blank accompanied the volatile samples at all times.

- iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

- v. Data quality or usability affected?

Comments:

The data quality and usability is not affected.

f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality and usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

- iii. Data quality or usability affected?

Comments:

We cannot assess whether cross-contamination occurred due to reusable sampling equipment, if any.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the E-flag to PAH analytes naphthalene, 1-methylnaphthalene, 2-methylnaphthalene, acenaphthene, fluorene, and phenanthrene in *MW-46-20211405* which exceeded the instrument calibration range. The sample was re-analyzed at a dilution. We have reported the re-analyzed results only for those analytes that were E-flagged, and otherwise report the original, undiluted sample results.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Dana Fjare / Validated by: Adam Wyborny, PE

Title:

Environmental Scientist / Senior Environmental Engineer

Date:

January 20, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21E0194

Laboratory Report Date:

December 13, 2021

Report Name:

Lower Duwamish

Project Number

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21E0194

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The project samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

We note that a date was only listed for the first sample on the COC. The intent was for this date to apply to all samples on the COC.

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The project was built with sulfite analysis, but sulfide containers (without preservative) were provided. Sulfide was cancelled, and sulfite analysis also needed to be cancelled because without preservative the analyte dissipates rapidly.

The volume provided for dissolved metals analysis arrived under-preserved for samples *MW-60-20211705*, *MW-58-20211705*, *MW-56-20211705*, and *EB-1-20211705*.

The volume provided for attenuation indicators arrived under-preserved for samples *MW-56-20211705*, *MW-58-20211705*, *MW-60-20211705*, and *MW-36-20211705*.

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Two of the VOA vials provided for sample *MW-56-20211705* contained bubbles.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

- e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt. Sulfite analysis was not performed because the analyte dissipates rapidly without proper preservation. The VOA vials containing headspace were not used for analysis. Data quality and usability were not affected.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8082A polychlorinated biphenyls (PCBs) surrogate tetrachlorometaxylene exhibited low recovery in sample *MW-60-20211705* on column zb-35. Data are reported from passing column zb-5.

The Method SW8270E-SIM polynuclear aromatic hydrocarbon (PAH) initial calibration verification (ICV) exhibited high recoveries for benzo(g,h,i)perylene and the surrogate dibenzo(a,h)anthracene-d14.

The Method SW8270E-SIM matrix spike (MS) and matrix spike duplicate (MSD) percent recoveries and relative percent difference were outside of laboratory control limits for several analytes. The analyst noted that some of the extract was spilled. Based upon surrogate recovery about 80% was spilled.

The EPA Method 6020B (metals) MSD recovery of dissolved iron exceeded the laboratory's upper QC limit.

There was a hold-time exceedance for nitrate and nitrite in samples *MW-58-20211705*, *MW-60-20211705*, and *MW-36-20211705*. The instrument stopped analyzing samples midway through a sequence. This was discovered after hold time had expired. Samples were analyzed as soon as discovery was made.

The Method RSK-175 (Volatile Gases) MS and MSD exhibited high recovery for methane.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The report was revised to correct the volatile organic compounds (VOCs) list and the RSK-175 list of reported analytes.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the analyte benzo(g,h,i)perylene in the ICV.

The laboratory applied the Q-flag to the surrogate dibenzo(a,h)anthracene-d14 recovery in the ICV.

The laboratory flagged PAH-analytes with low MS/MSD percent recovery and RPD values outside of laboratory control limits. The laboratory applied a flag to the dissolved iron result in the MSD for batch BJE0737.

Refer to subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐

Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐

Comments:

Nitrate and nitrite in samples *MW-58-20211705*, *MW-60-20211705*, and *MW-36-20211705* were analyzed outside of the method required holding time. The instrument stopped analyzing samples midway through a sequence. This was discovered after hold time had expired.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒

Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐

Comments:

Chromium and various PAH analytes were not detected in the included samples and were reported at limits of detection (LODs) which are greater than their associated regulatory limits.

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e. Data quality or usability affected?

The nitrate and nitrite results of samples *MW-58-20211705*, *MW-60-20211705*, and *MW-36-20211705* are assumed to have a low analytical bias due to the holding time exceedances. These non-detect results are flagged J* in the summary table.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project-specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

The PAH analytes naphthalene and pyrene were detected below the RL in the method blank sample associated with batch BJE0432.

Dissolved mercury was detected below the RL in the method blank sample associated with batch BJE0741.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

The samples *MW-56-20211705*, *MW-58-20211705*, *EB-1-20211705*, and *MW-60-20211705* are associated with batch BJE0432.

The samples *MW-36-20211705*, *MW-56-20211705*, *MW-58-20211705*, *EB-1-20211705*, and *MW-60-20211705* are associated with batch BJE0741.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Naphthalene was detected in samples *MW-56-20211705* and *EB-1-20211705* at concentrations within ten times the concentration detected in the method blank. The affected naphthalene results are considered estimated with a high analytical bias and are flagged JH* in the analytical database.

Pyrene was detected in samples *MW-56-20211705*, *MW-58-20211705*, and *MW-60-20211705* at concentrations within five times the concentration detected in the method blank. The affected pyrene results are considered false positives and are flagged B* at the LOQ in the analytical database.

The dissolved mercury concentrations detected in the project samples *MW-56-20211705*, *MW-58-20211705*, *EB-1-20211705*, *MW-36-20211705*, and *MW-60-20211705* are less than the LOQ and within five times the concentration detected in the method blank. As a result, the dissolved mercury results are considered false positives and are flagged B* at the LOQ in the analytical database.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, dissolved gases, DRO, and PCB analyses.

An LCS was reported for PAHs analysis. Refer to section 6.c for assessment of method precision.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

A LCS and laboratory duplicate samples were reported for total/dissolved mercury, total/dissolved metals, ferrous iron, chloride, sulfate, and nitrate/nitrite analyses

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The Method 7470A laboratory duplicate sample reported with batch BJE0681 exhibited a precision failure for total mercury.

The Method 7470A laboratory duplicate sample reported with batch BJE0741 exhibited a precision failure for total mercury.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The Method 7470A laboratory duplicate sample reported with batch BJE0681 was analyzed from the field sample *MW-56-20211705*. The total mercury result of this sample may lack precision.

The Method 7470A laboratory duplicate sample reported with batch BJE0741 was analyzed from the field sample *MW-56-20211705*. The total mercury result of this sample may lack precision.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The total mercury result of sample *MW-56-20211705* is considered estimated due to the precision failure demonstrated by the laboratory duplicate sample. This result is flagged J* in the summary table.

The dissolved mercury result of sample *MW-56-20211705* was previously identified as an artifact of laboratory contamination and qualified for a blank detection. See section 6.a for details.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for VOC, dissolved gases, PAH, and DRO analyses.

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ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for both total/dissolved metals and dissolved mercury analyses.

MS samples were reported for total mercury, ferrous iron, chloride, sulfate, and nitrate/nitrite analyses. Refer to section 6.b for assessment of method precision.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The MS and MSD pair BJE0454-MS1/BJE0454-MSD1 exhibited high recovery for methane.

The MS sample BJE0432-MS1 exhibited low recovery for all PAH analytes reported in batch BJE0432.

The MS sample BJF0053-MS2 exhibited high recovery for iron-57 and low recovery for manganese-55, and the associated MSD sample BJF0053-MSD2 exhibited high recoveries for iron-57 and manganese-55.

The MS sample BJE0737-MS2 exhibited low recovery for dissolved manganese. The associated MSD sample BJE0737-MSD2 exhibited low recovery for dissolved iron-57 and high recovery for dissolved manganese-55.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the recoveries for all PAH analytes was outside of acceptable limits in the MS/MSD reported with batch BJE0432.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The parent sample for BJE0454-MS1, BJE0454-MSD1, BJE0432-MS1, BJE0737-MS2, and BJF0053-MSD2 is project sample MW-56-20211705.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Because of variability in the matrix between samples, MS and MSD results are considered to only reflect on the matrix of the parent sample.

The spiking concentration for methane in BJE0454-MS1 and BJE0454-MSD1 is less than the methane concentration in the parent sample. When the MS and MSD spiking concentration is less than double the concentration in the parent sample for a given analyte, the MS/MSD recovery from the matrix cannot be measured accurately. Consequently, the *MW-56-20211705* results are considered unaffected by the high MS/MSD recovery for methane.

The case narrative noted that some of the extract was spilled for the BJE0432-MS1 PAH analysis. In this case, the MS is not accurate enough to evaluate the accuracy or precision of the analyte recovery from the matrix. Consequently, the *MW-56-20211705* results are considered unaffected by the low MS PAH recoveries and precision failures.

The spiking concentration for iron-57 and manganese-55 in BJE0053-MS2 and BJE0053-MSD2 is less than the associated concentrations in *MW-56-20211705*. The *MW-56-20211705* results are considered unaffected by the MS/MSD recovery failures.

The spiking concentrations for dissolved manganese-55 and dissolved iron-57 in BJE0737-MS2 and BJE0737-MSD2 are less than the associated concentrations in *MW-56-20211705*. The *MW-56-20211705* results are considered unaffected by the MS recovery failures.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality and usability are not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

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- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The PAH surrogates 2-methylnaphthalene-d10, dibenzo(a,h)anthracene-d14, and fluoranthene-d10 were not recovered in samples *MW-58-20211705* and *MW-60-20211705* due to high dilution.

The PCB surrogate tetrachlorometaxylene exhibited low recovery on one column in a dual-column analysis for project sample *MW-60-20211705*.

The PAH surrogates 2-methylnaphthalene-d10, dibenzo(a,h)anthracene-d14, and fluoranthene-d10 were recovered low in BJE0432-MS1 due to some of the extract being spilled.

- iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Surrogate recovery failures due to dilution are not considered to affect the project samples.

The recovery of tetrachlorometaxylene was within acceptable laboratory limits on the second column in the analysis. The lab reported data for the second column. Qualification of the data for low surrogate recovery is not required.

The PAH surrogate recovery from the duplicate of BJE0432-MS1 was within laboratory control limits and the surrogate recovery failures in BJE0432-MS1 were due to the extract being spilled; consequently, the project data is not affected by the low surrogate recovery.

- iv. Data quality or usability affected?

Comments:

The data quality and usability is not affected; see above.

e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

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ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☒ N/A ☐ Comments:

The cooler used to transport the trip blank and samples for volatile analysis is not marked on the COC; however, the trip blank accompanied the volatile samples at all times.

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality and usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration

R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality and usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

The equipment blank sample *EB-1-20211705* was submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Equipment blank results were less than the LOQ; however, the analytes naphthalene, 1-methylnaphthalene, 2-methylnaphthalene, acenaphthalene, total mercury, dissolved mercury, and dissolved manganese-55 were detected at estimated concentrations less than the LOQ.

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

Dissolved mercury and naphthalene were detected in the method blank, which was a quality control sample for the equipment blank. The project samples affected by the method blank detections have already been qualified and do not require further qualification for those analyte detections in the equipment blank.

Project sample *MW-56-20211705* had detections for 1-methylnaphthalene and 2-methylnaphthalene that were less than the LOQ. These results are affected by the equipment blank detection and are considered false positives. Affected results are flagged B* at the LOQ in the analytical database.

Total mercury was detected less than the LOQ in samples *MW-60-20211705*, *MW-36-20211705*, *MW-56-20211705*, and *MW-58-20211705*. These results are affected by the equipment blank detection and are considered false positives. Affected results are flagged B* at the LOQ in the analytical database.

The remaining results for these samples were not detected; therefore, qualification of the data due to the equipment blank detection was not required.

iii. Data quality or usability affected?

Comments:

The data quality and usability is affected; see above.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory applied the E-flag to PAH analyte naphthalene that exceeded the instrument calibration range in sample *MW-58-20211705*, and acenaphthene and fluorene in *MW-60-20211705*. The laboratory re-analyzed the affected samples at a dilution. We have reported the re-analyzed results only for those analytes that were E-flagged, and otherwise report the original, undiluted sample results.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Dana Fjare / Validated by: Adam Wyborny, PE

Title:

Environmental Scientist / Senior Environmental Engineer

Date:

January 24, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21E0206

Laboratory Report Date:

December 13, 2021

Report Name:

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Project Number

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The project samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals arrived under-preserved for samples *MW-71-20211805*, *MW-25-20211805*, *MW-45-20211805*, *MW-24-20211805*, and *MW-59-20211805*.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:Two of the VOA vials provided for sample *TB-4-20211805* contained bubbles.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt. The VOA vials containing headspace were not used for analysis. Data quality and usability were not affected.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E semi-volatile organic compounds (SVOC) surrogate 2,4,6-tribromophenol exhibited elevated recovery in the initial calibration verification (ICV) and continuing calibration verification (CCV) samples.

The Method SW8270E-SIM polynuclear aromatic hydrocarbon (PAH) surrogate dibenzo(a,h)anthracene exhibited elevated recovery in the re-analysis of project sample *MW-31-20211805* (lab ID 21E0206-10RE1), which has been flagged.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The report was revised to correct the list of target volatile organic compounds (VOCs).

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the surrogate 2,4,6-tribromophenol recoveries for the ICV, the CCV, and the associated QC samples.

The lab flagged data in project sample *MW-31-20211805* associated with the high dibenzo(a,h)anthracene surrogate recovery.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐

Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐

Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒

Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐

Comments:

Chromium and various SVOC and PAH analytes were not detected in the included samples and were reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project-specific QAPP to have RLs greater than the PCUL for the requested analyses.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

The PAH analytes naphthalene, 1-methylnaphthalene, 2-methylnaphthalene, and acenaphthene were detected below the RL in the method blank sample associated with batch BJE0492.

- iii. If above RL or project specified objectives, what samples are affected?

Comments:

1-Methylnaphthalene was detected in sample *MW-31-20211805* at a concentration within ten times the method blank concentration. Similarly, 1-methylnaphthalene was detected in sample *MW-71-20211805* at a concentration within five times the method blank concentration.

2-Methylnaphthalene was detected in samples *MW-31-20211805* and *MW-71-20211805* at concentrations within five times the method blank concentration.

Naphthalene was detected in samples *MW-71-20211805*, *MW-59-20211805*, *MW-31-20211805*, and *MW-25-20211805* at concentrations roughly equivalent to the concentration detected in the method blank.

Acenaphthene was either not detected or detected at concentrations greater than the method blank concentration in all field samples. The field sample results are not affected by this detection.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 1-methylnaphthalene result of sample *MW-31-20211805* is considered estimated with a high analytical bias and is flagged JH* to identify the external analyte contributions.

The 1-methylnaphthalene result of sample *MW-71-20211805* is assumed to be an artifact of laboratory contamination and is flagged B* in the summary table.

The 2-methylnaphthalene results of samples *MW-31-20211805* and *MW-71-20211805* are assumed to be artifacts of laboratory contamination and are flagged B* in the summary table.

The naphthalene results of samples *MW-71-20211805*, *MW-59-20211805*, *MW-31-20211805*, and *MW-25-20211805* are assumed to be artifacts of laboratory contamination and are flagged B* in the summary table.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOC, SVOC, PAH, DRO, and PCB analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

An LCS was reported for total isotopic metals and total mercury analyses. No measure of method precision was provided for this batch.

An LCS and laboratory duplicate sample were reported for dissolved mercury and dissolved isotopic metals analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for the total isotopic metals and total mercury analyses.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; LCS and LCSD accuracy and, where applicable, precision were within laboratory control limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

LCS and LCSD accuracy and precision were within laboratory control limits.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality and usability were not affected.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for dissolved isotopic metals and dissolved mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The recovery for dissolved manganese-55 exceeded the laboratory's upper control limit in the MSD sample BJJ0054-MSD4.

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for the total isotopic metals and total mercury analyses.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The project sample *MW-71-20211805* is the parent sample for MSD sample BJJ0054-MSD4.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The concentration of dissolved manganese-55 in the parent sample was much greater than the spike concentration. The spike recovery cannot be accurately evaluated if the spike concentration is less than double the concentration in the parent sample. Consequently, the *MW-71-20211805* results are considered unaffected by the high manganese recovery in the MSD.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality and usability are not affected.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The SVOC surrogate 2,4,6-tribromophenol exhibited elevated recovery in project samples *MW-24-20211805* and *MW-31-20211805*.

The PAH-surrogate dibenzo(a,h)anthracene-d14 exhibited low recovery in project sample *MW-31-20211805*.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Di-n-butylphthalate, pentachlorophenol, and n-nitrosodiphenylamine are associated with the surrogate 2,4,6-tribromophenol in the project SVOC list. These analytes were not detected in samples *MW-24-20211805* and *MW-31-20211805*. Consequently, data qualification is not required for the high 2,4,6-tribromophenol surrogate recovery.

Sample *MW-31-20211805* was diluted by a factor of 10X for PAH analysis. Surrogate recovery failures due to dilution are not considered to affect the project samples. Consequently, the data are considered unaffected by the low dibenzo(a,h)anthracene-d14 surrogate recovery.

iv. Data quality or usability affected?

Comments:

The data quality and usability is not affected.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☒ N/A ☐ Comments:

The cooler used to transport the trip blank and samples for volatile analysis is not marked on the COC; however, the trip blank accompanied the volatile samples at all times.

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

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v. Data quality or usability affected?

Comments:

The data quality and usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐

Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒

Comments:

A field duplicate sample was not submitted with this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☐ N/A ☒

Comments:

A field duplicate sample was not submitted with this work order.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality and usability is not affected.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒

Comments:

Equipment blank samples were not submitted with this work order.

21E0206

Laboratory Report Date:

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Report Name:

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i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

iii. Data quality or usability affected?

Comments:

We cannot assess whether cross-contamination occurred due to reusable sampling equipment, if any.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the E-flag to PAH analytes acenaphthene and phenanthrene in project sample MW-31-20211805 that exceeded the instrument calibration range. The sample was re-analyzed at a ten-fold dilution. We have reported the re-analyzed results only for those analytes that were E-flagged, and otherwise report the original, undiluted sample results.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Dana Fjare / Validated by: Michael Jaramillo

Title:

Environmental Scientist / Senior Chemist

Date:

January 25, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21E0213

Laboratory Report Date:

December 13, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21E0213

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December 13, 2021

Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The project samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under-preserved for samples *MW-9-20211905* and *MW-30-20211905*.

The volume provided for attenuation indicators analysis arrived under-preserved for sample *MW-30-20211905*.

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The samples were received in acceptable condition.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

- e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt. The laboratory did not mention whether the sample for sulfite analysis was preserved upon receipt at the laboratory. Sulfite dissipates rapidly without proper preservation. Data quality and usability were not affected.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The trip blank 21E0213-03 contained toluene above the reporting limit. The vial was prepared in October.

The sulfite holding time was exceeded upon sample receipt. The hold time is six hours and was analyzed as soon as possible by the laboratory.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

Corrective actions were not documented.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory did not mention an effect on data quality or usability. Refer to subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

Sulfite exceeded the hold time upon receipt at the laboratory. Because sulfite dissipates rapidly without preservation, the result is a hold time exceedance and we have flagged the non-detected sulfite result in project sample *MW-30-20211905* as 'UJ' to qualify the imprecision.

In addition, nitrate and nitrite were prepared outside the method hold time. The analytes were not detected and the result in project sample *MW-30-20211905* is flagged 'UJ' to qualify the imprecision.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

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d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Various PAH analytes were not detected in the included samples and were reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project-specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

The PAH analytes naphthalene, 1-methylnaphthalene, 2-methylnaphthalene, and acenaphthene were detected below the RL in the method blank sample associated with batch BJE0492.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

The samples *MW-57-20211905* and *MW-101-20211905* are associated with batch BJE0492.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene were detected in samples *MW-57-20211905* and *MW-101-20211905* at an estimated concentration less than the RL and within five times the analyte concentrations detected in the method blank. The sample results are considered estimated non-detected results and are qualified 'UB' at the RL in the analytical data tables.

Acenaphthene was not detected in project sample *MW-57-20211905* or *MW-101-20211905*. The sample results do not require qualification for the method blank detection.

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v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, Dissolved Gases, PAHs, and DRO analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

An LCS was reported for mercury, dissolved mercury, total metals, dissolved metals, sulfite, ferrous iron, chloride, nitrate, nitrite, and sulfate analyses. No measure of method precision was provided for this batch.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; LCS and LCSD accuracy and precision were within laboratory control limits.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

LCS and LCSD accuracy and precision were within laboratory control limits.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality and usability were not affected.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for dissolved mercury and total mercury.

MS samples were reported for chloride, nitrate, nitrite, ferrous iron, and sulfate.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; MS and MSD accuracy and precision were within laboratory control limits.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

MS and MSD accuracy and precision were within laboratory control limits.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality and usability are not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Surrogate recovery was within laboratory control limits.

iv. Data quality or usability affected?

Comments:

The data quality and usability is not affected.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☒ N/A ☐ Comments:

The cooler used to transport the trip blank and samples for volatile analysis is not marked on the COC; however, the trip blank accompanied the volatile samples at all times.

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iii. All results less than RL and project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Toluene was detected in the trip blank above the RL.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

The trip blank is a QC sample for *MW-9-20211905*, *MW-101-20211905*, *MW-57-20211905*, and *MW-49-20211905*. Toluene was not detected in any of these samples. Consequently, the data does not require qualification for the trip blank detection.

v. Data quality or usability affected?

Comments:

The data quality and usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:Field duplicate sample pair *MW-57-20211905* and *MW-101-20211905* was submitted with this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☒ N/A ☐ Comments:

The RPD for the duplicate pair was within the project objective of 30%, where calculable, except for dissolved copper.

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iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The copper result in duplicate pair *MW-57-20211905* and *MW-101-20211905* is flagged 'J' to qualify the imprecision.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

iii. Data quality or usability affected?

Comments:

The data quality and usability is not affected.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒ Comments:

Other data flags or qualifiers were not required.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Veselina Yakimova / Validated by: Michael Jaramillo

Title:

Geology Staff / Senior Chemist

Date:

January 26, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21E0244

Laboratory Report Date:

December 13, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21E0244

Laboratory Report Date:

December 13, 2021

Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

All analyses were performed by ARI.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples *MW-62-20211905*, *MW-103-20211905*, *MW-73-20212005*, *MW-64-20212005*, *MW-63-20212005*, *MW-40-20212005*, *MW-41-20212005*, and *MW-74-20211905*. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

- e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples were delivered to the laboratory on the same day as they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial calibration verification (ICV) exhibited high recovery for 2-Nitroaniline, 3-Nitroaniline, 4-Nitroaniline, Hexachlorobenzene and surrogate 2,4,6-Tribromophenol. The laboratory flagged associated samples with a Q-flag to identify the QC failure. Refer to Section 4.d for further assessment.

The Method SW8270E semi-volatile organic compounds (SVOC) Di-n-Butylphthalate method blank was outside of reporting limits. Refer to Section 6.a for further assessment.

The Method SW8270E blank spike (BS/LCS) exhibited low recovery for 4-Chloroaniline and high recovery for 2-Nitroaniline. Refer to Section 6.b for further assessment.

The Method SW8270E-SIM ICV exhibited high recovery for Benzo(g,h,i)perylene. The laboratory flagged associated samples with a Q-flag to identify the QC failure. Refer to Section 4.d for further assessment.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The report was revised to correct the reported list of volatile organic compounds (VOCs).

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to 2-Nitroaniline, 3-Nitroaniline, 4-Nitroaniline, Hexachlorobenzene, Benzo(g,h,i)perylene, and surrogate 2,4,6-Tribromophenol recoveries for samples *MW-63-20212005*, *MW-40-20212005*, *MW-40-20212005*, and several laboratory QC samples.

The laboratory applied the B qualifier to Di-n-Butylphthalate for samples *MW-40-20212005* and *MW-41-20212005* due to method blank detection.

The laboratory applied the *-flag to 4-Chloroaniline and 2-Nitroaniline for the SVOC LCS and LCS duplicate.

21E0244

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Di-n-Butylphthalate was detected above the RL in the method blank associated with batch BJE0574.

Dissolved mercury was detected below the RL in the method blank sample associated with batch BJE0234.

Dissolved manganese was detected below the RL in the method blank sample associated with batch BJE0145.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

Project samples *MW-40-20212005* and *MW-41-20212005* contain Di-n-Butylphthalate concentrations within 5X that of the concentration detected in the method blank. Project sample *MW-63-20212005* does not contain detectable concentrations of dissolved mercury.

The project samples *MW-103-20211905*, *MW-73-20212005*, *MW-64-20212005*, *MW-63-20212005*, *MW-40-20212005*, *MW-41-20212005*, and *MW-74-20211905* contain dissolved mercury concentrations within 5X that of the concentration detected in the method blank. The remaining samples do not contain detectable concentrations of dissolved mercury.

The project samples contain concentrations of dissolved manganese higher than 10X the concentration detected in the method blank.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The Di-n-Butylphthalate results of samples *MW-40-20212005* and *MW-41-20212005* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are considered non-detect and flagged 'B*' to identify the external analyte contributions.

The dissolved mercury results of samples *MW-103-20211905*, *MW-73-20212005*, *MW-64-20212005*, *MW-63-20212005*, *MW-40-20212005*, *MW-41-20212005*, and *MW-74-20211905* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are considered non-detect and flagged 'B*' to identify the external analyte contributions.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

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b. Laboratory Control Sample/Duplicate (LCS/LCSD)

- i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for both total and dissolved isotopic metals and mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The LCS and LCS duplicate exhibited low recovery for 4-Chloroaniline and the LCS exhibited high recovery for 2-Nitroaniline in batch BJE0574.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

4-Chloroaniline is not detected in sample MW-63-20212005 and is flagged “UJ” to identify the low LCS/LCSD recoveries.

2-Nitroaniline is not detected in sample MW-63-20212005 and is not considered affected by the high LCS recovery.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above for applied qualifiers.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for both total and dissolved isotopic metals and mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The EPA Method 600 MS and MSD samples reported with batch BJF0145 exhibited low recoveries for manganese-55 that were outside of acceptable limits.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The parent sample MW-62-20211905 is not affected by the MS/MSD (batch BJF0145) recovery failures for manganese-55. The manganese-55 spike added to the matrix was grossly low compared to the native concentration in the parent sample. The discrepancy in concentrations renders the spike recovery unquantifiable.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

No samples are affected; no qualification is required.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The Method SW8270E ICV exhibited high recovery for the surrogate 2,4,6-tribromophenol.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒

Comments:

No samples are affected; no qualification is required.

iv. Data quality or usability affected?

Comments:

The data quality is not affected.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐

Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐

Comments:

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iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate samples MW-62-20211905 and MW-103-20211905 were submitted with this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☒ N/A ☐ Comments:

The RPD for the Naphthalene, 2-Methylnaphthalene, 1-Methylnaphthalene, Perylene, and Iron results were outside control limits. Results are flagged with “J” to identify the discrepancy.

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iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is affected. See above for applied qualifications.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

An equipment/decontamination blank was not submitted with this work order. However, decontamination blanks were collected at the required frequency for the overall project.

i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment/decontamination blank was not submitted with this work order.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

An equipment/decontamination blank was not submitted with this work order.

iii. Data quality or usability affected?

Comments:

The data quality is not affected.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the surrogate 2,4,6-tribromophenol recoveries for samples MW-63-20212005, MW-40-20212005, MW-41-20212005, and the method blank, LCS and LCDS in batch BJE0574.

The laboratory applied the Q-flag to the benzo(g,h,i)perylene recoveries for the LCS and LCSD in batch BJE0573.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Dana Fjare / Validated by: Michael Jaramillo

Title:

Environmental Scientist / Senior Chemist

Date:

January 25, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21E0260

Laboratory Report Date:

December 14, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21E0260

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The project samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under-preserved for samples MW-50-20212105, MW-38-20212105, MW-37-20212105, MW-72-20212105, and MW-61-20212105.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The samples were received in acceptable condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt. Data quality and usability were not affected.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E semi-volatile organic compounds (SVOC) initial calibration verification (ICV) sample exhibited high recovery of 2-nitroaniline, 3-nitroaniline, 4-nitroaniline, hexachlorobenzene, and surrogate 2,4,6-tribromophenol.

The method blank had a detection of the SVOC analyte di-n-butylphthalate.

The Method SW8270E-SIM polynuclear aromatic hydrocarbons (PAH) ICV exhibited high recovery of benzo(g,h,i)perylene.

The relative percent difference (RPD) for zinc exceeded laboratory control limits in the total metals batch BJF0146 matrix spike and matrix spike duplicate (MS/MSD) samples.

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c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

Corrective actions were not documented.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the 2-nitroaniline, 3-nitroaniline, 4-nitroaniline, hexachlorobenzene, and surrogate 2,4,6-tribromophenol results in the ICV.

The laboratory applied the B-flag to all samples containing the analyte di-n-butylphthalate due to the method blank detection.

The laboratory applied the Q-flag to samples containing the analyte benzo(g,h,i)perylene due to the high recovery in the ICV.

The laboratory flagged the zinc result in the total metals MS/MSD samples due to the RPD failure.

Refer to subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

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d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Dissolved mercury and various SVOC and PAH analytes were not detected in the included samples and were reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project-specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

The SVOC analyte di-n-butylphthalate was detected above the RL in method blank sample associated with batch BJE0574.

The PAH analytes naphthalene, 1-methylnaphthalene, 2-methylnaphthalene, and phenanthrene were detected below the RL in the method blank sample associated with batch BJE0573.

Dissolved manganese was detected below the RL in the method blank sample associated with batch BJF0145.

Dissolved mercury was detected below the RL in the method blank sample associated with batch BJF0234.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

The samples *MW-51-20212105* and *MW-72-20212105* are associated with batch BJE0574.

The samples *MW-37-20212105* and *MW-61-20212105* are associated with batch BJE0573.

The samples *MW-61-20212105*, *MW-50-20212105*, *MW-38-20212105*, *MW-37-20212105*, and *MW-72-20212105* are associated with batch BJF0145.

The samples *MW-61-20212105* and *MW-72-20212105* are associated with batch BJF0234.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

The di-n-butylphthalate concentrations in samples *MW-51-20212105* and *MW-72-20212105* are above the RL and within five times the concentration detected in the method blank. The sample results are considered affected by the method blank detection and are flagged 'UB' at the sample result in the analytical data tables.

The naphthalene, 1-methylnaphthalene, 2-methylnaphthalene, and phenanthrene concentrations in samples *MW-37-20212105* and *MW-61-20212105* are less than the RL and within five times the analyte concentrations detected in the method blank. The sample results are considered estimated non-detected results and are qualified 'UB' at the RL in the analytical data tables.

The dissolved manganese concentration in sample *MW-38-20212105* is within ten times the concentration detected in the method blank. Consequently, the sample results are considered affected by the method blank detection and are flagged 'JH' in the analytical data tables. The dissolved manganese concentration in *MW-61-20212105*, *MW-50-20212105*, *MW-37-20212105*, and *MW-72-20212105* is greater than ten times the concentration detected in the method blank, and as a result do not require qualification for the method blank detection.

The dissolved mercury concentration in samples *MW-61-20212105* and *MW-72-20212105* is less than the RL and within five times the concentration detected in the method blank. The sample results are considered estimated non-detected results and are qualified 'UB' at the RL in the analytical data tables.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

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b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, DRO, PAH, and PCB analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

An LCS was reported for mercury, dissolved mercury, total metals, and dissolved metals analyses. No measure of method precision was provided for this batch.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The SVOC analyte 4-chloroaniline was recovered below laboratory QC limits, and 2-nitroaniline recovery exceeded laboratory QC limits, in the LCS associated with batch BJE0574. The recovery of 4-chloroaniline was below laboratory QC limits in the LCSD associated with batch BJE0574.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Project samples *MW-51-20212105* and *MW-72-20212105* are associated with batch BJE0574.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☒ N/A ☐ Comments:The analytes 4-chloroaniline and 2-nitroaniline were not detected in sample *MW-72-20212105* and were not requested for analysis in sample *MW-51-20212105*. Sample *MW-72-20212105* does not require qualification for the high 2-nitroaniline recovery; however, because the project sample result for 4-chloroaniline was not-detected and the recovery in the LCS and LCSD was low, the 4-chloroaniline result in *MW-72-20212105* is considered an estimated non-detected result and is flagged 'UJ' in the analytical data tables.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality and usability were affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for total metals analysis.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Manganese was recovered below laboratory QC limits in the MS sample associated with batch BJF0146.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The RPD for zinc exceeded laboratory control limits in the MS/MSD pair associated with batch BJF0146.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The parent sample for the MS/MSD is project sample MW-50-20212105.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The spiking concentration of manganese was less than the concentration in the parent sample; consequently, the accuracy of the recovery of manganese from the parent sample cannot be evaluated and the data do not require qualification for the MS accuracy failure.

The parent sample *MW-50-20212105* was not analyzed for zinc. The data did not require qualification for the MS/MSD RPD failure.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality and usability are not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E surrogate 2,4,6-tribromophenol exhibited elevated recovery in project samples *MW-51-20212105* and *MW-72-20212105*.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

4-bromophenyl-phenylether, anthracene, di-n-butylphthalate, fluoranthene, hexachlorobenzene, pentachlorophenol, n-nitrosodiphenylamine, phenanthrene, and 2-methyl-4,6-dinitrophenol are associated with the surrogate 2,4,6-tribromophenol in SVOC method SW8270E. These analytes were not detected in the SVOC results of samples *MW-46-20211405* and *MW-14-2-211405*, except for di-n-butylphthalate. The di-n-butylphthalate detection was the result of a method blank detection, for which these samples have already been qualified. Data qualification is not required for the high surrogate recovery failure because the project sample results were not-detected for these SVOC analytes.

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iv. Data quality or usability affected?

Comments:

The data quality and usability is not affected.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)Yes ☒ No ☐ N/A ☐

Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☒ N/A ☐

Comments:

The cooler used to transport the trip blank and samples for volatile analysis is not marked on the COC; however, the trip blank accompanied the volatile samples at all times.

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐

Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality and usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐

Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

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ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality and usability is not affected.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

iii. Data quality or usability affected?

Comments:

The data quality and usability is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒ Comments:

Other data flags or qualifiers were not required.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

January 25, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21E0290

Laboratory Report Date:

December 30, 2021

Report Name:

Lower Duwamish

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December 30, 2021

Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☒ No ☐ N/A ☐ Comments:

The dissolved mercury analyses were subcontracted to Fremont Analytical.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples *MW-75-20212405*, *MW-44-20212405*, *MW-43-20212405*, *MW-42-20212405*, *MW-54-20212405*, *MW-67-20212405*, *MW-32-20212405*, and *MW-102-20212405*. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☐ No ☒ N/A ☐ Comments:

The sample receipt form notes that VOA vial I of sample *MW-32-20212405* contained bubbles.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

- e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples were delivered to the laboratory on the same day as they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt. Additionally, VOA vial I of sample *MW-32-20212405* was not used for analysis.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8260D surrogate 1,2-dichloroethane-d4 exhibited elevated recovery in the sample MW-44-20212405.

The Method SW8270E initial calibration verification (ICV) and continuing calibration verification (CCV) exhibited low recovery for 4-chlorophenylphenyl ether. Additionally, the analytes n-nitroso-di-n-propylamine, 2-nitroaniline, 3-nitroaniline, diethyl phthalate, hexachlorobenzene, and the surrogate 2,4,6-tribromophenol exhibited elevated recoveries in these batch QC samples. The laboratory flagged associated samples with a Q-flag to identify the QC failures. Refer to Section 4.d for further assessment.

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the samples MW-75-20212405, MW-54-20212405, MW-67-20212405, MW-32-20212405, and MW-102-20212405. Refer to Section 4.d for further assessment.

The semi-volatile organic compounds (SVOC) method blank contained bis(2-ethylhexyl)phthalate.

The Method SW8270E laboratory control sample (LCS) exhibited low recovery for 4-chloroaniline and elevated recovery for 2-nitroaniline. Refer to Section 4.a for further assessment.

The method precision demonstrated by the SW6020B laboratory duplicate sample was outside of the advisory control limits for total copper. Refer to Section 4.b for further assessment.

The Method SW6020B matrix spike duplicate (MSD) exhibited low recovery for total manganese. Refer to Section 4.c for further assessment.

The Method 7470 analyses for dissolved mercury were conducted outside of the method required holding time. This occurred because an instrument failure at ARI necessitated subcontracting the analyses to Fremont Analytical. The delay caused the samples to break hold.

c. Were all corrective actions documented?

Yes ☐ No ☒ N/A ☐ Comments:

No corrective actions were documented in the case narrative.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the surrogate 1,2-dichloroethane-d4 recovery for sample MW-44-20212405.

The laboratory applied the Q-flag to the 4-chlorophenylphenyl ether, n-nitroso-di-n-propylamine, 2-nitroaniline, 3-nitroaniline, diethyl phthalate, hexachlorobenzene, and the surrogate 2,4,6-tribromophenol recoveries of the associated laboratory QC samples.

The laboratory applied the B-flag to all field samples with detectable concentrations of bis(2-ethylhexyl)phthalate.

The H-flag was applied to the dissolved mercury results due to the holding time exceedance.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The Method 7470 analyses for dissolved mercury were conducted outside of the method required holding time. This occurred because of instrument failure at ARI necessitated subcontracting the analyses to Fremont Analytical. The delay caused the samples to break hold.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

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e. Data quality or usability affected?

The dissolved mercury results of the project samples reported with this work order are assumed to have a low analytical bias due to the holding time exceedance. Mercury was not detected in the field samples. The non-detect results are flagged 'J*' in the summary table.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Bis(2-ethylhexyl)phthalate was detected in the method blank sample reported with preparation batch BJE0646.

The polynuclear aromatic hydrocarbon (PAH) analytes naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene were detected below the RL in the method blank sample associated with batch BJE0647.

Manganese-55, nickel-60, and zinc-67 were detected below the RL in the method blank sample associated with batch BJE0279.

Dissolved zinc-67 was detected at an estimated concentration below the RL in the method blank sample reported with batch BJE0430.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

The sample *MW-75-20212405* contains a concentration of bis(2-ethylhexyl)phthalate that is within 5X that of the concentration detected in the method blank.

The samples *MW-54-20212405*, *MW-32-20212405*, and *MW-102-20212405* contain concentrations of 1-methylnaphthalene and 2-methylnaphthalene within 5X that of the concentration detected in the method blank.

The samples *MW-54-20212405* and *MW-102-20212405* contain concentrations of naphthalene within 5X that of the concentration detected in the method blank.

The samples contain concentrations of manganese-55 greater than 10X that of the concentration detected in the method blank. Zinc-67 and dissolved Zinc-67 are not a target isotope for this project. The results are unaffected by these detections.

The sample *MW-54-20212405* contains a concentration of nickel-60 that is within 5X that of the concentration detected in the method blank.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The bis(2-ethylhexyl)phthalate result of sample *MW-75-20212405* is assumed to be an artifact of laboratory contamination and is considered a false positive. This result is flagged 'B*' to identify the external analyte contributions.

The 1-methylnaphthalene and 2-methylnaphthalene results of samples *MW-54-20212405*, *MW-32-20212405*, and *MW-102-20212405* are assumed to be artifacts of laboratory contamination. These results are flagged 'B*' to identify the external analyte contributions.

The naphthalene results of samples *MW-54-20212405* and *MW-102-20212405* are assumed to be artifacts of laboratory contamination. These results are flagged 'B*' to identify the external analyte contributions.

The nickel-60 result of sample *MW-54-20212405* is assumed to be an artifact of laboratory contamination and is considered a false positive. This result is flagged 'B*' to identify the external analyte contributions.

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v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐

Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐

Comments:

A LCS was reported for total mercury analysis. No measure of method precision was provided.

LCS and laboratory duplicate samples were reported for both total and dissolved isotopic metals and dissolved mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐

Comments:

4-Chloroaniline exhibited low recovery and 2-nitroaniline exhibited high recovery in the Method SW8270E LCS and LCSD reported with batch BJE0646.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐

Comments:

The Method SW6020B laboratory duplicate sample reported with batch BJE0279 exhibited precision failures for copper-60 and lead-208.

The Method SW6020B laboratory duplicate sample reported with batch BJE0327 exhibited a precision failure for dissolved copper-60.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

4-Chloroaniline was not detected in the samples associated with batch BJE0646. The non-detect results of samples *MW-75-20212405* and *MW-67-20212405* may be affected by low method recovery.

2-nitroaniline was not detected in the samples associated with batch BJE0646. The non-detect results are unaffected by the potentially elevated method recovery.

The Method SW6020B laboratory duplicate sample reported with batch BJE0279 was analyzed from the field sample *MW-67-20212405*. The copper-60 and lead-208 results of this sample may lack precision.

The Method SW6020B laboratory duplicate sample reported with batch BJE0327 was analyzed from the field sample *MW-75-20212405*. The dissolved copper-60 result of this sample may lack precision.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect 4-chloroaniline results of samples *MW-75-20212405* and *MW-67-20212405* are considered estimated and flagged J* in the summary table.

The copper-60 and lead-208 results of sample *MW-67-20212405* are considered estimated and flagged J* in the summary table.

The dissolved copper-60 result of sample *MW-75-20212405* is considered estimated and flagged J* in the summary table.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

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ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were only reported for total and dissolved isotopic metals and dissolved mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Manganese-55 exhibited low recovery in the Method SW6020B MSD sample reported with preparation batch BJF0278.

Dissolved manganese-55 exhibited low recovery in the Method SW6020B MS and MSD samples reported with preparation batch BJF0327.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The Method SW6020B MSD sample reported with preparation batch BJF0278 was spiked from the field sample *MW-42-20212405*. However, the manganese-55 spike was low relative to the native concentration in the parent sample. This discrepancy renders the spike difficult to quantify. The spike recovery may not be representative of actual method recovery.

The Method SW6020B MS/MSD samples reported with preparation batch BJF0327 were spiked from the field sample *MW-75-20212405*. However, the dissolved manganese-55 spike was grossly low relative to the native concentration in the parent sample. This discrepancy renders the spike unquantifiable. The spike recovery is not representative of actual method recovery.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The results do not require qualification; see above.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for the total mercury analysis.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The Method SW8270E ICV and CCV exhibited high recovery for the surrogate 2,4,6-tribromophenol.

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the samples *MW-75-20212405*, *MW-54-20212405*, *MW-67-20212405*, *MW-32-20212405*, and *MW-102-20212405*.

The Method SW8260D surrogate 1,2-dichloroethane-d4 exhibited elevated recovery in sample *MW-44-20212405*.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

1,2-Dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-chlorophenol, 2-methylphenol, benzyl alcohol, bis(2-chloroethyl)ether, hexachloroethane, n-nitrosodiphenylamine, n-nitroso-di-n-propylamine, and phenol are associated with the surrogate phenol-d5. These non-detect SVOC results of samples *MW-75-20212405*, *MW-54-20212405*, *MW-67-20212405*, *MW-32-20212405*, and *MW-102-20212405* are considered estimated with a low analytical bias and are flagged J* in the summary table.

1,1-Dichloroethene, cis-1,2-dichloroethene, benzene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride are associated with the surrogate 1,2-dichloroethane-d4. The sample *MW-44-20212405* did not contain detectable concentrations of these compounds. The results are therefore unaffected by the elevated surrogate recovery.

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iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applies qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐

Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐

Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐

Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐

Comments:

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ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

The field duplicate samples *MW-32-20212405* and *MW-102-20212405* were submitted with this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated by the detected results of the field duplicate samples was within the recommended DQO of 30% for all analytes except 1-methylnaphthalene, 2-methylnaphthalene, and DRO. The 1-methylnaphthalene and 2-methylnaphthalene results of these samples were previously qualified as false positives due to a method blank detection. The DRO results of these samples may lack precision and are considered estimated. These results are flagged J* in the summary table.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality is affected; see above for applied qualifiers.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank was not submitted with this work order.

i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; An equipment blank was not submitted with this work order.

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iii. Data quality or usability affected?

Comments:

We cannot assess whether equipment-based sample cross-contamination occurred for these results.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory applied the Q-flag to the surrogate 1,2-dichloroethane-d4 recovery for sample *MW-44-20212405*.

The laboratory applied the Q-flag to the 4-chlorophenylphenyl ether, n-nitroso-di-n-propylamine, 2-nitroaniline, 3-nitroaniline, diethyl phthalate, hexachlorobenzene, and the surrogate 2,4,6-tribromophenol recoveries of the associated laboratory QC samples.

The laboratory applied the B-flag to all field samples with detectable concentrations of bis(2-ethylhexyl)phthalate.

The H-flag was applied to the dissolved mercury results due to the holding time exceedance.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

January 21, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

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Laboratory Report Date:

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Project Number

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☒ No ☐ N/A ☐ Comments:

The total and dissolved mercury analyses were subcontracted to Fremont Analytical.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples *EB-2-20212505*, *MW-53-20212505*, *MW-10R-20212505*, and *MW-11-20212505*. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples were delivered to the laboratory on the same day as they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial calibration verification (ICV) exhibited high recovery for the surrogate 2,4,6-tribromophenol. The laboratory flagged associated samples with a Q-flag to identify the QC failure. Refer to Section 4.d for further assessment.

The Method SW8270E semi-volatile organic compounds (SVOC) surrogate phenol-d5 exhibited low recovery in sample EB-2-20212505. Conversely, the surrogate 2,4,6-tribromophenol exhibited elevated recovery for this sample. Refer to Section 6.d for further assessment.

The Method 7470 analyses for dissolved mercury were conducted outside of the method required holding time. This occurred because an instrument failure at ARI necessitated subcontracting the analyses to Fremont Analytical. The delay caused the samples to break hold.

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c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The report was revised to correct the reported list of volatile organic compounds (VOCs) and metals.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the surrogate 2,4,6-tribromophenol recoveries for sample *EB-2-20212505* and several laboratory QC samples.

The H-flag was applied to the total and dissolved mercury results due to the holding time exceedance.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The Method 7470 analyses for dissolved mercury were conducted outside of the method required holding time. This occurred because of instrument failure at ARI necessitated subcontracting the analyses to Fremont Analytical. The delay caused the samples to break hold.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

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e. Data quality or usability affected?

The dissolved mercury results of the project samples reported with this work order are assumed to have a low analytical bias due to the holding time exceedance. Mercury was not detected in the field samples. The non-detect results are flagged J* in the summary table.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Manganese-55 and nickel-60 were detected below the RL in the method blank sample associated with batch BJF0279.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

The samples either do not contain detectable concentrations of manganese-55 or the detections are greater than 10X that of the concentration detected in the method blank.

The sample *MW-53-20212505* contains a concentration of nickel-60 that is within 5X that of the concentration detected in the method blank.

The sample *MW-10R-20212505* contains a concentration of nickel-60 that is within 10X that of the concentration detected in the method blank.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The nickel-60 result of sample *MW-53-20212505* is assumed to be an artifact of laboratory contamination and is considered a false positive. This result is flagged 'B*' to identify the external analyte contributions.

The nickel-60 result of sample *MW-10R-20212505* is assumed to have a high analytical bias and is flagged JH* in the summary table.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☒ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, DRO, and PCBs analyses.

An LCS was reported for PAHs analysis. No measure of method precision was provided.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS was reported for both total isotopic metals analysis. No measure of method precision was provided.

LCS and laboratory duplicate samples were reported for dissolved isotopic metals and mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and, where applicable, precision were demonstrated to be within acceptable limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The results do not require qualification; see above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for the PAHs and total isotopic metals analyses.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were only reported for dissolved isotopic metals and mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and precision were demonstrated to be within acceptable limits for dissolved isotopic metals and mercury.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The results do not require qualification; see above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for the total isotopic metals analysis.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E ICV exhibited high recovery for the surrogate 2,4,6-tribromophenol.

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the equipment blank sample EB-2-20212505.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

1,2-Dichlorobenzene, 1,4-dichlorobenzene, and n-nitrosodiphenylamine are associated with the surrogate phenol-d5. These compounds were not detected in the equipment blank sample *EB-2-20212505*. These non-detect results are considered estimated and flagged J* in the summary table.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applies qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

The equipment blank sample EB-2-20212505 was submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Naphthalene was detected at an estimated concentration below the RL in the equipment blank sample.

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

Naphthalene was not detected in the other field samples. The results are therefore unaffected by equipment contamination.

iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory applied the Q-flag to the surrogate 2,4,6-tribromophenol recoveries for sample *EB-2-20212505* and several laboratory QC samples.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

January 21, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21E0323

Laboratory Report Date:

December 14, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21E0323

Laboratory Report Date:

December 14, 2021

Report Name:

Lower Duwamish

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☒ No ☐ N/A ☐ Comments:

The total and dissolved mercury analyses were subcontracted to Fremont Analytical.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples MW-7-20212705 and MW-47-20212705. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that one vial for sample MW-47-20212705 was received with a hairline fracture in the container which allowed for some sample volume to trickle out. The laboratory disposed of the broken container.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples were delivered to the laboratory on the same day as they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt. The broken sample vial was not used for analysis.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial calibration verification (ICV) and continuing calibration verification (CCV) exhibited high recovery for n-nitroso-di-propylamine, 2-nitroaniline, 3-nitroaniline, diethyl phthalate, hexachlorobenzene, and the surrogate 2,4,6-tribromophenol. The laboratory flagged associated samples with a Q-flag to identify the QC failure. Refer to Section 4.d for further assessment.

The Method SW8270E laboratory control sample (LCS) and LCS duplicate (LCSD) exhibited low recoveries for 4-chloroaniline and hexachlorocyclopentadiene. Additionally, the relative precision demonstrated between the 3,3'-dichlorobenzidine recoveries of the LCS and LCSD did not meet acceptance criteria. Refer to Section 6.b for further assessment.

The Method 6020B matrix spike (MS) reported with batch BJF0554 exhibited high recovery for nickel. Refer to section 6.c for further assessment.

The Method 7470 analyses for total and dissolved mercury were conducted outside of the method required holding time. This occurred because an instrument failure at ARI necessitated subcontracting the analyses to Fremont Analytical. The delay caused the samples to break hold.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The report was revised to correct the reported list of volatile organic compounds (VOCs) and metals.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the n-nitroso-di-propylamine, 2-nitroaniline, 3-nitroaniline, diethyl phthalate, hexachlorobenzene, and the surrogate 2,4,6-tribromophenol results of the QC samples in batch BJF0002.

The H-flag was applied to the dissolved mercury results due to the holding time exceedance.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

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b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The Method 7470 analyses for dissolved mercury were conducted outside of the method required holding time. This occurred because of an instrument failure at ARI necessitated subcontracting the analyses to Fremont Analytical. The delay caused the samples to break hold.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Dissolved chromium and several SVOC analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

The dissolved mercury results of the project samples reported with this work order are assumed to have a low analytical bias due to the holding time exceedance. Mercury was not detected in the field samples. The non-detect results are flagged J* in the summary table.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Mercury was detected below the RL in the method blank sample associated with batch BJF0354. However, this detection does not apply to the project samples because the mercury analyses were conducted by Fremont Analytical.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

The samples were not affected by laboratory contamination.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification is not required; see above.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for VOCs, SVOCs, and PCBs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for both total and dissolved mercury and chromium, and hexavalent chromium analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

4-Chloroaniline exhibited low recovery in the LCS reported with batch BJF0002.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the hexachlorocyclopentadiene and 3,3'-dichlorobenzidine recoveries of the LCS and LCSD did not meet acceptance criteria.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The non-detect 4-chloroaniline result of sample *MW-47-20212705* may be affected by low method recovery.

The non-detect hexachlorocyclopentadiene and 3,3'-dichlorobenzidine results of samples *MW-47-20212705* may lack precision.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 3,3'-dichlorobenzidine, 4-chloroaniline, and hexachlorocyclopentadiene results of sample *MW-47-20212705* are considered estimated non-detections and flagged J* in the summary table.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for both total and dissolved mercury and chromium.

An MS sample was reported for hexavalent chromium analysis. Refer to section 6.b.iv for assessment of method precision.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The EPA Method 7470 MS and MSD samples reported with Fremont batch 32769 exhibited complete recovery failures for total mercury.

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The parent sample from which the total mercury MS/MSD samples were spiked is not a field sample associated with this project. Potential matrix impacts on method recovery are not applicable to the reported samples.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The results did not require qualification; see above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E ICV and CCV exhibited high recovery for the surrogate 2,4,6-tribromophenol.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☒ N/A ☐ Comments:

Review of ICV and CCV results are outside the scope of a stage II review. Additionally, the surrogate recoveries in the associated LCS/LCSD were within acceptable limits.

iv. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank was not submitted with this work order.

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; see above.

iii. Data quality or usability affected?

Comments:

We cannot assess whether foreign contaminants were introduced into the samples through equipment contamination.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory applied the Q-flag to the n-nitroso-di-propylamine, 2-nitroaniline, 3-nitroaniline, diethyl phthalate, hexachlorobenzene, and the surrogate 2,4,6-tribromophenol results of the QC samples in batch BJJ0002.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

January 20, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21E0352

Laboratory Report Date:

December 14, 2021

Report Name:

Lower Duwamish

Project Number

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21E0352

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☒ No ☐ N/A ☐ Comments:

The total and dissolved mercury analyses were subcontracted to Fremont Analytical.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

We note that a date was only listed for the first sample on the COC. The intent was for this date to apply to all samples on the COC.

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples MW-8-20212605, Decon-20212605, MW-4-20212605, MW-52-20212605, MW-70-20212605, and MW-69-20212605. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples were delivered to the laboratory on the same day as they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial calibration verification (ICV) exhibited high recovery for the surrogate 2,4,6-tribromophenol. The laboratory flagged associated samples with a Q-flag to identify the QC failure. Refer to Section 4.d for further assessment.

The Method SW8270E semi-volatile organic compounds (SVOC) surrogate phenol-d5 exhibited low recovery in the method blank and samples *Decon-20212605* and *MW-69-20212605*. Refer to Section 6.d for further assessment.

The Method 6020B matrix spike duplicate (MSD) reported with batch BJF0328 exhibited low recoveries for calcium and magnesium. Refer to section 6.c for further assessment.

The Method 6020B matrix spike (MS) and MSD reported with batch BJF0379 exhibited low recoveries for dissolved lead. Refer to section 6.c for further assessment.

The Method 7470 analyses for total and dissolved mercury were conducted outside of the method required holding time. This occurred because an instrument failure at ARI necessitated subcontracting the analyses to Fremont Analytical. The delay caused the samples to break hold.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The report was revised to correct the reported list of volatile organic compounds (VOCs) and metals.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the surrogate 2,4,6-tribromophenol recoveries for samples *Decon-20212605* and *MW-69-20212605* and several laboratory QC samples.

The laboratory applied the * qualifier to the surrogate phenol-d5 recoveries for samples *Decon-20212605* and *MW-69-20216905*.

The H-flag was applied to the total and dissolved mercury results due to the holding time exceedance.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The Method 7470 analyses for total and dissolved mercury were conducted outside of the method required holding time. This occurred because an instrument failure at ARI necessitated subcontracting the analyses to Fremont Analytical. The delay caused the samples to break hold.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

The total and dissolved mercury results of the project samples reported with this work order are assumed to have a low analytical bias due to the holding time exceedance. Mercury was not detected in the field samples. The non-detect results are flagged J* in the summary table.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

The PAH analytes naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene were detected below the RL in the method blank sample associated with batch BJF0019.

Barium was detected below the RL in the method blank sample associated with batch BJF0328.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

The samples *MW-52-20212605* and *MW-70-20212605* contain 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene concentrations within 5X that of the concentration detected in the method blank.

The samples either do not contain detectable concentrations of barium or the detections are greater than 10X that of the concentration detected in the method blank.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene results of samples *MW-52-20212605* and *MW-70-20212605* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged 'B*' to identify the external analyte contributions.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for both total and dissolved isotopic metals and mercury analyses.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and precision were demonstrated to be within acceptable limits.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The results do not require qualification; see above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for both total and dissolved isotopic metals and mercury analyses.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The EPA Method 7470 MS and MSD samples reported with Fremont batch 32769 exhibited complete recovery failures for total mercury.

The EPA Method 600 MS and MSD samples reported with batch BJF0328 exhibited low recoveries for manganese-55 that were outside of acceptable limits.

The EPA Method 600 MSD sample reported with batch BJF0328 exhibited low recovery for magnesium-24.

The EPA Method 600 MS and MSD samples reported with batch BJF0379 exhibited low recoveries for dissolved lead-208.

The EPA Method 600 MSD sample reported with batch BJF0379 exhibited low recovery for dissolved manganese-55.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The parent sample from which the total mercury MS/MSD samples were spiked is not a field sample associated with this project. Potential matrix impacts on method recovery are not applicable to the reported samples.

The parent sample *MW-8-20212605* is not affected by the MS/MSD (batch BJF0328) recovery failures for manganese-55. The manganese-55 spike added to the matrix was grossly low compared to the native concentration in the parent sample. The discrepancy in concentrations renders the spike recovery unquantifiable.

The parent sample *MW-8-20212605* is not affected by the MSD (batch BJF0328) recovery failure for magnesium-24. The magnesium-24 spike added to the matrix was grossly low compared to the native concentration in the parent sample. The discrepancy in concentrations renders the spike recovery unquantifiable.

The matrix of parent sample *MW-69-20212605* may be adversely affecting method recovery for dissolved lead isotope 208 as evidenced by the low recovery of the spiking concentration in the MS/MSD reported with batch BJF0379.

The parent sample *MW-69-20212605* is not affected by the MSD (batch BJF0379) recovery failure for dissolved manganese-55. The dissolved manganese-55 spike added to the matrix was grossly low compared to the native concentration in the parent sample. The discrepancy in concentrations renders the spike recovery unquantifiable.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect dissolved lead-208 result of sample *MW-69-20212605* is considered estimated due to the low method recovery. It is flagged J* in the summary table.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

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- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E ICV exhibited high recovery for the surrogate 2,4,6-tribromophenol.

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the method blank and samples *Decon-20212605* and *MW-69-20212605*.

- iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

1,2-Dichlorobenzene, 1,4-dichlorobenzene, and n-nitrosodiphenylamine are associated with the surrogate phenol-d5. Detected concentrations of these analytes in the SVOC results of samples *Decon-20212605* and *MW-69-20212605* are considered estimated with a low analytical bias and are flagged JL*. Non-detect results are considered estimated and flagged J* in the summary table.

- iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applies qualifiers.

e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

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iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

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- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

The decontamination blank sample *Decon-20212605* was submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Manganese-55 and dissolved silver-107 were detected at estimated concentrations below the RL in the decontamination blank sample.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

Sample *MW-8-20212605* contains a dissolved silver-107 concentration within 5X that of the concentration detected in the decontamination blank sample, implying that this could be an artifact of equipment contamination. This result is considered a false-positive and is flagged B* at the LOQ in the summary table.

- iii. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

- a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the surrogate 2,4,6-tribromophenol recoveries for samples *Decon-20212605* and *MW-69-20212605* and several laboratory QC samples.

The laboratory applied the * qualifier to the surrogate phenol-d5 recoveries for samples *Decon-20212605* and *MW-69-20216905*.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

January 20, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21E0361

Laboratory Report Date:

December 14, 2021

Report Name:

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Project Number

21-1-12596-035

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The project samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples MW-3-20212805 and MW-39-20212805. These containers were preserved with 0.3 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples were delivered to the laboratory on the same day as they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☐ No ☐ N/A ☒ Comments:

There were no discrepancies, errors, or QC failures noted in the case narrative.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The report was revised to correct the reported list of volatile organic compounds (VOCs).

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The case narrative does not imply that the data are affected.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium was not detected in one of the included samples and reported at a limit of detection (LOD) which is greater than the associated regulatory limit.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the method blank samples.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification was not required; see above.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

An LCS and laboratory duplicate samples were reported for both total and dissolved isotopic metals and hexavalent chromium analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and precision were demonstrated to be within acceptable limits.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

No samples are affected; see above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS and laboratory duplicate samples were reported for both total isotopic metals and hexavalent chromium analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

MSD samples were not reported for this batch. Refer to section 6.b.iv for assessment of method precision.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy was demonstrated to be within acceptable limits.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The results did not require qualification; see above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

There are no surrogate recovery failures for the reported samples.

iv. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

- v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

- iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒ Comments:

No additional data flags/qualifiers are required.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Dana Fjare / Validated by: Michael Jaramillo

Title:

Environmental Scientist / Senior Chemist

Date:

January 25, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21H0207

Laboratory Report Date:

September 6, 2021

Report Name:

Lower Duwamish Q3

Project Number

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21H0207

Laboratory Report Date:

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Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The project samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☐ No ☒ N/A ☐ Comments:

The sample cooler was 13.9 degrees Celsius upon receipt by the laboratory.

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under-preserved for samples MW-46-20211708 and MW-71-20211708.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory report noted that samples were received in acceptable condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory noted that the samples were packed in ice. Temperature exceedances are considered not to affect sample results if samples are submitted to the laboratory on the day of collection and if the samples are packed in ice. The laboratory adjusted the pH of the under-preserved sample volume upon receipt. Data quality and usability were not affected.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8082A polychlorinated biphenyl (PCB) method blank, blank spike, and blank spike duplicate and sample MW-71-20211708 exhibited low recoveries for the surrogate tetrachlorometaxylene.

The Method SW8270E semi-volatile organic compounds (SVOC) initial and continuing calibrations exhibited low recovery of pentachlorophenol.

The SVOC method blank exhibited low recovery for the surrogate phenol-d5.

Total manganese was detected in the Method 6020B method blank.

The Wet Chemistry matrix spike (MS) and post-preparation spike percent recoveries were outside of laboratory control limits (low). Deviations have been flagged.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

Corrective actions were not documented.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the pentachlorophenol results in the project samples.

The laboratory applied the B-flag to the total manganese results in the project samples.

Refer to subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

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c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Dissolved chromium, dissolved mercury, and various SVOC and PAH analytes were not detected in the included samples and were reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project-specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

The polynuclear aromatic hydrocarbon (PAH) analyte naphthalene was detected below the RL in the method blank sample associated with batch BJH0469.

Manganese was detected above the RL in the method blank sample associated with batch BJH0670.

Dissolved mercury was detected below the RL in the method blank sample associated with batch BJH0599.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

The samples *MW-46-20211708* and *MW-71-20211708* are associated with batch BJH0469, BJH0670, and BJH0599.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The naphthalene concentration in samples *MW-46-20211708* and *MW-71-20211708* is less than the RL and within five times the concentration detected in the method blank. The sample results are considered estimated non-detections and are flagged 'UB' at the RL in the analytical data tables.

Manganese was detected in both *MW-46-20211708* and *MW-71-20211708* at a concentration greater than ten times the concentration detected in the method blank. The results did not require qualification for the method blank detection.

Dissolved mercury was not detected in either *MW-46-20211708* or *MW-71-20211708*, so the results did not require qualification for the method blank detection.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for SVOC, PAH, DRO, and PCB analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

An LCS was reported for mercury, total metals, and dissolved metals analyses. We have no measure of method precision for these analyses.

An LCS and laboratory duplicate were reported for dissolved mercury and hexavalent chromium analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; LCS and LCSD accuracy and precision were within laboratory control limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

LCS and LCSD accuracy and precision were within laboratory control limits.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality and usability were not affected.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for dissolved mercury analysis.

An MS sample was reported for hexavalent chromium analysis.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The hexavalent chromium MS exhibited low recovery.

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The parent sample for the MS and MSD is project sample *MW-46-20211708*.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Hexavalent chromium was not detected in the parent sample. The result is considered affected by the low MS recovery and is considered an estimated non-detected result. The hexavalent chromium result in *MW-46-20211708* is flagged 'UJ' to qualify the imprecision.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality and usability are affected; see above for applied qualifiers.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The Method 8082A polychlorinated biphenyl (PCB) surrogate tetrachlorometaxylene exhibited low recovery in project sample *MW-71-20211708*, method blank BJH0467-BLK1, blank spike BJH0467-BS1, and blank spike duplicate BJH0467-BSD1.

The SVOC surrogate phenol-d5 exhibited low recovery in the method blank BJH0468-BLK1.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

PCB analytes were not detected in project sample *MW-71-20211708*. The results are considered affected by the low surrogate recovery for both columns analyzed. However, the other surrogate was within QC limits. The non-detect results for this sample are considered estimated and flagged 'UJ' to qualify the imprecision.

Project samples are not affected by surrogate recovery failures in QC samples.

iv. Data quality or usability affected?

Comments:

The data quality and usability is affected; see above for qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☐ No ☐ N/A ☒ Comments:

Volatile sample analysis was not requested with this work order.

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☐ N/A ☒ Comments:

A trip blank was not submitted with this work order.

iii. All results less than RL and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

A trip blank was not submitted with this work order.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; a trip blank was not submitted with this work order.

v. Data quality or usability affected?

Comments:

The data quality and usability is not affected.

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality and usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

iii. Data quality or usability affected?

Comments:

The data quality and usability is not affected.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory applied the E-flag to the PAH analyte acenaphthene in *MW-46-20211708* which exceeded the instrument calibration range. The sample was re-analyzed at a three-fold dilution. We have reported the re-analyzed results only for those analytes that were E-flagged, and otherwise report the original, undiluted sample results.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Dana Fjare / Validated by: Michael Jaramillo

Title:

Environmental Scientist / Senior Chemist

Date:

January 26, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21H0209

Laboratory Report Date:

September 6, 2021

Report Name:

Lower Duwamish Q3

Project Number

21-1-12596-035

21H0209

Laboratory Report Date:

September 6, 2021

Report Name:

Lower Duwamish Q3

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The project samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☐ No ☒ N/A ☐ Comments:

The sample cooler was 12.2 degrees Celsius upon receipt by the laboratory.

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under-preserved for samples MW-68-20211708 and MW-76-20211708.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory report noted that samples were received in acceptable condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory noted that the samples were packed in ice. Temperature exceedances are considered not to affect sample results if samples are submitted to the laboratory on the day of collection and if the samples are packed in ice. The laboratory adjusted the pH of the under-preserved sample volume upon receipt. Data quality and usability were not affected.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8082A polychlorinated biphenyl (PCB) method blank, blank spike, and blank spike duplicate and sample MW-68-20211708 exhibited low recovery for the surrogate tetrachlorometaxylene.

The blank spike and blank spike duplicate relative percent difference (RPD) exceeded laboratory control limits for the PCB analyte aroclor 1016.

The Method SW8270E semi-volatile organic compounds (SVOC) initial and continuing calibrations were within method requirements except 2,4-dinitrophenol, pentachlorophenol, and 3,3-dichlorobenzene were recovered below laboratory control limits. Fluoranthene was recovered in exceedance of laboratory control limits.

The SVOC surrogate phenol-d5 exhibited low recovery in the method blank.

The SVOC blank spike and blank spike duplicate exhibited low recovery for 4-chloroaniline.

Total manganese was detected above the reporting limit (RL) in the method blank.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

Corrective actions were not documented.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the 2,4-dinitrophenol, pentachlorophenol, fluoranthene, and 3,3-dichlorobenzene results in the project samples.

The laboratory applied the B-flag to the total manganese results in the project samples.

Refer to subsequent sections for further assessment.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Dissolved chromium, total chromium, and various SVOC and PAH analytes were not detected in the included samples and were reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project-specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

The SVOC analyte phenol was detected below the RL in the method blank sample associated with batch BJH0468.

The polynuclear aromatic hydrocarbon (PAH) analyte naphthalene was detected below the RL in the method blank sample associated with batch BJH0469.

Manganese was detected above the RL in the method blank sample associated with batch BJH0670.

Dissolved mercury was detected below the RL in the method blank sample associated with batch BJH0599.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

The samples *MW-68-20211708* and *MW-76-20211708* are associated with batch BJH0468, BJH0670, and BJH0599.

The sample *MW-76-20211708* is associated with batch BJH0469.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The naphthalene concentration in samples *MW-76-20211708* is less than the RL and within five times the concentration detected in the method blank. The sample result is considered an estimated non-detection and is flagged 'UB' at the RL in the analytical data tables.

Manganese was detected in both *MW-68-20211708* and *MW-76-20211708* at a concentration greater than ten times the concentration detected in the method blank. The results did not require qualification for the method blank detection.

Dissolved mercury was detected in *MW-68-20211708* and *MW-76-20211708* at a concentration less than the RL and within five times the concentration detected in the method blank. The sample results are considered estimated non-detections and are flagged 'UB' at the RL in the analytical data tables.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

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b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for SVOC, PAH, DRO, and PCB analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

An LCS was reported for mercury, dissolved mercury, calcium and magnesium, total metals, and dissolved metals analyses. No measure of method precision was provided for this batch.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

4-Chloroaniline exhibited low recovery in the LCS and LCS duplicate in batch BJH0468.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The project samples MW-68-20211708 and MW-76-20211708 are associated with batch BJH0468.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The analyte 4-chloroaniline was not detected in either project sample. Due to the low LCS/LCSD recovery, the 4-chloroaniline results are considered estimated non-detected results and are flagged 'UJ' to qualify the imprecision.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality and usability were affected; see above.

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c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for calcium and magnesium, iron and manganese, and dissolved metals.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The MS and MSD associated with batch BJH0642 exhibited low recovery for dissolved manganese.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The parent sample for the MS and MSD is project sample MW-68-20211708.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The recovery of the matrix spike cannot be evaluated because the concentration of dissolved manganese in the parent sample is greater than the spiking concentration. Consequently, the project sample results are considered unaffected by the low matrix spike recovery.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality and usability are not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The Method 8082A polychlorinated biphenyl (PCB) surrogate tetrachlorometaxylene exhibited low recovery on both columns in project sample *MW-68-20211708*, the method blank, LCS, and LCSD.

The SVOC surrogate phenol-d5 exhibited low recovery in the method blank BJH0468-BLK1.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

PCB analytes were not detected in project sample *MW-68-20211708*. The results are considered estimated non-detected results and are flagged 'UJ' to qualify the imprecision.

Laboratory quality control samples do not require qualification for surrogate recovery failures. The blank spike and blank spike duplicate recovery for PCB analytes was within laboratory acceptance limits.

iv. Data quality or usability affected?

Comments:

The data quality and usability is affected; see above for qualifiers.

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e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☐ No ☐ N/A ☒ Comments:

Volatile sample analysis was not requested with this work order.

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☐ N/A ☒ Comments:

A trip blank was not submitted with this work order.

- iii. All results less than RL and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

A trip blank was not submitted with this work order.

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; a trip blank was not submitted with this work order.

- v. Data quality or usability affected?

Comments:

The data quality and usability is not affected.

f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality and usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

- iii. Data quality or usability affected?

Comments:

The data quality and usability is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒ Comments:

Other data flags and qualifiers were not required.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Veselina Yakimova / Validated by: Michael Jaramillo

Title:

Geology Staff / Senior Chemist

Date:

February 4, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21H0210

Laboratory Report Date:

September 3, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21H0210

Laboratory Report Date:

September 3, 2021

Report Name:

Lower Duwamish

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

All project analyses were performed by ARI.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☐ No ☒ N/A ☐ Comments:

The cooler arrived at 18.9° C. We suspect here was not enough time for the cooler temperature to adjust as the samples were delivered to the lab the same day they were collected.

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples were delivered to the laboratory on the same day as they were collected. The laboratory indicates there was a sufficient amount of ice in the cooler.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☐ No ☐ N/A ☒ Comments:

No discrepancies, errors or QC failures were identified by the lab.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

No corrective actions required.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The data quality/usability is not affected.

21H0210

Laboratory Report Date:

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Report Name:

Lower Duwamish

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Several SVOC analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

No samples are affected; no qualification is required.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

No samples are affected; no qualification is required.

v. Data quality or usability affected?

Comments:

The data quality is not affected; see above.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, BTEX and HVOCs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals analysis was not part of this work order.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

No samples are affected; no qualification is required.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is not affected; see above.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals analysis was not part of this work order.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported in this work order.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported in this work order.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

No samples are affected.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

No samples are affected; no qualification is required.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

No samples are affected; no qualification is required.

iv. Data quality or usability affected?

Comments:

The data quality is not affected.

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e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

However, toluene was detected at an estimated concentration below the RL in the trip blank sample.

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

Sample MW-71-20211708 had a detection for toluene within five times the trip blank detection. The sample result is considered non-detect and is flagged "UB" at the RL.

- v. Data quality or usability affected?

Comments:

The data quality/usability is affected.

f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration

R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

An equipment/decontamination blank was not submitted with this work order. However, decontamination blanks were collected at the required frequency for the overall project.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment/decontamination blank was not submitted with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

An equipment/decontamination blank was not submitted with this work order.

- iii. Data quality or usability affected?

Comments:

The data quality is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒ Comments:

No other data flags/qualifiers applied.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Veselina Yakimova / Validated by: Michael Jaramillo

Title:

Geology Staff / Senior Chemist

Date:

February 4, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21H0222

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Project Number

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

All analyses were performed by ARI.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples *MW-36-20211808*, *MW-38-20211808*, *MW-42-20211808*, *MW-67-20211808*, and *MW-103-20211808*. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

Air bubbles were documented in the one of the VOA vials for samples *MW-36-20211808*, *MW-38-20211808* and *MW-103-20211808*.

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

- e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples were delivered to the laboratory on the same day as they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

Samples for volatile analyses were not performed with containers documented to have air bubbles. Reported results are not affected by the sample handling anomaly.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial and continuing calibration verifications exhibited high recovery for 2-Nitrophenol, 2,4,6-Trichlorophenol, 2-Nitroaniline, Fluoranthene, Butylbenzylphthalate and bis(2-Ethylhexyl)Phthalate; and low recovery for Pentachlorophenol. The low concentration calibration verification was out of control low for 2,4-Dinitrophenol, Hexachlorocyclopentadiene and Pentachlorophenol. The laboratory flagged associated samples with a Q-flag to identify the QC failure. Refer to Section 4.d for further assessment.

The Method SW8270E Phenol-d5 surrogate recovery was low in project sample *MW-67-20211808*, the method blank, the blank spike (BS/LCS) and the BS/LCS duplicate (BSD/LCSD).

The Method SW8270E BS/LCS and BSD/LCSD exhibited low recovery and a relative percent difference (RPD) outside laboratory limits for Phenol, Benzoic Acid, 4-Chloroaniline and 4-Nitrophenol. Refer to Section 6.b for further assessment.

The Method 6020B total manganese method blank was outside of reporting limits. Refer to Section 6.a for further assessment.

The holding time for Sulfite was exceeded upon sample receipt.

The wet chemistry laboratory duplicate RPD was outside control limits for sulfate in preparatory batch BJH0487. The laboratory applied the *-flag.

The Method NW-TPHDx BS/BSD RPD was outside control limits due to loss of the BSD in extraction and has been flagged.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

See above.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The holding time for Sulfite was exceeded upon sample receipt.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Several SVOC analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

bis(2-Ethylhexyl)phthalate was detected at the RL in the method blank associated with batch BJH0569.

Manganese was detected below the RL in the method blank associated with batch BJH0670.

Dissolved mercury was detected below the RL in the method blank associated with batch BJH0611.

Dissolved copper was detected below the RL in the method blank associated with batch BJI0013.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

Project sample *MW-67-20211808* did not contain detectable concentrations of bis(2-Ethylhexyl)phthalate. No qualification required.

All project samples had concentrations of manganese more than 10 times the method blank detection, so they are not considered affected. No qualification required.

Project samples *MW-36-20211808*, *MW-42-20211808* and *MW-67-20211808* had concentration of dissolved mercury less than the RL and are flagged "UB" at the RL.

Dissolved copper was not detected in sample *MW-36-20211808* and was detected at concentration 10 times higher than the method blank concentration in sample *MW-67-20211808*. No qualification required.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above for required qualification.

v. Data quality or usability affected?

Comments:

The data quality is not affected; see above.

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b. Laboratory Control Sample/Duplicate (LCS/LCSD)

- i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, DRO, and PCBs analyses.

- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for both total and dissolved isotopic metals, wet chemistry, and mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The LCS and LCS duplicate exhibited low recovery for phenol, benzoic acid and 4-chloroaniline, and the LCS exhibited low recovery for 4-nitrophenol in batch BJH0569.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The DRO RPD for the LCS/LCSD in batch BJH0530 was above the laboratory limits.

The laboratory duplicate for batch BJH0508 had an RPD failure for sulfate.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

4-nitrophenol, phenol, benzoic acid, and 4-chloroaniline were not detected in sample *MW-67-20211808* and are flagged 'UJ' to identify the low LCS/LCSD recoveries.DRO were detected in sample *MW-36-20211808* and were flagged 'J' to identify the LCS/LCSD RPD failure.DRO were not detected in samples *MW-38-20211808*, *MW-42-20211808*, and *MW-103-20211808*, and were flagged 'UJ' to identify the LCS/LCSD RPD failure.Sulfate in sample *MW-36-20211808* was flagged 'J' to identify the RPD failure in the laboratory duplicate.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above for applied qualifiers.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for both total and dissolved isotopic metals and mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

No samples affected.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

No qualification is required.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:The Method SW8270E Phenol-d5 surrogate recovery was low in project sample *MW-67-20211808*, the method blank, the blank spike (BS/LCS) and the BS/LCS duplicate (BSD/LCSD) in batch BJH0569.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2-Chlorophenol, 2-Methylphenol, 4-Methylphenol, Benzyl alcohol, Bis(2-Chloroethyl)ether, Hexachloroethane, N-Nitroso-di-n-propylamine, and Phenol were not detected in *MW-67-20211808* and are flagged “UJ” to identify the low Phenol-d5 surrogate recovery.

The surrogate recovery failure in the QC samples does not affect the associated project samples.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for qualification of results.

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e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Toluene was detected below the RL in the associated trip blank.

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

All samples were submitted for VOC analysis. However, toluene was not detected in any of the project samples.

- v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples MW-38-20211808 and MW-103-20211808 were submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☒ N/A ☐ Comments:

The dissolved manganese results exceed the RPD limit and are flagged “J” to identify the discrepancy.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is affected. See above for required qualification.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

An equipment/decontamination blank was not submitted with this work order. However, decontamination blanks were collected at the required frequency for the overall project.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment/decontamination blank was not submitted with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

An equipment/decontamination blank was not submitted with this work order.

- iii. Data quality or usability affected?

Comments:

The data quality is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to 2-Nitrophenol, 2,4,6-Trichlorophenol, 2-Nitroaniline, Fluoranthene, Butylbenzylphthalate, Pentachlorophenol, and 2,4-Dinitrophenol for the LCS/LCSD recoveries in batch BJH0569.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Veselina Yakimova / Validated by: Michael Jaramillo

Title:

Geology Staff / Senior Chemist

Date:

February 4, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

All analyses were performed by ARI.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no documented discrepancies.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method 6020B total manganese method blank was outside of reporting limits. Refer to Section 6.a for further assessment.

The Method 6020B dissolved manganese and dissolved chromium matrix spike (MS) was outside of reporting limits. Refer to Section 6.c for further assessment.

The Method NW-TPHDx DRO blank spike and blank spike duplicate (LCS and LCSD) relative percent difference (RPD) was outside control limits and has been flagged. Section 6.b for further assessment.

Batch BJH0530 LCSD leaked during the extraction process on the first shake out. Lost ~3-5% of solution.

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c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory does not specify an effect on the data; refer to subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Several SVOC analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Manganese was detected below the RL in the method blank associated with batch BJH0670.

- iii. If above RL or project specified objectives, what samples are affected?

Comments:

Project sample *MW-43-20211908* had a concentration of manganese more than 10 times the method blank detection, so it is not considered affected. No qualification required.

- iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☒ N/A ☐ Comments:

No qualification required.

- v. Data quality or usability affected?

Comments:

The data quality is not affected; see above.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

- i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, DRO, and PCBs analyses.

- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for both total and dissolved isotopic metals, wet chemistry, and mercury analyses.

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- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The DRO RPD for the LCS/LCSD in batch BJH0530 was above the laboratory limits.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

DRO were detected in samples *MW-43-20211908* and *MW-67-20211908* and were flagged 'J' to identify the high LCS/LCSD RPD.

DRO were not detected in sample *MW-39-20211908* and were flagged 'UJ' to identify the high LCS/LCSD RPD.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above for applied qualifiers.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for both total and dissolved isotopic metals and mercury analyses.

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- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The dissolved chromium and dissolved manganese MS recoveries were lower than the laboratory limits.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Project sample *MW-39-20211908* was used as the parent sample for the MS analysis.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Dissolved chromium and dissolved manganese were detected in project sample *MW-39-20211908* and results are flagged “JL” to identify the low MS recoveries.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected, see above for qualification of results.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Data quality or usability affected?

Comments:

The data quality is not affected.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Toluene was detected below the RL in the trip blank.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

All project samples were submitted for toluene analysis. However, toluene was not detected in any of the project samples.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

An equipment/decontamination blank was not submitted with this work order. However, decontamination blanks were collected at the required frequency for the overall project.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment/decontamination blank was not submitted with this work order.

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

An equipment/decontamination blank was not submitted with this work order.

iii. Data quality or usability affected?

Comments:

The data quality is not affected.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒ Comments:

No additional flags/qualifiers applied.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Veselina Yakimova / Validated by: Michael Jaramillo

Title:

Geology Staff / Senior Chemist

Date:

February 10, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21H0248

Laboratory Report Date:

September 28, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21H0248

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

All analyses were performed by ARI.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples *MW-30-20212008*, *MW-15-20212008*, *EB-1-20212008*, *MW-44-20212008*, *MW-100-20212008* and *MW-54-20212008*. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

Air bubbles were documented in the one of the VOA vials for sample *MW-44-20212008*.

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

- e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples were delivered to the laboratory on the same day as they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

Analyses were not performed for volatile analyses with VOA vials containing bubbles. Reported results are not affected by the sample handling anomaly.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial and continuing calibration verifications exhibited high recovery for Butylbenzylphthalate; and low recovery for Pentachlorophenol. The low concentration calibration verification was out of control low for Pentachlorophenol. The laboratory flagged associated samples with a Q-flag to identify the QC failure. Refer to Section 4.d for further assessment.

The Method SW8270E Phenol-d5 surrogate recovery was low in project sample *MW-54-20212008*, the equipment blank *EB-1-20212008*, the method blank, the blank spike (BS/LCS) and the BS/LCS duplicate (BSD/LCSD). Deviations have been flagged. Refer to Section 6.c for further assessment.

The Method SW8270E 2-Fluorophenol surrogate recovery was low in project sample *MW-54-20212008*. Deviations have been flagged. Refer to Section 6.c for further assessment.

The Method SW8270E bis(2-Ethylhexyl)phthalate method blank was outside of reporting limits. All samples which contain analyte have been flagged with a "B" qualifier. Refer to Section 6.a for further assessment.

The Method SW8270E BS/LCS and BSD/LCSD exhibited low recovery and a relative percent difference (RPD) outside laboratory limits for Benzoic Acid. Refer to Section 6.b for further assessment.

The Method 6020B total manganese method blank was outside of reporting limits. All samples which contain analyte have been flagged with a "B" qualifier. Refer to Section 6.a for further assessment.

The holding time for Sulfite was exceeded upon sample receipt. All samples which contain analyte have been flagged with a "B" qualifier.

The wet chemistry matrix spike (MS) recovery for nitrite was outside control limits and has been flagged.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

See above for applied qualifications and corrective actions.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

See above.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The holding time for Sulfite was exceeded upon sample receipt. Sulfite was not detected in samples MW-15-20212008 and MW-30-20212008. Sample results are considered estimated and flagged "UJ" in the analytical database.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Several SVOC analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

bis(2-Ethylhexyl)phthalate was detected at the RL in the method blank associated with batch BJH0569.

Manganese was detected below the RL in the method blank associated with batch BJH0670.

Naphthalene and 2-Methylnaphthalene were detected below the RL in the method blank associated with batch BJH0570.

Sulfate was detected above the RL in the method blank associated with batch BJH0549.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples *EB-1-20212008* and *MW-54-20212008* did not contain detectable concentrations of bis(2-Ethylhexyl)phthalate. No qualification required.

Samples *EB-1-20212008* and *MW-54-20212008* contained concentrations of Naphthalene and 2-Methylnaphthalene below the RL and are flagged "UB" at the RL.

All project samples had concentrations of manganese more than 10 times the method blank detection, so they are not considered affected. No qualification required.

Sulfate was detected at concentration more than 10 times the concentration in the method blank in samples *MW-30-20212008* and *MW-15-20212008*. No qualification required.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☒ N/A ☐ Comments:

See above for required qualification.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above.

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b. Laboratory Control Sample/Duplicate (LCS/LCSD)

- i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, DRO, and PCBs analyses.

- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for both total and dissolved isotopic metals, wet chemistry and mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The LCS and LCS duplicate exhibited low recovery for benzoic acid in batch BJH0569.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Benzoic acid was not detected in samples *EB-1-20212008* and *MW-54-20212008* and are flagged 'UJ' to identify the low LCS/LCSD recoveries.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above for applied qualifiers.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

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c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for both total and dissolved isotopic metals and mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The MS recovery for Nitrite-N was below the laboratory limits on batch BJH0549.

The MS recovery for ferrous iron was below the laboratory limits on batch BJH05550.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Sample MW-30-20212008 was used as the parent sample for the Nitrite-N and ferrous iron MS analysis. It does not contain Nitrite-N and is flagged “UJ” to identify the low MS recovery. The sample result for ferrous iron is higher than the spiking concentration. The sample result is not considered affected.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above for applied qualification.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E Phenol-d5 surrogate recovery was low in samples *EB-1-20212008*, *MW-54-20212008*, the method blank, the blank spike (BS/LCS) and the BS/LCS duplicate (BSD/LCSD) in batch BJH0569.

The Method SW8270E 2-Fluorophenol surrogate recovery was low in sample *MW-54-20212008*.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The analytes 1,2-dichlorobenzene, 1,4-dichlorobenzene, and benzoic acid are associated with the surrogate phenol-d5. Samples *EB-1-20212008* and *MW-54-20212008* did not have detections for these analytes and the results are flagged “UJ” to identify the low Phenol-d5 surrogate recovery.

N-Nitrosodiphenylamine was not detected in *MW-54-20212008* and is flagged “UJ” to identify the low 2-Fluorophenol surrogate recovery.

The surrogate recovery failure in the QC samples does not affect the associated project samples.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for qualification of results.

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e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Toluene was detected below the RL in the trip blank sample *TB-4-20212008*.

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

Toluene was not detected in samples *MW-44-20212008* and *MW-54-20212008*. No qualification required.

- v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate samples *MW-15-20212008* and *MW-100-20212008* were submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☒ No ☐ N/A ☐ Comments:

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Naphthalene, 2-Methylnaphthalene, 1-Methylnaphthalene, Acenaphthylene, Dibenzofuran, Fluorene, Phenanthrene, Anthracene, Carbazole, Fluoranthene, Pyrene, Iron, Manganese were detected in the equipment blank sample *EB-1-20212008*.

Naphthalene and 2-Methylnaphthalene were detected at similar concentrations in the associated method blank. The equipment blank results are considered non-detect for these analytes due to the method blank contamination.

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

Sample *MW-54-20212008* has a concentration of 1-Methylnaphthalene below the RL and less than 5 times the concentrations detected in the equipment blank. The associated result is flagged “UB” at the RL.

Acenaphthylene, Dibenzofuran, Fluorene, Phenanthrene, Anthracene, Carbazole, Fluoranthene, Pyrene, and Iron were not detected in sample *MW-54-20212008*. No qualification required.

In all project samples manganese was detected at concentrations higher than 10 times the concentration in the equipment blank. No qualification is required.

iii. Data quality or usability affected?

Comments:

The data quality is affected. See above for required qualification.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory applied the Q-flag to Butylbenzylphthalate and Pentachlorophenol for the LCS/LCSD recoveries in batch BJH0569.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Veselina Yakimova / Validated by: Adam Wyborny, PE

Title:

Geology Staff / Senior Environmental Engineer

Date:

February 9, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21H0282

Laboratory Report Date:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

All analyses were performed by ARI.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

The samples *MW-66* and *MW-102* were marked for TPH-G analysis when TPH-Dx is what was intended. This error was resolved in the appended email during the sample login process. The proper analyses were run.

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that *MW-70* lacked a label and was identified by process of elimination.

The sample receipt form also notes that samples *MW-66* and *MW-102* listed 15 containers on the COC but arrived with only 13 containers.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. All samples were identified and there was enough volume provided to run the requested analyses.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method 6020B method blank had a detection of manganese-55 and the associated results were flagged with the "B" qualifier. Refer to Section 6.a for further assessment.

The NW-TPHDx laboratory control sample (LCS) reported with batch BJH0731 exhibited high recovery for diesel range organics (DRO) and was flagged. Refer to Section 6.b for further assessment.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

No corrective actions were documented in the case narrative.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The case narrative does not specify an effect on the data. The laboratory applied qualifiers to the samples containing detectable concentrations of manganese-55.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Manganese-55 was detected in the method blank sample reported with batch BJH0670.

Dissolved copper-63 was detected at an estimated concentration below the RL in the method blank sample reported with batch BJI0069.

Dissolved mercury was detected at an estimated concentration below the RL in the method blank sample reported with batch BJI0075.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples associated with batch BJH0670 contain concentrations of manganese-55 more than ten times that of the method blank concentration. No qualification required.

Samples *MW-102-20212308* and *MW-66-20212308* contain concentrations of dissolved copper-63 below the RL and roughly equivalent to the concentration in the method blank. These results are assumed to be artifacts of laboratory contamination.Samples *MW-102-20212308*, *MW-70-20212308* and *MW-66-20212308* contain concentrations of dissolved mercury below the RL and roughly equivalent to the concentration in the method blank. These results are assumed to be artifacts of laboratory contamination.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:The dissolved copper-63 results of samples *MW-102-20212308* and *MW-66-20212308* are assumed to be false positives and are flagged B* in the summary table.The dissolved mercury results of samples *MW-102-20212308*, *MW-70-20212308* and *MW-66-20212308* are assumed to be false positives and are flagged B* in the summary table.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

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b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, PAHs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for dissolved isotopic metals and dissolved mercury analyses.

An LCS was reported for total mercury and total isotopic metals analyses. No measure of method precision was provided.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The LCS exhibited high recovery for DRO in batch BJH0731.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The EPA Method 600 laboratory duplicate sample reported with batch BJI0069 exhibited a precision failure for dissolved copper-63.

The EPA Method 7470A laboratory duplicate sample reported with batch BJI0075 exhibited a precision failure for dissolved mercury.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

DRO was not detected in samples *MW-66-20212308* and *MW-102-20212308*, associated with batch BJH0731. No qualification is required.

The EPA Method 600 laboratory duplicate sample reported with batch BJI0069 was analyzed from the field sample *MW-66-20212308*. However, this result was already determined to be an artifact of laboratory contamination. See section 6.a for details.

The EPA Method 7470A laboratory duplicate sample reported with batch BJI0075 was analyzed from the field sample *MW-66-20212308*. However, this result was already determined to be an artifact of laboratory contamination. See section 6.a for details.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Additional qualification is not required; see above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected; see above.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for dissolved isotopic metals and dissolved mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The MS recovery for dissolved manganese-55 in batch BJI0069 was outside control limits.

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for the total isotopic metals nor total mercury analyses.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Sample MW-66-20212308, which was used as the parent sample for the MS/MSD analysis, contains dissolved manganese-55 at concentrations much greater than that of the spiking concentration. The spike concentration could not be accurately quantified against the background concentration. The sample results are not considered affected.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

No qualification is required; see above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for the total isotopic metals nor total mercury analyses.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

No surrogate recovery failures reported.

iv. Data quality or usability affected?

Comments:

The data quality is not affected; no qualification required.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Toluene was detected below the RL in the trip blank.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

Toluene was detected at more than five times the concentration of the trip blank in samples *MW-66-20212308* and *MW-102-20212308* and qualification is not required.

Toluene was detected at a concentration less than the RL in sample *MW-70-20212308* and is flagged B* at the RL in the summary table.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples *MW-66-20212308* and *MW-102-20212308* were submitted with this work order.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the detected results of the field duplicate samples was within the DQO of 30% for all analytes except the following: iron-54, vanadium-51a, arsenic-75a, copper-63, and dissolved iron-57. These results are considered estimated and are flagged J* to identify the discrepancy.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality is affected. See above for applied qualifiers.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

An equipment/decontamination blank was not submitted with this work order. However, decontamination blanks were collected at the required frequency for the overall project.

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i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment/decontamination blank was not submitted with this work order.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

An equipment/decontamination blank was not submitted with this work order.

iii. Data quality or usability affected?

Comments:

The data quality is not affected.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the B-flag to the total manganese-55 results of the field samples due to the method blank detection. We note that all field samples contained manganese-55 at concentrations greater than 10X that of the concentration detected in the method blank.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Veselina Yakimova / Validated by: Adam Wyborny, PE

Title:

Geology Staff / Senior Environmental Engineer

Date:

February 4, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21H0291

Laboratory Report Date:

September 21, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21H0291

Laboratory Report Date:

September 21, 2021

Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

All analyses were performed by ARI.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples MW-25-20212408, MW-55-20212408, and MW-69-20212408. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples were delivered to the laboratory on the same day they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The recovery of the Method SW8270E surrogate Phenol-d5 was low in project sample MW-69-20212408, the method blank, and the laboratory control sample duplicate (LCSD). The laboratory applied the *-flag to the affected results. Refer to Section 6.d for further assessment.

The Method SW8270E laboratory control sample (LCS) and LCSD reported with batch BJH0669 exhibited low recoveries for Benzoic Acid. Refer to Section 6.b for further assessment.

The wet chemistry matrix spike (MS) and post preparation spike (PS) recoveries for hexavalent chromium were out of control low and have been flagged. Refer to Section 6.c for further assessment.

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c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

No corrective actions were documented in the case narrative.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory qualified affected results; see section 4.b.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several PAH and SVOC analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. If above RL or project specified objectives, what samples are affected?

Comments:

No samples are affected. Target analytes were not detected in the method blank samples.

- iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

No qualification required; see above.

- v. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

- i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for both total and dissolved isotopic metals, total mercury, and hexavalent chromium analyses.

An LCS was reported for dissolved mercury analysis. No measure of method precision was provided.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The LCS and LCSD exhibited low recoveries for benzoic acid in batch BJH0669.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The EPA Method 600 laboratory duplicate sample reported with batch BJI0141 exhibited a precision failure for nickel-60.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Benzoic acid was not detected in samples *MW-51-20212408* and *MW-69-20212408*, which are included in batch BJH0669. These non-detect results may be affected by low method recovery.

The EPA Method 600 laboratory duplicate sample reported with batch BJI0141 was analyzed from the field sample *MW-69-20212408*. The nickel-60 result of this sample may lack precision.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect benzoic acid results of samples *MW-51-20212408* and *MW-69-20212408* are considered estimated and flagged J* to identify the low method recovery.

The nickel-60 result of sample *MW-69-20212408* is considered estimated and flagged J* to identify the imprecision.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for both total and dissolved isotopic metals and total mercury analyses.

An MS and PS were reported for hexavalent chromium analysis. Refer to section 6.b for assessment of method precision.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The MS and MSD recoveries for manganese-55 in batch BJI0141 and dissolved manganese in batch BJI0016 were outside control limits.

The MS and MSD exhibited gross recovery failures for hexavalent chromium in batch BJI0625.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for the dissolved mercury analysis.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The re-analysis of sample *MW-69-20212408* was used as the parent sample for the EPA Method 600 MS/MSD analysis. The parent sample contains manganese and dissolved manganese at concentrations much greater than that of the spiking concentration. The spike concentration cannot be accurately quantified against a high background concentration. The sample results are not considered affected.

The sample *MW-55-20212408* was used as the parent sample for the MS/PS in batch BJH0625. The parent sample does not contain hexavalent chromium; however, the gross recovery failure of the spike concentration may imply that the matrix is adversely affecting method performance.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The hexavalent chromium result of sample *MW-55-20212408* is rejected due to the gross recovery failure demonstrated by the MS/PS. The affected result is flagged R* in the summary table.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is affected; see above for applied qualifiers.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E Phenol-d5 surrogate recovery was low in project sample *MW-69-20212408*, the method blank, and the LCSD in batch BJH0669.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

1,2-Dichlorobenzene and 1,4-Dichlorobenzene were detected in *MW-69-20212408* and are flagged JL* to identify the low Phenol-d5 surrogate recovery.

The surrogate recovery failure in the QC samples does not affect the associated project samples.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Toluene was detected below the RL in the trip blank.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

Toluene was detected at a concentration within 10X that of the concentration of the trip blank in sample *MW-48-20212408*. This result is considered estimated with a high analytical bias and is flagged JH* in the summary table.

Toluene was detected at estimated concentrations less than the RL in samples *MW-55-20212408* and *MW-69-20212408*. These results are assumed to be artifacts of external contamination and are flagged B* at the RL in the summary table.

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v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐

Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒

Comments:

A field duplicate sample was not submitted with this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration

R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒

Comments:

A field duplicate sample was not submitted with this work order.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐

Comments:

An equipment/decontamination blank was not submitted with this work order. However, decontamination blanks were collected at the required frequency for the overall project.

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i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment/decontamination blank was not submitted with this work order.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

An equipment/decontamination blank was not submitted with this work order.

iii. Data quality or usability affected?

Comments:

The data quality is not affected.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒ Comments:

No additional data flags/qualifiers are required.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

February 9, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21H0304

Laboratory Report Date:

September 28, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21H0304

Laboratory Report Date:

September 28, 2021

Report Name:

Lower Duwamish

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

No analyses were requested for the equipment blank sample on the COC. This omission was corrected in the appended email correspondence. Additionally, the project manager added diesel range organics (DRO) analysis to the request for sample MW-23.

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☐ No ☒ N/A ☐ Comments:

Three of the four coolers submitted for this sample batch were measured at temperatures between 7° and 9° C.

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples *MW-24-20212508*, *MW-49-20212508*, *MW-59-20212508*, *EB-2-20212508*, *MW-23-20212508*, and *MW-58-20212508*. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that one of the VOA vials provided for samples *MW-23-20212508*, *MW-58-20212508*, and the trip blank contained a bubble of unspecified size.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

No additional discrepancies were noted by the laboratory.

- e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The minor temperature exceedance does not meaningfully affect the results because the samples were out of temp for few hours at most. The laboratory chilled the samples and adjusted the pH of the under-preserved sample volume upon receipt.

The laboratory marked the VOA vials containing headspace. These vials were not used for analysis.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8082A surrogate decachlorobiphenyl exhibited low recovery on both columns of the laboratory control sample duplicate (LCSD) reported with batch BJI0002.

The Method SW8082A LCSD reported with batch BJI0002 exhibited low recovery for Aroclor-1260, causing the relative percent difference (RPD) between the recovery as compared to the associated laboratory control sample (LCS) to exceed control limits.

The Method SW8260D surrogate 1,2-dichloroethane exhibited elevated recovery in the sample MW-58-20212508.

The case narrative notes that vinyl chloride was omitted from the Method SW8260D-SIM analysis of the equipment blank sample EB-2-20212508 due to a laboratory error.

The Method SW8260D-SIM surrogates 1,2-dichloroethane and 4-bromofluorobenzene exhibited elevated recoveries in the sample MW-58-20212508.

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the field sample MW-24-20212508 and the method blank and LCS/LCSD reported in batch BJI0012. Refer to section 6.d for further assessment.

The Method SW8270E LCS and LCSD reported with batch BJI0012 exhibited low recoveries for benzoic acid. Refer to Section 6.b for further assessment.

The case narrative notes that the holding times for the sulfite and chloride analyses were exceeded. The holding time for sulfite was exceeded upon receipt at the laboratory while chloride required several re-analyses to achieve results within the instrument's calibration range.

The EPA Method 7196A matrix spike (MS) sample reported with batch BJH0304 exhibited low recovery for hexavalent chromium. A post spike was analyzed which also exhibited low recovery.

The Method NW-TPHDx LCS reported with batch BJH0731 exhibited high recovery for diesel range organics (DRO).

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c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory analyzed a post-digestion bench spike sample in response to the recovery failure for hexavalent chromium in the MS sample reported in batch BJH0304. This post-digestion spike also exhibited low recovery.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory flagged all deviations in the QC samples. See subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☐ No ☒ N/A ☐ Comments:

Vinyl chloride was omitted from the Method SW8260D-SIM analysis of the equipment blank sample *EB-2-20212508* due to a laboratory error.

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The 15-minute holding time for sulfite analysis was exceeded due to the impracticality of delivering the sample to the laboratory within the limited timeframe.

The holding time for chloride was exceeded due to the sample requiring several re-analyses to bring the concentration within the instrument's calibration range.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

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e. Data quality or usability affected?

The non-detect sulfite results of samples *MW-23-20212508* and *MW-58-20212508* are considered estimated and flagged J* due to the holding time exceedance.

The chloride results of samples *MW-23-20212508* and *MW-58-20212508* are considered estimated with a low analytical bias and flagged JL* due to the holding time exceedance.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

1-Methylnaphthalene, 2-methylnaphthalene, dibenzofuran, and naphthalene were detected at estimated concentrations below the RL in the method blank sample reported with preparation batch BJH0668.

1-Methylnaphthalene, 2-methylnaphthalene, and naphthalene were detected at estimated concentrations below the RL in the method blank sample reported with preparation batch BJH0745.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

The sample *MW-59-20212508* contains 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene concentrations within 5X those of the concentrations detected in the method blank reported with batch BJH0668.

The samples *MW-58-20212508* and *MW-59-20212508* contain dibenzofuran concentrations within 5X that of the concentration detected in the method blank reported with batch BJH0668.

The equipment blank sample *EB-2-20212508* contains 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene concentrations within 5X those of the concentrations detected in the method blank reported with batch BJH0745.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

The 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene results of samples *MW-59-20212508* and *EB-2-20212508* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

The dibenzofuran results of samples *MW-58-20212508* and *MW-59-20212508* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐

Comments:

LCS/LCSDs were reported for GRO, VOCs, dissolved gases, SVOCs, PAHs, DRO, and PCBs analyses.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS was reported for total and dissolved isotopic metals, total mercury, sulfate, chloride, and nitrate/nitrite analyses. No measure of method precision was provided.

A LCS and laboratory duplicate samples were reported for dissolved mercury, ferrous iron, hexavalent chromium, and sulfite analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The recovery of benzoic acid was below the lower control limit in the LCS and LCSD reported with preparation batches BJI0669 and BJI0012.

The recovery of DRO was above the upper control limit in the LCS reported with preparation batch BJH0731.

The recovery of PCB Aroclor-1260 was below the lower control limit in the LCSD reported with preparation batches BJI0002.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the Aroclor-1260 recoveries of the LCS/LCSD reported with preparation batch BJI0002 did not meet acceptance criteria.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The sample *MW-24-20212508* and the equipment blank *EB-2-20212508* are included in preparation batches BJH0669 and BJI0012. The benzoic acid results of these samples may be affected by low method recovery.

The equipment blank *EB-2-20212508* is included in preparation batch BJH0731. DRO was not detected in this sample. The results are not affected.

The equipment blank *EB-2-20212508* is included in preparation batch BJI0002. PCBs were not detected in this sample. The non-detect Aroclor-1260 result may be affected by low method recovery.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect benzoic acid results of samples *MW-24-20212508* and *EB-2-20212508* are considered estimated and flagged J* in the summary table.

The non-detect Aroclor-1260 result of sample *EB-2-20212508* is considered estimated and flagged J* in the summary table.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for dissolved mercury analysis.

MS samples were reported for ferrous iron and hexavalent chromium analyses. Refer to section 6.b for assessment of method precision.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The Method SM 5310 A-00 MS and post-spike samples associated with preparation batch BJH0653 exhibited total recovery failures for hexavalent chromium.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for total and dissolved isotopic metals, total mercury, sulfate, chloride, and nitrate/nitrite analyses.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The SM 5310 A-00 MS and post-spike samples reported with preparation batch BJH0653 were spiked from the field sample *MW-23-20212508*. The gross recovery failure may imply that the sample matrix is adversely affecting method performance.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

The non-detect hexavalent chromium result of sample *MW-23-20212508* is rejected due to the gross recovery failure and is flagged R* in the summary table.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is affected; see above for applied qualifiers.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the field sample *MW-24-20212508*, the equipment blank sample *EB-2-20212508*, the method blank and LCS/LCSDs reported in batches BJH0669 and BJI0012.

The Method SW8260D surrogate 1,2-dichloroethane exhibited elevated recovery in the sample *MW-58-20212508*.

The Method SW8260D-SIM surrogates 1,2-dichloroethane and 4-bromofluorobenzene exhibited elevated recoveries in the sample *MW-58-20212508*.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

1,2-Dichlorobenzene, 1,4-dichlorobenzene, and n-nitrosodiphenylamine are associated with the surrogate phenol-d5. The affected results of samples *MW-24-20212508* and *EB-2-20212508* are considered estimated with a low analytical bias and are flagged J* in the summary table.

1,1-Dichloroethene, benzene, cis-1,2-dichloroethene, trans-1,2-dichloroethene, trichloroethene, and vinyl chloride are associated with the surrogate 1,2-dichloroethane-d4. Of these analytes, only benzene was detected in sample *MW-58-20212508*. The benzene result is assumed to have a high analytical bias and is flagged JH* in the summary table.

Vinyl chloride was not detected in the SW8260D-SIM analysis of sample *MW-58-20212508*. The result is therefore unaffected by the elevated surrogate recoveries.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Toluene was detected at an estimated concentration in the trip blank sample submitted with this work order.

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iv. If above RL or project specified objectives, what samples are affected?

Comments:

The field samples either did not contain detectable concentrations of toluene or contained concentrations greater than 10X that of the concentration detected in the trip blank. The results are therefore unaffected.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order. However, field duplicates have been submitted at the required frequency for the overall project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

Field duplicate samples were not submitted with this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

See above.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

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- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

The equipment blank sample *EB-2-20212508* was submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

1-Methylnaphthalene, 1-methylnaphthalene, ethylbenzene, manganese, naphthalene, and phenanthrene were detected at estimated concentrations below their RLs in the equipment blank sample.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

The 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene results of the equipment blank sample *EB-2-20212508* are assumed to be artifacts of laboratory contamination as identified in the method blank.

The samples either did not contain detectable concentrations of ethylbenzene and manganese or those concentrations were greater than 10X those of the concentrations detected in the equipment blank.

The samples *MW-58-20212508* and *MW-59-20212508* contain phenanthrene concentrations within 5X that of the concentration detected in the equipment blank.

- iii. Data quality or usability affected?

Comments:

The phenanthrene results of samples *MW-58-20212508* and *MW-59-20212508* are assumed to be artifacts of equipment contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

- a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the H-flag to the sulfite and chloride results of samples *MW-23-20212508* and *MW-58-20212508* due to the method holding time exceedances.

The laboratory applied the E-flag to several VOC and SVOC results due to the detected concentrations exceeding the instrument's calibration range. However, these analytes were re-analyzed and the results of the diluted extraction are used for reporting purposes.

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Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

February 8, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21H0320

Laboratory Report Date:

September 27, 2021

Report Name:

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Project Number

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples MW-7-20212608, MW-32-20212608, MW-72-20212608, MW-11-20212608, MW-14-20212608, and MW-50-20212608. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that one of the VOA vials provided for sample *MW-34-20212608* contained a bubble of unspecified size.

The sample receipt form notes that the 500 mL HCl-preserved amber glass jar for sample *MW-14-20212608* contained significant headspace.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

No additional discrepancies were noted by the laboratory.

e. Data quality or usability affected?

Comments:

The 500 mL HCl-preserved amber glass jar for sample *MW-14-20212608* was used for the analysis of ferrous iron. The excess headspace in the sample container may result in a low analytical bias. The sample was extracted and analyzed within four hours of collection, so the effect on the data is likely minor to inconsequential. Out of an abundance of caution, we have applied the JL* qualifier to this result.

The samples were delivered to the laboratory on the same day they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt. Additionally, the gasoline range organics (GRO) analysis of sample *MW-34-20212608* was run using the VOA vial that did not contain bubbles.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial calibration verification (ICV) reported in batch SIJ0333 exhibited low recoveries for 2,4-dinitrophenol, benzoic acid, bis(2-ethylhexyl)phthalate, hexachlorocyclopentadiene, pentachlorophenol and elevated recovery for 3,3'-dichlorobenzidine.

The Method SW8270E continuing calibration verification (CCV) reported in batch SIJ0333 exhibited low recoveries for benzo(g,h,i)perylene and hexachlorocyclopentadiene.

The Method SW8270E low concentration calibration verification (LCV) reported in batch SIJ0333 exhibited low recoveries for 2,4-dichlorophenol, 2,4,5-trichlorophenol, 2,4,6-trichlorophenol, 4,6-dinitro-2-methylphenol, benzyl alcohol, and benzoic acid.

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the field samples *MW-32-20212608* and *MW-72-20212608* and the method blank and laboratory control sample (LCS) reported in batch BJI0045. Refer to section 6.d for further assessment.

The Method SW8270E LCS and LCS duplicate (LCSD) reported with batch BJI0045 exhibited low recoveries for 4-chlorocyclopentadiene, 4-nitrophenol, benzyl alcohol, benzoic acid, and phenol. Refer to Section 6.b for further assessment.

The case narrative notes that the holding time for sulfite analysis was exceeded upon receipt at the laboratory.

The EPA Method 353.2 matrix spike (MS) sample reported with batch BJH0703 exhibited low recovery for nitrite.

The Method NW-TPHDx LCS reported with batch BJH0731 exhibited high recovery for diesel range organics (DRO).

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

No corrective actions were detailed in the case narrative.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the 2,4-dinitrophenol, benzoic acid, bis(2-ethylhexyl)phthalate, hexachlorocyclopentadiene, pentachlorophenol, and 3,3'-dichlorobenzidine results of the laboratory QC samples reported in batch SIJ0333.

The laboratory applied the H-flag to the sulfite result of sample *MW-14-20212608* due to the method holding time exceedance.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐

Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐

Comments:

The 15-minute holding time for sulfite analysis was exceeded due to the impracticality of delivering the sample to the laboratory within the limited timeframe.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒

Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐

Comments:

Chromium and several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

The non-detect sulfite result of sample *MW-14-20212608* is considered estimated and flagged J* due to the holding time exceedance.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

1-Methylnaphthalene, 2-methylnaphthalene, and naphthalene were detected at estimated concentrations below the RL in the method blank sample reported with preparation batch BJH0745.

Mercury was detected at an estimated concentration below the RL in the method blank sample reported with preparation batch BJI0293.

Dissolved iron-57 and dissolved manganese-55 were detected at estimated concentrations below the RL in the method blank sample reported with preparation batch BJI0312.

- iii. If above RL or project specified objectives, what samples are affected?

Comments:

The sample *MW-32-20212608* contains 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene concentrations within 5X those of the concentrations detected in the method blank.

The samples *MW-14-20212608* and *MW-72-20212608* contain total mercury concentrations within 5X that of the concentration detected in the method blank.

Dissolved manganese-55 was detected in all samples at concentrations greater than 10X that of the concentration detected in the method blank. Dissolved iron-57 is not a target analyte for this project.

- iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene results of sample *MW-32-20212608* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

The total mercury result of samples *MW-14-20212608* and *MW-72-20212608* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

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v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS was reported for total isotopic metals and total mercury analyses. No measure of method precision was provided.

A LCS and laboratory duplicate samples were reported for dissolved isotopic metals, dissolved mercury, ferrous iron, hexavalent chromium, sulfite, sulfate, chloride, and nitrate/nitrite analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The recoveries of 4-chloroaniline, 4-nitrophenol, benzyl alcohol, benzoic acid, and phenol were below their lower control limits in the LCS and/or LCSD reported with preparation batch BJI0045.

The recovery of DRO was above the upper control limit in the LCS reported with preparation batch BJH0731.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the 4-nitrophenol recoveries of the LCS/LCSD reported with preparation batch BJI0045 did not meet acceptance criteria.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The samples *MW-32-20212608* and *MW-72-20212608* are included in preparation batch BJI0045. The 4-chloroaniline, 4-nitrophenol, benzyl alcohol, benzoic acid, and phenol results of these samples may be affected by low method recovery.

The samples *MW-11-20212608*, *MW-14-20212608*, *MW-32-20212608*, *MW-34-20212608*, and *MW-72-20212608* are included in preparation batch BJH0731. The DRO results of these samples may be affected by high method recovery. However, DRO was not detected in samples *MW-14-20212608* and *MW-72-20212608*.

The sample *MW-72-20212608* is included in preparation batch BJI0045 and had 4-nitrophenol requested as a target analyte. The 4-nitrophenol result of this sample may lack precision.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

The non-detect 4-chloroaniline, 4-nitrophenol, benzyl alcohol, benzoic acid, and phenol results of samples *MW-32-20212608* and *MW-72-20212608* are considered estimated and flagged J* in the summary table.

The DRO results of samples *MW-11-20212608*, *MW-32-20212608*, and *MW-34-20212608* are considered estimated with a high analytical bias. These results are flagged JH* in the summary table.

The 4-nitrophenol result of sample *MW-72-20212608* is considered estimated and flagged J* in the summary table.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒

Comments:

MS/MSD samples were not reported for organic analyses.

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ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for dissolved isotopic metals and dissolved mercury analyses.

MS samples were reported for ferrous iron, hexavalent chromium, sulfate, chloride, and nitrate/nitrite analyses. Refer to section 6.b for assessment of method precision.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW6020B MSD sample associated with preparation batch BJI0312 exhibited high recovery for dissolved manganese-55.

The EPA Method 353.2 MS sample associated with preparation batch BJH0703 exhibited low recovery for nitrite.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for total isotopic metals nor total mercury analyses.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The Method SW6020B MSD sample reported with preparation batch BJI0312 were spiked from the re-analysis of field sample *MW-72-20212608*. However, the dissolved manganese-55 spike added to the matrix was grossly low compared to the native concentration in the parent sample. This discrepancy can render the spike concentration unquantifiable against the background concentration. The recovery may not be representative of actual method performance.

The EPA Method 353.2 MS sample reported with preparation batch BJH0703 was spiked from the field sample *MW-14-20212608*. The low recovery may imply that the sample matrix is adversely affecting method performance.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect nitrite result of sample *MW-14-20212608* is assumed to have a low analytical bias and is flagged J* in the summary table.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the field samples MW-32-20212608 and MW-72-20212608 and the method blank and LCS reported in batch BJI0045

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

1,2-Dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-chlorophenol, 2-methylphenol, benzyl alcohol, bis(2-chloroethyl)ether, hexachloroethane, n-nitrosodiphenylamine, n-nitroso-di-n-propylamine, and phenol are associated with the surrogate phenol-d5. The affected results are considered estimated with a low analytical bias. Detected concentrations are flagged JL* while the remaining non-detect results are flagged J* in the summary table.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐

Comments:

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ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Toluene was detected at an estimated concentration in the trip blank sample submitted with this work order.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

The field samples shipped with the trip blank did not contain detectable concentrations of toluene. The non-detect results are therefore unaffected.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order. However, field duplicates have been submitted at the required frequency for the overall project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

Field duplicate samples were not submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted with this work order.

- iii. Data quality or usability affected?

Comments:

We cannot assess whether equipment contamination affected the results.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory applied the Q-flag to the 2,4-dinitrophenol, benzoic acid, bis(2-ethylhexyl)phthalate, hexachlorocyclopentadiene, pentachlorophenol, and 3,3'-dichlorobenzidine results of the laboratory QC samples reported in batch SIJ0333.

The laboratory applied the H-flag to the sulfite result of sample *MW-14-20212608* due to the method holding time exceedance.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

February 4, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that four of the five VOA vials provided for sample *MW-45-20212708* contained one or more bubbles of an unspecified size.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that sample *MW-31-20212708* and the associated volume provided for the matrix spike (MS) and MS duplicate (MSD) list eight sample containers each on the COC but 11 were provided. The results are not affected by the inclusion of additional sample volume.

e. Data quality or usability affected?

Comments:

The sample receipt form indicates that the laboratory would determine the amount of headspace in the four VOA vials containing bubbles. The case narrative makes no mention of excess headspace. Out of an abundance of caution, we assume a low bias for the volatile organic compound (VOC) results of the sample *MW-31-20212708*. Affected results are flagged J* in the summary table.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The method SW8082A initial calibration verification (ICV) reported with batch SJI0341 exhibited elevated recovery of the surrogate decachlorobiphenyl.

The Method SW8270E ICV and continuing calibration verification (CCV) reported in batch BJI0074 exhibited elevated recoveries for 3,3'-dichlorobenzidine.

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the field sample MW-47-20212708 and the method blank sample BJI0074-BLK1.

The Method SW8270E laboratory control sample (LCS) reported with batch BJI0074 exhibited low recoveries for 2,4-dimethylphenol, 4-chloroaniline, benzoic acid, and hexachlorocyclopentadiene. Refer to Section 6.b for further assessment.

The Method SW8270E MS/MSD reported with batch BJI0074 exhibited low recoveries for 3,3'-dichlorobenzidine, 4-chloroaniline, hexachlorocyclopentadiene, and phenol. Refer to Section 6.c for further assessment.

The Method SW8270E-SIM MS/MSD reported with batch BJH0745 exhibited low recoveries for acenaphthene and phenanthrene. Refer to Section 6.c for further assessment.

The case narrative notes that samples MW-73-20212708, MW-13R-20212708, MW-31-20212708, and MW-45-20212708 may contain a light oil other than diesel which eluted in the diesel range.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

No corrective actions were detailed in the case narrative.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the 3,3'-dichlorobenzidine results of the laboratory QC samples reported in batch BJI0074.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

1-Methylnaphthalene, 2-methylnaphthalene, and naphthalene were detected at estimated concentrations below the RL in the method blank sample reported with preparation batch BJH0745.

Mercury was detected at an estimated concentration below the RL in the method blank sample reported with preparation batch BJI0293.

Dissolved mercury was detected at an estimated concentration below the RL in the method blank sample reported with preparation batch BJI0294.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

The sample *MW-52-20212708* contains a 1-methylnaphthalene concentration roughly equivalent to that of the concentration detected in the method blank.

The sample *MW-73-20212708* contains a 1-methylnaphthalene concentration within 10X that of the concentrations detected in the method blank.

The samples *MW-31-20212708*, *MW-52-20212708*, and *MW-73-20212708* contain 2-methylnaphthalene and naphthalene concentrations within 5X those of the concentrations detected in the method blank.

The sample *MW-73-20212708* contains a total mercury concentration within 5X that of the concentration detected in the method blank.

The sample *MW-73-20212708* contains a dissolved mercury concentration equivalent to that of the concentration detected in the method blank.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 1-methylnaphthalene result of sample *MW-52-20212708* is assumed to be an artifact of laboratory contamination and is considered a false positive. This result is flagged B* to identify the external analyte contributions.

The 1-methylnaphthalene result of sample *MW-73-20212708* may be influenced by laboratory contamination. This result is flagged JH* to identify the high analytical bias.

The 2-methylnaphthalene and naphthalene results of samples *MW-31-20212708*, *MW-52-20212708*, and *MW-73-20212708* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

The total mercury result of sample *MW-73-20212708* is assumed to be an artifact of laboratory contamination and is considered a false positive. This result is flagged B* to identify the external analyte contributions.

The dissolved mercury result of sample *MW-73-20212708* is assumed to be an artifact of laboratory contamination and is considered a false positive. This result is flagged B* to identify the external analyte contributions.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, PAHs, and PCBs analyses.

An LCS was reported for SVOC and DRO analyses. Refer to section 6.c for assessment of method precision.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS was reported for total mercury and hexavalent chromium analyses. No measure of method precision was provided.

A LCS and laboratory duplicate samples were reported for total and dissolved isotopic metals and dissolved mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The recoveries of 2,4-dimethylphenol, 4-chloroaniline, benzoic acid, and hexachlorocyclopentadiene were below their lower control limits in the LCS reported with preparation batch BJI0074.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the vinyl chloride recoveries of the LCS/LCSD reported with preparation batch BJI0132 did not meet acceptance criteria.

The method precision demonstrated by the SW7470A laboratory duplicate sample reported with preparation batch BJI0294 did not meet acceptance criteria for dissolved mercury.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The samples *MW-31-20212708* and *MW-47-20212708* are included in preparation batch BJI0074. The 2,4-dimethylphenol, 4-chloroaniline, benzoic acid, and hexachlorocyclopentadiene results of these samples may be affected by low method recovery.

The samples *MW-31-20212708*, *MW-45-20212708*, *MW-47-20212708*, *MW-73-20212708*, and the trip blank are included in preparation batch BJI0132. The vinyl chloride results of these samples may lack precision.

The Method SW7470A laboratory duplicate sample was analyzed from the field sample *MW-73-20212708*. However, the mercury result of this sample was determined to be an artifact of laboratory contamination. Additional qualification is not required.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect 2,4-dimethylphenol, 4-chloroaniline, benzoic acid, and hexachlorocyclopentadiene results of samples *MW-31-20212708* and *MW-47-20212708* are considered estimated and flagged J* in the summary table.

The vinyl chloride results of samples *MW-31-20212708*, *MW-45-20212708*, *MW-47-20212708*, *MW-73-20212708*, and the trip blank are considered estimated and flagged J* in the summary table.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for VOCs, SVOCs, PAHs, and DRO analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for total and dissolved isotopic metals and dissolved mercury analyses.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E MS and MSD reported with batch BJI0074 exhibited a complete recovery failure for 3,3'-dichlorobenzidine and low recoveries for 4-chloroaniline and hexachlorocyclopentadiene. Additionally, the MSD exhibited low recovery for phenol.

The Method SW8270E-SIM MS and MSD reported with batch BJI0075 exhibited low recoveries for acenaphthene and phenanthrene. We note that these analytes exceeded the instrument's upper calibration limit in the parent sample.

The Method SW6020B MS sample associated with preparation batch BJI0217 exhibited low recovery for manganese-55.

The Method SW6020B MS3 and MSD3 samples associated with preparation batch BJI0385 exhibited high recoveries for dissolved manganese-55.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for mercury nor hexavalent chromium analyses.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The Method SW8270E MS and MSD samples reported with preparation batch BJI0074 were spiked from the field sample *MW-31-20212708*. The low recoveries of the analytes listed in section 6.c.iii imply that the sample matrix may be adversely affecting method performance.

The Method SW8270E-SIM MS and MSD samples reported with preparation batch BJI0075 were spiked from the field sample *MW-31-20212708*. However, the acenaphthene and phenanthrene spike concentrations added to the matrix were grossly low compared to the native concentration in the parent sample. This discrepancy can render the spike concentrations unquantifiable against the background concentration. The recoveries may not be representative of actual method performance.

The Method SW6020B MS reported with preparation batch BJI0217 was spiked from the field sample *MW-47-20212708*. However, the manganese-55 spike added to the matrix was low compared to the native concentration in the parent sample. This discrepancy can render the spike concentration unquantifiable against the background concentration. The recovery may not be representative of actual method performance.

The Method SW6020B MS3 and MSD3 samples reported with preparation batch BJI0385 were spiked from the re-analysis of field sample *MW-73-20212708*. However, the dissolved manganese-55 spike added to the matrix was grossly low compared to the native concentration in the parent sample. This discrepancy can render the spike concentration unquantifiable against the background concentration. The recovery may not be representative of actual method performance.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 3,3'-dichlorobenzidine result of sample *MW-31-20212708* is rejected due to the gross recovery failure. However, 3,3'-dichlorobenzidine is not a target analyte for this sample. The result is not reported.

The 4-chloroaniline, hexachlorocyclopentadiene, and phenol results of sample *MW-31-20212708* are considered estimated with a low analytical bias. However, the afore mentioned analytes were not requested for this sample and are not reported.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is affected, but the affected results are not reported.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the field sample *MW-47-20212708* and the method blank sample BJI0074-BLK1

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

1,2-Dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-chlorophenol, 2-methylphenol, benzyl alcohol, bis(2-chloroethyl)ether, hexachloroethane, n-nitrosodiphenylamine, n-nitroso-di-n-propylamine, and phenol are associated with the surrogate phenol-d5. With the exception of 1,3'-dichlorobenzene, these compounds were not detected in sample *MW-47-20212708*. The affected results are considered estimated with a low analytical bias. The 1,3'-dichlorobenzene result of this sample is flagged JL* while the remaining non-detect results are flagged J* in the summary table.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐

Comments:

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ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Toluene was detected at an estimated concentration in the trip blank sample submitted with this work order.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

The field samples shipped with the trip blank did not contain detectable concentrations of toluene. The non-detect results are therefore unaffected.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order. However, field duplicates have been submitted at the required frequency for the overall project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

Field duplicate samples were not submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted with this work order.

- iii. Data quality or usability affected?

Comments:

We cannot assess whether equipment contamination affected the results.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the 3,3'-dichlorobenzidine results of the laboratory QC samples reported in batch BJI0074.

The laboratory applied the E-flag to the acenaphthene and phenanthrene results of the initial run of sample *MW-31-20212708* due to the concentrations exceeding the instrument's upper calibration limit. The acenaphthene and phenanthrene results of the re-analysis are used for reporting purposes.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

February 4, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21H0367

Laboratory Report Date:

September 29, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21H0367

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

Samples MW-56 was provided with volume for natural attenuation analysis, but it was erroneously omitted from the COC. Sample MW-3 should have included methyl-t-butyl ether (MTBE) analysis, but this too was omitted from the COC. These errors were corrected via the attached email during sample login. The results are not affected.

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no discrepancies documented by the laboratory.

- e. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8260D-SIM laboratory control sample (LCS) and LCS duplicate (LCSD) exhibited a method precision failure for vinyl chloride. Refer to Section 6.b for further assessment.

The Method SW6020B matrix spike duplicate (MSD) reported with preparation batch BJI0387 exhibited low recovery for dissolved iron. Refer to Section 6.c for further assessment.

The case narrative notes that the holding time for sulfite was exceeded upon receipt at the laboratory.

The case narrative notes that the samples may contain a light oil other than diesel which eluted in the diesel range.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

No corrective actions were detailed in the case narrative.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The case narrative does not specify an effect on data quality. Refer to the subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The sulfite analysis of sample MW-56-20213008 occurred on the same day as collection but outside the method required holding time of 15 minutes.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

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d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

The non-detect sulfite result of sample *MW-56-20213008* is considered estimated due to the holding time exceedance. This result is flagged J* in the summary table.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

2-Methylnaphthalene, benzo(a)anthracene, benzo(b)fluoranthene, chrysene, dibenzofuran, fluoranthene, naphthalene, phenanthrene, and pyrene were detected at estimated concentrations below the RL in the method blank sample reported with preparation batch BJI0106.

Mercury was detected at an estimated concentration below the RL in the method blank sample reported with preparation batch BJI0293.

Dissolved mercury was detected at an estimated concentration below the RL in the method blank sample reported with preparation batch BJI0347.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

The sample *MW-56-20213008* contains 2-methylnaphthalene, benzo(a)anthracene, benzo(b)fluoranthene, chrysene, dibenzofuran, fluoranthene, naphthalene, phenanthrene, and pyrene concentrations roughly equivalent to those of the concentrations detected in the method blank.

The samples *MW-4-20213008*, *MW-8-20213008*, and *MW-56-20213008* contain total mercury concentrations equivalent to that of the concentration detected in the method blank.

The samples *MW-4-20213008*, *MW-8-20213008*, and *MW-56-20213008* contain dissolved mercury concentrations equivalent to that of the concentration detected in the method blank.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 2-methylnaphthalene, benzo(a)anthracene, benzo(b)fluoranthene, chrysene, dibenzofuran, fluoranthene, naphthalene, phenanthrene, and pyrene results of sample *MW-56-20213008* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

The total mercury results of samples *MW-4-20213008*, *MW-8-20213008*, and *MW-56-20213008* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

The dissolved mercury results of samples *MW-4-20213008*, *MW-8-20213008*, and *MW-56-20213008* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, dissolved gases, and PAHs analyses.

An LCS was reported for DRO analysis. No measure of method precision was provided.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS was reported for total isotopic metals and total mercury analyses. No measure of method precision was provided.

A LCS and laboratory duplicate samples were reported for dissolved isotopic metals, dissolved mercury, sulfite, ferrous iron, sulfate, chloride, and nitrate/nitrite analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The recovery of sulfite exceeded the upper control limit in the LCS reported with preparation batch BJH0769.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the vinyl chloride recoveries of the LCS/LCSD reported with preparation batch BJI0132 did not meet acceptance criteria.

The method precision demonstrated by the SW7470A laboratory duplicate sample reported with preparation batch BJI0347 did not meet acceptance criteria for dissolved mercury.

The method precision demonstrated by the SW6020B laboratory duplicate sample reported with preparation batch BJI0387 did not meet acceptance criteria for dissolved nickel.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Sulfite was not detected in the field samples. The results are not affected by the potentially elevated method recovery.

The trip blank is the only sample included in preparation batch BJI0132 containing a detectable concentration of vinyl chloride; however, the non-detect results of samples *MW-3-20213008* and *MW-56-20213008* may also lack precision.

The Method SW7470A laboratory duplicate sample was analyzed from the field sample *MW-4-20213008*. However, the mercury result of this sample was determined to be an artifact of laboratory contamination. Additional qualification is not required.

The Method SW6020B laboratory duplicate sample was analyzed from the field sample *MW-56-20213008*. The dissolved nickel-60 result of this sample may lack precision.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

The non-detect vinyl chloride results of samples *MW-3-20213008* and *MW-56-20213008* and the detected vinyl chloride result of the trip blank *TB-10-20213008* are considered estimated and flagged J* in the summary table.

The dissolved nickel-60 result of sample *MW-56-20213008* is considered estimated and flagged J* in the summary table.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒

Comments:

MS/MSD samples were not reported for organic analyses.

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ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for dissolved isotopic metals and dissolved mercury analyses.

An MS was reported for ferrous iron, sulfate, chloride, and nitrate/nitrite analyses. Refer to section 6.b for assessment of method precision.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW6020B MSD sample associated with preparation batch BJI0387 exhibited low recovery for dissolved iron-54.

The Method SW6020B MSD3 sample associated with preparation batch BJI0387 exhibited low recovery for dissolved manganese-55.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for DRO nor total metals analyses.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The Method SW6020B MSD reported with preparation batch BJI0387 was spiked from the field sample MW-56-20213008. However, the dissolved iron-54 spiking concentration was low relative to the native concentration in the parent sample. The resulting uncertainty may render the spike recovery unrepresentative of actual method performance.

The Method SW6020B MSD3 reported with preparation batch BJI0387 was spiked from the re-analysis of field sample MW-56-20213008. However, the dissolved manganese-55 spiking concentration was low relative to the native concentration in the parent sample. The resulting uncertainty may render the spike recovery unrepresentative of actual method performance.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The results do not require qualification; see above.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for the DRO and total metals analyses.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

There are no surrogate recovery failures associated with the field samples reported in this work order.

iv. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

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iii. All results less than RL and project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Vinyl chloride was detected in the trip blank sample at a concentration above the RL.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

The field samples shipped with the trip blank did not contain detectable concentrations of vinyl chloride. The non-detect results are therefore unaffected.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order. However, field duplicates have been submitted at the required frequency for the overall project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

Field duplicate samples were not submitted with this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☐ N/A ☒ Comments:

See above.

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iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank was not submitted with this work order.

i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted with this work order.

iii. Data quality or usability affected?

Comments:

We cannot assess whether equipment contamination affected the results.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒ Comments:

No additional data flags/qualifiers are required.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

February 2, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21I0001

Laboratory Report Date:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

Samples MW-75 and MW-101 were erroneously marked for gasoline analysis rather than HVOCs analysis. The error was corrected via the attached email during sample login. The results are not affected.

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no discrepancies documented by the laboratory.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial calibration verification (ICV) sample SJI0377-ICV1 exhibited high recovery for 3,3'-dichlorobenzidine.

The Method SW8270E second source calibration verification (SCV) sample SJI0377-SCV1 exhibited low recoveries for 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, and benzoic acid. This SVC also exhibited elevated recoveries for bis(2-ethylhexyl)phthalate and isophorone.

The Method SW8270E semi-volatile organic compounds (SVOC) surrogate phenol-d5 exhibited low recovery in the field samples *MW-75-20213108*, *MW-101-20213108*, and the method blank BJI0074-BLK1. Refer to Section 6.d for further assessment.

The Method SW8270E laboratory control sample (LCS) exhibited low recoveries for 2,4-dimethylphenol, benzoic acid, 4-chloroaniline, and hexachlorocyclopentadiene. Refer to Section 6.b for further assessment.

The Method SW8270E-SIM ICV sample SJI0424-ICV1 exhibited high recovery for dibenzo(a,h)anthracene and the surrogate dibenzo(a,h)anthracene-d14.

The case narrative notes that samples *MW-57-20213108*, *MW-75-20213108*, and *MW-101-20213108* may contain a light oil that eluted in the diesel range rather than diesel.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

No corrective actions were detailed in the case narrative.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the 3,3'-dichlorobenzidine results of all samples containing this compound.

The laboratory applied the Q-flag to the dibenzo(a,h)anthracene and dibenzo(a,h)anthracene-d14 results of all samples containing these compounds.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

1-Methylnaphthalene, 2-methylnaphthalene, dibenzofuran, and naphthalene were detected at estimated concentrations below the RL in the method blank sample reported with preparation batch BJI0154.

Mercury was detected at an estimated concentration below the RL in the method blank sample reported with preparation batch BJI0293.

Dissolved mercury was detected at an estimated concentration below the RL in the method blank sample reported with preparation batch BJI0349.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

The samples *MW-10R-20213108* and *MW-62-20213108* contain 1-methylnaphthalene and 2-methylnaphthalene concentrations within 5X those of the concentrations detected in the method blank. The sample *MW-57-20213108* contains 1-methylnaphthalene and 2-methylnaphthalene concentrations within 10X those of the concentrations detected in the method blank.

The samples *MW-10R-20213108*, *MW-57-20213108*, and *MW-62-20213108* contain dibenzofuran and naphthalene concentrations equivalent to those of the concentrations detected in the method blank.

The samples *MW-10R-20213108*, *MW-57-20213108*, *MW-62-20213108*, *MW-75-20213108*, and *MW-101-20213108* contain total mercury concentrations equivalent to that of the concentration detected in the method blank.

The samples *MW-10R-20213108*, *MW-57-20213108*, *MW-62-20213108*, *MW-75-20213108*, and *MW-101-20213108* contain dissolved mercury concentrations equivalent to that of the concentration detected in the method blank.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 1-methylnaphthalene and 2-methylnaphthalene results of samples *MW-10R-20213108* and *MW-62-20213108* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

The 1-methylnaphthalene and 2-methylnaphthalene results of sample *MW-57-20213108* may be influenced by laboratory contamination and are assumed to have a high analytical bias. These results are flagged JH* in the summary table.

The dibenzofuran and naphthalene results of samples *MW-10R-20213108*, *MW-57-20213108*, and *MW-62-20213108* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

The total mercury results of samples *MW-10R-20213108*, *MW-57-20213108*, *MW-62-20213108*, *MW-75-20213108*, and *MW-101-20213108* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

The dissolved mercury results of samples *MW-10R-20213108*, *MW-57-20213108*, *MW-62-20213108*, *MW-75-20213108*, and *MW-101-20213108* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO and VOCs analyses.

An LCS was reported for SVOC, PAHs, DRO, and PCBs analyses. Refer to MS/MSD discussion for assessment of method precision.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS and laboratory duplicate samples were reported for total and dissolved isotopic metals and mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E LCS associated with preparation batch BJI0074 exhibited low recoveries for 2,4-dimethylphenol, 4-chloroaniline, benzoic acid, and hexachlorocyclopentadiene.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The non-detect 2,4-dimethylphenol, 4-chloroaniline, benzoic acid, and hexachlorocyclopentadiene results of the field samples included in preparation batch BJI0074 are considered estimated with a low analytical bias due to the low method recovery demonstrated by the LCS.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect 2,4-dimethylphenol, 4-chloroaniline, benzoic acid, and hexachlorocyclopentadiene results of samples *MW-75-20213108* and *MW-101-20213108* are considered estimated and flagged J* in the summary table.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

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c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)**i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?**Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for VOCs, PAHs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for total and dissolved isotopic metals and mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?Yes ☐ No ☒ N/A ☐ Comments:

The Method SW6020B MS and MSD samples associated with preparation batch BJI0423 exhibited low recovery for manganese-55.

The Method SW6020B MSD sample associated with preparation batch BJI0419 exhibited low recovery for dissolved manganese-55.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for SVOCs analysis.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The Method SW6020B MS/MSD reported with preparation batch BJI0423 was spiked from the field sample *MW-62-20213108*. However, the manganese-55 spiking concentration was low relative to the native concentration in the parent sample. The resulting uncertainty may render the spike recovery unrepresentative of actual method performance.

The Method SW6020B MSD reported with preparation batch BJI0419 was spiked from the field sample *MW-62-20213108*. However, the dissolved manganese-55 spiking concentration was low relative to the native concentration in the parent sample. The resulting uncertainty may render the spike recovery unrepresentative of actual method performance.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The results do not require qualification; see above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for the SVOCs analysis.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:The Method SW8270E surrogate phenol-d5 exhibited low recovery in samples *MW-75-20213108*, *MW-101-20213108*, and the associated method blank.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:1,2-Dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-chlorophenol, 2-methylphenol, benzyl alcohol, bis(2-chloroethyl)ether, hexachloroethane, n-nitrosodiphenylamine, n-nitroso-di-n-propylamine, and phenol are associated with the surrogate phenol-d5. These compounds were not detected in the samples *MW-75-20213108* and *MW-101-20213108*. These non-detect results are considered estimated and flagged J* in the summary table.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

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e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

- v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

The field duplicate samples *MW-75-20213108* and *MW-101-20213108* were submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the detected results of the field duplicate samples was within the recommended DQO of 30% for all analytes except diethyl phthalate, iron, and vanadium-51a. These results are considered estimated in the field duplicate samples and flagged J* in the summary table.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality is affected; see above for applied qualifiers.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted with this work order.

- iii. Data quality or usability affected?

Comments:

We cannot assess whether equipment contamination affected the results.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the 3,3'-dichlorobenzidine results of all samples containing this compound.

The laboratory applied the Q-flag to the dibenzo(a,h)anthracene and dibenzo(a,h)anthracene-d14 results of all samples containing these compounds.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

February 1, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21I0012

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples MW-60-20210109, MW-53-20210109, MW-63-20210109, MW-64-20210109, MW-41-20210109, and MW-40-20210109. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that one of the VOA vials for the trip blank sample *TB-12-20210109* contained bubbles. This vial was not used for analysis.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples were delivered to the laboratory on the same day as they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E continuing calibration verification (CCV) sample SJI0403-CCV1 exhibited low recoveries for benzo(g,h,i)perylene and hexachlorocyclopentadiene.

The Method SW8270E second source calibration verification (SCV) sample SJI0403-SCV1 exhibited low recoveries for pentachlorophenol, 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, 4-nitrophenol, benzoic acid, and hexachlorocyclopentadiene. This SVC also exhibited elevated recoveries for 2,2'-oxybis(1-chloropropane) and isophorone.

The Method SW8270E semi-volatile organic compounds (SVOC) surrogate phenol-d5 exhibited low recovery in the field samples MW-53-20210109, MW-63-20210109, MW-41-20210109, MW-40-20210109, and several laboratory QC samples. Refer to Section 6.d for further assessment.

The Method SW8270E laboratory control sample (LCS) and LCS duplicate (LCSD) associated with preparation batch BJI0012 exhibited low recoveries for benzoic acid, 4-chloroaniline, hexachlorocyclopentadiene, 4-nitrophenol, and the surrogate phenol-d5. Refer to Section 6.b for further assessment.

The Method SW8270E-SIM initial calibration verification (ICV) sample SJI0424-ICV1 exhibited high recoveries for dibenzo(a,h)anthracene and the surrogate dibenzo(a,h)anthracene-d14.

The case narrative notes that the holding time for sulfite analysis was exceeded upon receipt of the samples at the laboratory.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

No corrective actions were detailed in the case narrative.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the dibenzo(a,h)anthracene and dibenzo(a,h)anthracene-d14 results of all samples containing these compounds.

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5. Samples Results

- a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

- b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The sulfite analysis was performed outside of the method required 15-minute holding time due to the impracticality of getting the sample to the laboratory and completing the analysis within that time frame.

- c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

- d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

- e. Data quality or usability affected?

The non-detect sulfite result of sample MW-60-20210109 is considered estimated and assumed to have a low analytical bias. This result is flagged J* in the summary table.

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

- a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Vinyl chloride was detected at an estimated concentration below the RL in the method blank sample reported with preparation batch BJI0273.

2-Methylnaphthalene, dibenzofuran, and naphthalene were detected at estimated concentrations below the RL in the method blank sample reported with preparation batch BJI0190.

Mercury was detected at an estimated concentration below the RL in the method blank sample reported with preparation batch BJI0293.

Dissolved mercury was detected at estimated concentrations below the RL in the method blank samples reported with preparation batches BJI0349 and BJI0383.

Dissolved manganese-55 was detected at an estimated concentration below the RL in the method blank sample reported with preparation batch BJI0460.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

The samples *MW-53-20210109* and *MW-60-20210109* contain concentrations of vinyl chloride that are within 5X that of the concentration detected in the method blank.

The samples *MW-40-20210109*, *MW-41-20210109*, *MW-53-20210109*, and *MW-64-20210109* contain 2-methylnaphthalene and dibenzofuran concentrations within 5X those of the concentrations detected in the method blank. The sample *MW-60-20210109* contains a 2-methylnaphthalene concentration within 10X that of the concentration detected in the method blank.

The samples *MW-40-20210109*, *MW-53-20210109*, *MW-60-20210109*, and *MW-64-20210109* contain naphthalene concentrations within 5X that of the concentration detected in the method blank. The sample *MW-41-20210109* contains a naphthalene concentration within 10X that of the concentration detected in the method blank.

The samples *MW-40-20210109*, *MW-41-20210109*, *MW-53-20210109*, *MW-60-20210109*, *MW-63-20210109*, and *MW-64-20210109* contain dissolved mercury concentrations equivalent to that of the concentration detected in the method blank.

All field samples contain concentrations of dissolved manganese-55 greater than 10X that of the concentration detected in the method blank. The results are therefore not meaningfully affected.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The vinyl chloride results of samples *MW-53-20210109* and *MW-60-20210109* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

The 2-methylnaphthalene and dibenzofuran results of samples *MW-40-20210109*, *MW-41-20210109*, *MW-53-20210109*, and *MW-64-20210109* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged 'B*' to identify the external analyte contributions.

The 2-methylnaphthalene result of sample *MW-60-20210109* may be influenced by laboratory contamination and is assumed to have a high analytical bias. This result is flagged JH* in the summary table.

The naphthalene results of samples *MW-40-20210109*, *MW-53-20210109*, *MW-60-20210109*, and *MW-64-20210109* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged 'B*' to identify the external analyte contributions.

The naphthalene result of sample *MW-41-20210109* may be influenced by laboratory contamination and is assumed to have a high analytical bias. This result is flagged JH* in the summary table.

The dissolved mercury results of samples *MW-40-20210109*, *MW-41-20210109*, *MW-53-20210109*, *MW-60-20210109*, *MW-63-20210109*, and *MW-64-20210109* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged 'B*' to identify the external analyte contributions.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

LCS/LCSDs and laboratory duplicate (DUP) samples were reported for dissolved gases.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS was reported for total isotopic metals and total mercury analyses. No measure of method precision was provided.

A LCS and laboratory duplicate sample were reported for dissolved isotopic metals, dissolved mercury, ferrous iron, sulfite, sulfate, chloride, and nitrate/nitrite analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E LCS and LCSD associated with preparation batch BJI0189 exhibited low recoveries for 4-chloroaniline, 4-nitroaniline, benzoic acid, hexachlorocyclopentadiene, and phenol.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the hexachlorocyclopentadiene recoveries of the Method SW8270E LCS/LCSD did not meet acceptance criteria.

The method precision demonstrated by the Method SW7470A DUP reported with preparation batch BJI0383 did not meet acceptance criteria for dissolved mercury.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The non-detect 4-chloroaniline, 4-nitroaniline, benzoic acid, hexachlorocyclopentadiene, and phenol results of the field samples included in preparation batch BJI0189 are considered estimated with a low analytical bias due to the low method recovery demonstrated by the LCS/LCSD.

The Method SW7470A DUP reported with preparation batch BJI0383 was performed on sample MW-40-20210109. The dissolved mercury result of this sample was determined to be an artifact of laboratory contamination. Additional qualification is not required.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect 4-chloroaniline, 4-nitroaniline, benzoic acid, hexachlorocyclopentadiene, and phenol results of samples *MW-40-20210109*, *MW-41-20210109*, *MW-53-20210109*, and *MW-63-20210109* are considered estimated and flagged J* in the summary table.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for dissolved isotopic metals and dissolved mercury analyses.

An MS sample was reported for ferrous iron, sulfate, chloride, and nitrate/nitrite analyses. See section 6.b for assessment of method precision.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW6020B MSD sample associated with preparation batch BJI0460 exhibited low recovery for dissolved manganese-55.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The Method SW6020B MSD reported with preparation batch BJI0460 was spiked from the field sample *MW-53-20210109*. However, the manganese-55 spiking concentration was low relative to the native concentration in the parent sample. The resulting uncertainty may render the spike recovery unrepresentative of actual method performance.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The results do not require qualification; see above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for the total isotopic metals nor total mercury analyses.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E surrogate phenol-d5 exhibited low recovery in samples *MW-53-20210109*, *MW-63-20210109*, *MW-41-20210109*, *MW-40-20210109*, and the associated method blank and LCS/LCSD.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

1,2-Dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-chlorophenol, 2-methylphenol, benzyl alcohol, bis(2-chloroethyl)ether, hexachloroethane, n-nitrosodiphenylamine, n-nitroso-di-n-propylamine, and phenol are associated with the surrogate phenol-d5. These compounds were not detected in the samples *MW-53-20210109*, *MW-63-20210109*, *MW-41-20210109*, *MW-40-20210109*. These non-detect results are considered estimated and flagged J* in the summary table.

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iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applies qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐

Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐

Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐

Comments:

Toluene was detected at an estimated concentration below the RL in the trip blank sample.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

Samples *MW-60-20210109* and *MW-64-20210109* contained toluene concentrations roughly equivalent to that of the concentration detected in the trip blank. The toluene results of these samples may be artifacts of external contamination and are flagged B* in the summary table.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐

Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

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ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank was not submitted with this work order.

i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted with this work order.

iii. Data quality or usability affected?

Comments:

We cannot assess whether equipment contamination affected the results.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the E-flag to the acenaphthene and fluorene results of several samples due to the detected concentrations exceeding the instrument's upper calibration limit. However, the results of the re-extracted batch are reported in these instances.

The laboratory applied the Q-flag to the surrogate dibenzo(a,h)anthracene-d14 recoveries of all field samples reported in this work order.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

February 1, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21I0040

Laboratory Report Date:

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Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

Sample MW-37 was incorrectly marked for mercury analysis rather than selenium. This error was corrected in the attached email correspondence and the correct analyses were performed.

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples EB-3-20210209, MW-37-20210209, MW-65-20210209, MW-74-20210209, and MW-61-20210209. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples were delivered to the laboratory on the same day as they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E semi-volatile organic compounds (SVOC) surrogate phenol-d5 exhibited low recovery in samples MW-14-20210209 and EB-3-20210209. Refer to Section 6.d for further assessment.

The Method SW8270E laboratory control sample duplicate (LCSD) associated with preparation batch BJI0254 exhibited low recovery for benzoic acid. Refer to Section 6.b for further assessment.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

No corrective actions were detailed in the case narrative.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the * qualifier to the surrogate phenol-d5 recoveries for samples *MW-14-20210209* and *EB-3-20210209*.

The laboratory applied the Q-flag to the benzoic acid recovery of the LCSD reported in preparation batch BJI0254.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐

Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐

Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒

Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐

Comments:

Chromium and several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Vinyl chloride was detected at an estimated concentration below the RL in the method blank sample reported with preparation batch BJI0273.

1-Methylnaphthalene, 2-methylnaphthalene, dibenzofuran, and naphthalene were detected at estimated concentrations below the RL in the method blank sample reported with preparation batch BJI0253.

Dissolved mercury was detected at an estimated concentration below the RL in the method blank sample reported with preparation batch BJI0383.

Dissolved manganese-55 was detected at an estimated concentration below the RL in the method blank sample reported with preparation batch BJI0460.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

The sample *MW-37-20210209* contains a concentration of vinyl chloride that is within 5X that of the concentration detected in the method blank.

The samples *MW-37-20210209* and *MW-65-20210209* contain 1-methylnaphthalene and 2-methylnaphthalene concentrations within 5X those of the concentrations detected in the method blank. Samples *MW-61-20210209* and *MW-74-20210209* contain 1-methylnaphthalene and 2-methylnaphthalene concentrations within 10X those of the concentrations detected in the method blank.

The samples *MW-37-20210209*, *MW-61-20210209*, *MW-65-20210209*, and *MW-74-20210209* contain naphthalene concentrations within 5X that of the concentration detected in the method blank.

The samples *MW-37-20210209*, *MW-65-20210209*, and *MW-74-20210209* contain dibenzofuran concentrations equivalent to that of the concentration detected in the method blank. The sample *MW-61-20210209* contains a dibenzofuran concentration within 10X that of the concentration detected in the method blank.

The samples *MW-61-20210209*, *MW-65-20210209*, *MW-74-20210209*, and the equipment blank *EB-3-20210209* contain dissolved mercury concentrations equivalent to that of the concentration detected in the method blank.

The equipment blank sample *EB-3-20210209* contains a concentration of dissolved manganese-55 within 10X that of the concentration detected in the method blank.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The vinyl chloride result of sample *MW-37-20210209* is assumed to be an artifact of laboratory contamination and is considered a false positive. This result is flagged 'B*' to identify the external analyte contributions.

The 1-methylnaphthalene and 2-methylnaphthalene results of samples *MW-37-20210209* and *MW-65-20210209* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged 'B*' to identify the external analyte contributions.

The 1-methylnaphthalene and 2-methylnaphthalene results of samples *MW-61-20210209* and *MW-74-20210209* may be influenced by laboratory contamination and are assumed to have a high analytical bias. These results are flagged JH* in the summary table.

The naphthalene results of samples *MW-37-20210209*, *MW-61-20210209*, *MW-65-20210209*, and *MW-74-20210209* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged 'B*' to identify the external analyte contributions.

The dibenzofuran results of samples *MW-37-20210209*, *MW-65-20210209*, and *MW-74-20210209* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged 'B*' to identify the external analyte contributions.

The dibenzofuran result of sample *MW-61-20210209* may be influenced by laboratory contamination and is assumed to have a high analytical bias. This result is flagged JH* in the summary table.

The dissolved mercury results of samples *MW-61-20210209*, *MW-65-20210209*, *MW-74-20210209*, and the equipment blank *EB-3-20210209* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged 'B*' to identify the external analyte contributions.

The dissolved manganese-55 result of the equipment blank sample *EB-3-20210209* may be influenced by laboratory contamination and is assumed to have a high analytical bias. This result is flagged JH* in the summary table.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

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b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS was reported for both total and dissolved isotopic metals and dissolved mercury analyses. No measure of method precision was provided.

LCS and laboratory duplicate samples were reported for total mercury analysis.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E LCSD associated with preparation batch BJI0254 exhibited low recovery for benzoic acid.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Benzoic acid was not detected in the field samples included in preparation batch BJI0254. These non-detect results are considered estimated.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:The non-detect benzoic acid results of samples *MW-14-20210209*, *MW-65-20210209*, and *EB-3-20210209* are considered estimated and flagged J* in the summary table.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were only reported for total mercury analysis.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and precision were demonstrated to be within acceptable limits for total mercury.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

The results do not require qualification; see above.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for the total and dissolved isotopic metals nor dissolved mercury analyses.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The Method SW8270E surrogate phenol-d5 exhibited low recovery in samples *MW-14-20210209* and *EB-3-20210209*.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

1,2-Dichlorobenzene, 1,4-dichlorobenzene, and n-nitrosodiphenylamine are associated with the surrogate phenol-d5. These compounds were not detected in the equipment blank samples *MW-14-20210209* and *EB-3-20210209*. These non-detect results are considered estimated and flagged J* in the summary table.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applies qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐

Comments:

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ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:The equipment blank sample *EB-3-20210209* was submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Dissolved manganese-55 was detected in the equipment blank at a concentration above the RL. We note that this concentration may have a high bias due to analyte contributions from contaminated laboratory equipment.

Dissolved mercury was detected at an estimated concentration below the RL in the equipment blank sample. However, this analyte was detected at an equivalent concentration in the associated method blank and determined to be an artifact of laboratory contamination.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

All field samples contained concentrations of dissolved manganese-55 greater than 10X that of the concentration detected in the equipment blank. The results are therefore not meaningfully affected.

- iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the E-flag to the acenaphthene result of sample *MW-61-20210209* due to the detected concentration exceeding the instrument's upper calibration limit.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

December 15, 2021

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

Project samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition and properly preserved.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that there were no custody seals present on the cooler. However, the sample coolers were hand delivered to the laboratory by the sampler, so custody seals were not required.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory screened the samples prior to extraction for polychlorinated biphenyls (PCBs) analysis. The screened PCB concentrations in samples *SB-2021-050:2.5-10042021* and *SB-2021-053:2.8-10042021* exceeded the instrument's calibration range. The instrument was switched from low-level analysis to medium level for these samples.

The EPA method SW8082A surrogate decachlorobiphenyl exhibited elevated recovery in both columns for samples *SB-2021-048:1.5-10042021* and *SB-2021-051:1.2-10042021*. The recovery of decachlorobiphenyl was elevated in column 1 for samples *SB-2021-051:6.5-10042021*, *SB-2021-055:0.5-10042021*, *SB-2021-056:1.0-10042021*, and the matrix spike (MS) and MS duplicate (MSD) samples reported in batch BJJ0466. Similarly, the recovery of decachlorobiphenyl was elevated in column 2 for samples *SB-2021-048:2.2-10042021* and *SB-2021-057:2.4-10042021*. Refer to Section 6.d for further assessment.

The EPA method SW8082A surrogate tetrachlorometaxylene exhibited low recovery in both columns in sample *SB-2021-049:1-10042021*. Refer to Section 6.d for further assessment.

The PCB Aroclor-1260 exhibited low recovery in the MS and MSD samples reported with batch BJJ0471.

NW-TPHDx diesel range organics (DRO)/heavy oil range organics exhibited elevated recovery in the MS and MSD samples reported with batch BJJ0428. DRO also exhibited elevated recovery in the MSD reported in batch BJJ0430; however, the associated MS sample exhibited low recovery.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

Corrective actions were not documented.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied flags to the PCB Aroclor surrogates with recovery failures.

The laboratory applied the *-flag to the DRO MS/MSD results affected by recovery failures.

Refer to subsequent sections for further assessment.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☒ No ☐ N/A ☐ Comments:

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Several samples did not contain detectable concentrations of the PCB Aroclor 1260 and were reported at detection limits which were greater than the associated regulatory limit.

e. Data quality or usability affected?

We cannot assess whether the PCB Aroclor 1260 is present in the affected samples at concentrations greater than the regulatory limit but below the laboratory's reporting limits.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the method blank samples.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

An LCS was reported for DRO analysis in conjunction with batches BJJ0428 and BJJ0448.

An LCS and LCSD were reported for DRO analysis in conjunction with batches BJJ0429 and BJJ0430.

An LCS and LCSD were reported for PCB analysis in conjunction with batches BJJ0434, BJJ0466, and BJJ0467.

An LCS was reported for PCB analysis in conjunction with batch BJJ0471.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals/Inorganics analyses were not requested with this work order.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and precision were demonstrated to be within acceptable limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification is not required; see above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS and MSD samples were reported for DRO analysis in conjunction with batches BJJ0428, BJJ0429, BJJ0430, and BJJ0448.

MS and MSD samples were reported for PCB analysis in conjunction with batches BJJ0466, BJJ0467, and BJJ0471.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals/Inorganics analyses were not requested with this work order.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The recovery for DRO exceeded the laboratory's upper control limit in the MS and MSD samples reported with batch BJJ0428.

The recovery for DRO exceeded the laboratory's upper control limit in the MSD sample reported with batch BJJ0430 but the associated MS sample exhibited low recovery.

The recovery of the PCB Aroclor 1260 was below the laboratory's lower control limit in the MS and MSD samples reported with batch BJJ0471.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The MS/MSD samples reported with batch BJJ0428 were spiked from the field sample *SB-2021-048:1.5-10042021*. However, the DRO spike added to the matrix was low relative to the native concentration in the parent sample. The uncertainty introduced by an insufficient spike may render the recovery calculations unrepresentative of actual method performance. The results are considered unaffected.

The MS/MSD samples reported with batch BJJ0430 were spiked from the field sample *SB-2021-057:2.4-10042021*. However, the DRO spike added to the matrix was low relative to the native concentration in the parent sample. The uncertainty introduced by an insufficient spike may render the recovery calculations unrepresentative of actual method performance. The results are considered unaffected.

The MS/MSD samples reported with batch BJJ0471 were spiked from the field sample *SB-2021-050:2.5-10042021*. However, the DRO spike added to the matrix was low relative to the native concentration in the parent sample. The uncertainty introduced by an insufficient spike may render the recovery calculations unrepresentative of actual method performance. The results are considered unaffected.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Qualification is not required; see above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

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- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The EPA method SW8082A surrogate decachlorobiphenyl exhibited elevated recovery in both columns for samples *SB-2021-048:1.5-10042021* and *SB-2021-051:1.2-10042021*. The detected PCB Aroclor results of these samples are affected by elevated method recovery.

The EPA method SW8082A surrogate decachlorobiphenyl exhibited elevated recovery in column 1 for samples *SB-2021-051:6.5-10042021*, *SB-2021-055:0.5-10042021*, *SB-2021-056:1.0-10042021*, and the MS and MSD samples reported in batch BJJ0466. However, the surrogate was recovered within acceptance criteria in the second column. Sample results are not affected by the surrogate recovery failure.

The EPA method SW8082A surrogate decachlorobiphenyl exhibited elevated recovery in column 2 for samples *SB-2021-048:2.2-10042021* and *SB-2021-057:2.4-10042021*. However, the surrogate was recovered within acceptance criteria in the second column. Sample results are not affected by the surrogate recovery failure.

The EPA method SW8082A surrogate tetrachlormetaxylene exhibited low recovery in both columns in sample *SB-2021-049:1-10042021*. However, the sample was analyzed at a dilution. Surrogate recovery failures attributable to sample dilution do not affect data quality.

The EPA method SW8082A surrogates were unrecoverable in samples *SB-2021-053:2.8-10042021*, *SB-2021-056:2.5-10042021*, *SB-2021-057:5.5-10042021*, and *Drum-Comp-10042021* due to the samples being analyzed at dilutions. Surrogate recovery failures attributable to sample dilution do not affect data quality.

The NWTPH-Dx surrogates were unrecoverable in sample *SB-2021-050:2.5-10042021* due to the sample being analyzed at a dilution. Surrogate recovery failures attributable to sample dilution do not affect data quality.

- iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The PCB Aroclors 1254 and 1268 were detected in sample *SB-2021-048:1.5-10042021* while the Aroclors 1254 and 1262 were detected in sample *SB-2021-051:1.2-10042021*. These results are assumed to have a high analytical bias and are flagged 'JH*' for reporting purposes.

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iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applies qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☐ No ☐ N/A ☒

Comments:

Volatile analyses were not requested for this work order. A trip blank is not required.

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☐ N/A ☒

Comments:

A trip blank is not required for DRO and PCB analyses.

iii. All results less than RL and project specified objectives?

Yes ☐ No ☐ N/A ☒

Comments:

A trip blank is not required for DRO and PCB analyses.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

A trip blank is not required for DRO and PCB analyses.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☐ No ☐ N/A ☐

Comments:

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ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

The following field duplicate pairs were submitted with this work order:

- SB-2021-057:2.4-10042021 / SB-2021-Dup

iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated between the detected results of the field duplicate samples SB-2021-057:2.4-10042021 and SB-2021-Dup were, where calculable, outside the recommended DQO of 50% for all analytes; DRO, RRO, Aroclor 1254, and Aroclor 1260.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The above listed results of the field duplicate samples are considered estimated and flagged “J*” (unless already qualified) to identify the lack of precision.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

Equipment blank samples were not submitted with this work order.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted for this work order.

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iii. Data quality or usability affected?

Comments:

The data quality and usability are not affected; see above.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory applied the E-flag to the DRO and motor oil range organics results for samples *SB-2021-048:1.5-10042021*, *SB-2021-048:2.2-10042021*, *SB-2021-049:2.2-10042021*, and *SB-2021-053:2.8-10042021*. The results were E-flagged because the analyte concentrations exceeded the upper limit of the calibration range of the instrument established by the ICAL. These analytes were re-extracted and within the method recognized hold time and within the laboratory ICAL. The re-extracted results are used for reporting purposes.

The samples *SB-2021-048:1.5-10042021*, *SB-2021-048:8.5-10042021*, *SB-2021-052:0.1-10042021*, and *SB-2021-052:2.4-10042021* exhibited RPD failures between the primary and secondary columns for the analysis of Aroclor 1268. The laboratory qualified the data with a P1-flag. The sample results are considered estimated, and the P1-flag is replaced with a J*-flag to identify the imprecision, unless previously qualified for other QC failures.

The sample *SB-2021-051:8.0-10042021* exhibited an RPD failure between the primary and secondary columns for the analysis of Aroclor 1260. The laboratory qualified the data with a P1-flag. The sample result is considered estimated, and the P1-flag is replaced with a J*-flag to identify the imprecision.

The samples *SB-2021-056:5.5-10042021* and *SB-2021-057:0.8-10042021* exhibited RPD failures between the primary and secondary columns for the analysis of Aroclor 1262. The laboratory qualified the data with a P1-flag. The sample results are considered estimated, and the P1-flag is replaced with a J*-flag to identify the imprecision.

The sample *SB-2021-057:2.4-10042021* exhibited an RPD failure between the primary and secondary columns for the analysis of the surrogate tetrachlorometaxylene. The laboratory qualified the data with a P1-flag. However, the reported results were within control limits. Sample results are not affected by the surrogate RPD failure.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Dana Fjare / Validated by: Michael Jaramillo

Title:

Environmental Scientist / Senior Chemist

Date:

February 11, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21K0165

Laboratory Report Date:

December 1, 2021

Report Name:

Lower Duwamish Q4

Project Number

21-1-12596-035

21K0165

Laboratory Report Date:

December 1, 2021

Report Name:

Lower Duwamish Q4

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

The COC record was incomplete for ice present, number of coolers, and the cooler temperatures. This information was recorded on the laboratory cooler receipt form.

- b. Correct analyses requested?

Yes ☐ No ☒ N/A ☐ Comments:

Copper was omitted from the total dissolved metals list for sample *MW-65-20210911*. The laboratory corrected this error via email correspondence and the sample was analyzed for the intended list of dissolved metals.

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples *MW-38-20210911*, *MW-50-20210911*, *MW-103-20210911* and *MW-65-20210911*. These containers were filtered at 0.45 µm and preserved with 0.75 mL of HNO₃.

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The five of five volatile organic analysis (VOA) vials for the trip blank contained bubbles. The target analytes were not detected in the project samples. The sample results are flagged 'UJ' in the analytical database.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The total metals bottle for sample *MW-65-20210911* was missing a label. After a preservative check, the laboratory found that the dissolved metals bottle had been labeled incorrectly and should have been logged as total metals, with the unlabeled bottle then being the volume for dissolved metals. The laboratory assigned the correct labels to the sample bottles.

- e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial calibration verification (ICV) reported with batch SJK0381 exhibited low recovery for pentachlorophenol and elevated recovery for butylbenzylphthalate, bis(2-ethylhexyl)phthalate and surrogate p-terphenyl-d14.

The Method SW8270E continuing calibration verification (CCV) reported with batch SJK0381 exhibited low recovery for pentachlorophenol. The low concentration calibration verification (LCV) exhibited low recovery for pentachlorophenol and high recovery for butylbenzylphthalate.

The Method SW8270E surrogate phenol-d5 exhibited low recovery in sample MW-65-20210911.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

No corrective actions were detailed in the case narrative.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory Q-flagged the pentachlorophenol, pentachlorophenol, butylbenzylphthalate, and bis(2-ethylhexyl)phthalate results of the QC samples reported in batch SJK0381. Refer to subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

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d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOC analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Analytes were not detected in the method blank at a concentration greater than the RL; however, some analytes were detected in the method blank below the RL.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

The method blank associated with batch BJK0333 had detections for PAH-analytes naphthalene, dibenzofuran, carbazole, and pyrene. The project sample *MW-65-20210911* is associated with batch BJK0333.

The method blank associated with batch BJK0287 had a detection for mercury. The project sample *MW-65-20210911* is associated with batch BJK0287.

The method blank associated with batch BJK0508 had a detection for manganese. The project samples *MW-38-20210911*, *MW-50-20210911*, *MW-103-20210911*, and *MW-65-20210911* are associated with batch BJK0508.

The method blank associated with batch BJK0618 had detections for dissolved silver, dissolved cobalt, and dissolved selenium. The project sample *MW-65-20210911* is associated with batch BJK0618 and was analyzed for these metals.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The analytes naphthalene, dibenzofuran, carbazole, pyrene, and mercury were detected at an estimated concentration in project sample *MW-65-20210911*, less than the RL and within five times the concentration detected in the method blank. The project sample results for these analytes are considered estimated non-detections and are flagged 'UB' at the RL in the analytical data tables.

Other analytes detected in the method blanks were either not detected in the corresponding project samples or were detected at a concentration greater than ten times the concentration detected in the method blank. The data did not require qualification in these instances.

v. Data quality or usability affected?

Comments:

The data quality/usability is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

An LCS/LCSD was reported for HVOC, BTEX, VOC, SVOC, PAH, GRO, DRO, and PCB analyses.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS was reported for total metals and total mercury analyses. No measure of method precision was provided.

A LCS and laboratory duplicate samples were reported for dissolved metals and dissolved mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; laboratory LCS and LCSD accuracy and precision were within laboratory control limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

LCS and LCSD accuracy and precision were within laboratory control limits.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality or usability are not affected.

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c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for dissolved metals and dissolved mercury analyses.

No measure of method precision was provided for total metals and total mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and, where applicable, precision were demonstrated to be within acceptable limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for total metals and total mercury.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E surrogate phenol-d5 exhibited low recovery in project sample MW-65-20210911.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The analytes 1,2-dichlorobenzene and 1,4-dichlorobenzene are associated with the surrogate phenol-d5. These analytes were not detected in project sample MW-65-20210911; consequently, the results are considered affected by the low surrogate recovery and are flagged 'UJ' to qualify the imprecision.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

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ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate sample pair *MW-50-20210911* and *MW-103-20210911* were submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☒ N/A ☐ Comments:

The duplicate RPDs were within the recommended data quality objective of 30% except for manganese.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The manganese result in the duplicate pair is considered estimated and is flagged 'J' in the analytical tables.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted with this work order.

- iii. Data quality or usability affected?

Comments:

We cannot assess whether equipment contamination affected the results.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory Q-flagged the pentachlorophenol, pentachlorophenol, butylbenzylphthalate, and bis(2-ethylhexyl)phthalate results of the QC samples reported in batch SJK0381.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Dana Fjare / Validated by: Michael Jaramillo

Title:

Environmental Scientist / Senior Chemist

Date:

February 11, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21K0213

Laboratory Report Date:

December 1, 2021

Report Name:

Lower Duwamish Q4

Project Number

21-1-12596-035

21K0213

Laboratory Report Date:

December 1, 2021

Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples *MW-9-20211011*, *MW-25-20211011*, *MW-66-20211011* and *EB-1-20211011*. These containers were filtered at 0.45 µm and preserved with 0.75 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Four of the five volatile organic analysis (VOA) vials for the trip blank contained bubbles.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The trip blank label listed MTBE as one of the requested analyses, but there were no other samples analyzed for MTBE. The laboratory did not log in the trip blank for MTBE analysis.

The COC listed “Cn” as a metal analysis but it was likely an error for “Cr”.

e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

The laboratory used one of the trip blank VOA vials with headspace for analysis of vinyl chloride by SW8260D-SIM. The results are considered biased low, though we do not expect analyte detections in the trip blank. Non-detect results are flagged ‘J*’ in the analytical data tables.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial calibration verification (ICV) reported with batch SJK0381 exhibited low recovery for pentachlorophenol and elevated recovery for butylbenzylphthalate, bis(2-ethylhexyl)phthalate and surrogate p-terphenyl-d14.

The Method SW8270E continuing calibration verification (CCV) reported with batch SJK0381 exhibited low recovery for pentachlorophenol. The low concentration calibration verification (LCV) exhibited low recovery for pentachlorophenol and high recovery for butylbenzylphthalate.

The Method SW8270E surrogate phenol-d5 exhibited low recovery in sample *EB-1-20211011*.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

No corrective actions were detailed in the case narrative.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory Q-flagged the pentachlorophenol, pentachlorophenol, butylbenzylphthalate, and bis(2-ethylhexyl)phthalate results of the QC samples reported in batch SJK0381.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

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d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium, dissolved chromium, mercury, dissolved mercury, and several PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Analytes were not detected in the method blank at a concentration greater than the RL; however, some analytes were detected in the method blank below the RL.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

The method blank associated with batch BJK0333 had detections for PAH-analytes naphthalene, dibenzofuran, carbazole, and pyrene. The project samples *MW-25-20211011*, *MW-66-20211011*, and *EB-1-20211011* are associated with batch BJK0333.

The method blank associated with batch BJK0287 had a detection for mercury. The project sample *MW-66-20211011* and *EB-1-20211011* are associated with batch BJK0287.

The method blank associated with batch BJK0413 had a detection for dissolved mercury. The project samples *MW-66-20211011* and *EB-1-20211011* are associated with batch BJK0413.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The PAH analytes naphthalene, dibenzofuran, carbazole, and pyrene were detected in project samples *MW-25-20211011* and *MW-66-20211011*, and naphthalene and carbazole were detected in project sample *EB-1-20211011*, at an estimated concentration less than the RL and within five times the concentration detected in the method blank. The project sample results for these analytes are considered estimated non-detections and are flagged 'UB' at the RL in the analytical data tables.

Dissolved mercury and total mercury were detected in project samples *MW-66-20211011* and *EB-1-20211011* at an estimated concentration less than the RL and within five times the concentration detected in the method blank. The project sample results for these analytes are considered estimated non-detections and are flagged 'UB' at the RL in the analytical data tables.

Other analytes detected in the method blanks were not detected in the corresponding project samples and as a result the data did not require qualification.

v. Data quality or usability affected?

Comments:

The data quality/usability is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

An LCS/LCSD was reported for HVOC, BTEX, VOC, SVOC, PAH, GRO, DRO, and PCB analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS was reported for total metals, dissolved metals, total mercury, and dissolved mercury analyses. No measure of method precision was provided.

A LCS and laboratory duplicate samples were reported for total metals, dissolved metals, total mercury, and dissolved mercury analyses.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; laboratory LCS and LCSD accuracy and precision were within laboratory control limits.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

LCS and LCSD accuracy and precision were within laboratory control limits.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality or usability are not affected.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for total metals, dissolved metals, total mercury, and dissolved mercury analyses.

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- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and precision were demonstrated to be within acceptable limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:The Method SW8270E surrogate phenol-d5 exhibited low recovery in project sample *EB-1-20211011*.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The analytes 1,2-dichlorobenzene and 1,4-dichlorobenzene are associated with the surrogate phenol-d5. These analytes were not detected in project sample *EB-1-20211011*; consequently, the results are considered estimated non-detections and are flagged 'UJ' to qualify the imprecision.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order. However, field duplicates have been collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

- i. All results less than RLs and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

All analyte results were less than the RL in the equipment blank; however, the analytes toluene, naphthalene, 2-methylnaphthalene, carbazole, mercury, and dissolved mercury were detected in the equipment blank at estimated concentrations less than the RLs.

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

The equipment blank is a quality control sample for project samples *MW-9-20211011*, *MW-25-20211011*, and *MW-66-20211011*.

iii. Data quality or usability affected?

Comments:

The naphthalene and carbazole detections in the equipment blank were previously qualified due to a method blank detection. PAH analysis was not performed for sample *MW-9-20211011*. As a result, *MW-9-20211011*, *MW-25-20211011*, and *MW-66-20211011* do not require qualification for the equipment blank naphthalene and carbazole detections, and additionally *MW-9-20211011* does not require qualification for the 2-methylnaphthalene detection.

2-methylnaphthalene was detected at an estimated concentration within five times the concentration detected in the equipment blank in samples *MW-25-20211011*, and *MW-66-20211011*. The results are considered estimated non-detections and are flagged 'UB' at the RL to qualify the imprecision.

The equipment blank and *MW-66-20211011* results for total and dissolved mercury were previously qualified due to method blank detections. The sample results do not require further qualification. Project samples *MW-9-20211011* and *MW-25-20211011* were not analyzed for total or dissolved mercury.

Project samples *MW-9-20211011* and *MW-25-20211011* were not analyzed for toluene, and toluene was not detected in *MW-66-20211011*. Consequently, the sample results are considered unaffected by the toluene detection in the equipment blank.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory Q-flagged the pentachlorophenol, pentachlorophenol, butylbenzylphthalate, and bis(2-ethylhexyl)phthalate results of the QC samples reported in batch SJK0381.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Veselina Yakimova / Validated by: Michael Jaramillo

Title:

Geology Staff / Senior Chemist

Date:

February 14, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21K0240

Laboratory Report Date:

December 3, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

All analyses were performed by ARI.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples *MW-40-20211111*, *MW-102-20211111*, *MW-41-20211111*, *MW-57-20211111*, and *MW-62-20211111*. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

Air bubbles < 2 mm in diameter were documented in the VOA vials for the trip blank.

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

- e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples were delivered to the laboratory on the same day as they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

Vinyl Chloride, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Benzene, Trichloroethene, Toluene, Tetrachloroethene, Ethylbenzene, m,p-Xylene, o-Xylene, and total Xylenes were not detected in the trip blank sample *TB-3-20211111* and are flagged “UJ” to identify the discrepancy from the headspace present in the VOA vials.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial calibration verifications exhibited high recovery for surrogate p-Terphenyl-d14, Butylbenzylphthalate and bis(2-Ethylhexyl)Phthalate; and the continuing calibration verification exhibited low recovery for Pentachlorophenol. The concentration calibration verification was out of control low for Benzoic Acid and Pentachlorophenol. The laboratory flagged associated samples with a Q-flag to identify the QC failure. Refer to Section 4.d for further assessment.

The Method SW8270E Phenol-d5 surrogate recovery was low in project samples *MW-40-20211111*, *MW-41-20211111*, and the method blank.

The Method 6020B Chromium was out of control low in the matrix spike (MS) and Copper was out of control high in the matrix spike duplicate (MSD). Deviations have been flagged. Refer to Section 6.c for further assessment.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

See above for corrective actions applied.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

See above.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

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d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Several SVOC analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Naphthalene, 2-methylnaphthalene, and 1-methylnaphthalene, were detected below the RL in the method blank associated with batch BJK380.

Manganese was detected below the RL in the method blank associated with batch BJK0508.

Mercury was detected below the RL in the method blank associated with batch BJK0411.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

Samples *MW-40-20211111*, *MW-102-20211111*, *MW-62-20211111* and *MW-57-20211111* had concentration of naphthalene, 2-methylnaphthalene, and 1-methylnaphthalene less than the RL and are flagged “UB” at the RL.

Sample *MW-41-20211111* had a concentration of 2-methylnaphthalene less than the RL and is flagged “UB” at the RL.

Sample *MW-41-20211111* had a concentration of naphthalene five times that of the method blank and is flagged “JH”.

Samples *MW-40-20211111*, *MW-41-20211111*, *MW-102-20211111*, *MW-62-20211111* and *MW-57-20211111* had concentration of mercury less than the RL and are flagged “UB” at the RL.

Samples *MW-40-20211111*, *MW-102-20211111*, *MW-41-20211111*, *MW-62-20211111* and *MW-57-20211111* had concentrations of manganese more than 10 times that of the method blank. No qualification required.

Sample *MW-41-20211111* had a concentration of 1-methylnaphthalene more than 10 times that of the method blank. No qualification is required.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above for required qualification.

v. Data quality or usability affected?

Comments:

The data quality is not affected; see above.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, DRO, and PCBs analyses.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for both total and dissolved isotopic metals, wet chemistry, and mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The laboratory duplicate associated with batch BJK0410 had an RPD failure for dissolved chromium. However, the parent sample *MW-40-20211111* was not analyzed for dissolved chromium. Sample result is not affected.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Sample results were not affected; see above.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

No qualification required.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is not affected.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

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ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for both total and dissolved isotopic metals and mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The MS for chromium in batch BJK0508 is below the control limits.

The MSD and MS/MSD RPD for copper in batch BJK0508 are above the control limits.

The MSD for manganese in batch BJK0508 and MS for dissolved manganese in batch BJK0410 are above the control limits.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Sample *MW-40-20211111* was used as a parent sample for the MS analysis, however, the project did not request metals analysis for chromium in this sample. No qualification required.

The manganese and dissolved manganese results in sample *MW-40-20211111* are high relative to the spiking levels and the sample is not considered affected. No qualification required.

The copper result in sample *MW-40-20211111* is considered estimated, biased high, and is flagged “JH” in the analytical database.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

No qualification is required.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The Method SW8270E Phenol-d5 surrogate recovery was low in project samples *MW-40-20211111*, *MW-41-20211111*, and the method blank.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

1,2-Dichlorobenzene and 1,4-Dichlorobenzene were not detected in samples *MW-40-20211111* and *MW-41-20211111* and are flagged “UJ” to identify the low Phenol-d5 surrogate recovery.

The surrogate recovery failure in the QC samples does not affect the associated project samples.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for qualification of results.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐

Comments:

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ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

No analytes were detected in the trip blank.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples MW-40-20211111 and MW-102-20211111 were submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration

R_2 = Field Duplicate Concentration

Yes ☐ No ☒ N/A ☐ Comments:

The vinyl chloride, anthracene, pyrene, lead, copper, nickel, and dissolved selenium results exceed the RPD limit and are flagged “J” to identify the discrepancy.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is affected. See above for required qualification.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

An equipment/decontamination blank was not submitted with this work order. However, decontamination blanks were collected at the required frequency for the overall project.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment/decontamination blank was not submitted with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

An equipment/decontamination blank was not submitted with this work order.

- iii. Data quality or usability affected?

Comments:

The data quality is not affected.

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Laboratory Report Date:

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory applied the Q-flag to the p-Terphenyl-d14 surrogate in samples *MW-40-20211111*, *MW-102-20211111*, and *MW-41-20211111*, and the LCS, LCSD, and method blank in batch BJK0383. The laboratory applied the Q-flag to Butylbenzylphthalate, Pentachlorophenol, and bis(2-Ethylhexyl)phthalate for the LCS/LCSD recoveries in batch BJK0383.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Veselina Yakimova / Validated by: Michael Jaramillo

Title:

Geology Staff / Senior Chemist

Date:

February 14, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21K0245

Laboratory Report Date:

December 17, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21K0245

Laboratory Report Date:

December 17, 2021

Report Name:

Lower Duwamish

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

All analyses were performed by ARI.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples *MW-58-20211211*, *MW-75-20211211*, *MW-36-20211211*, and *MW-30-20211211*. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

Air bubbles were documented in the VOA vials for the trip blank.

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

- e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples were delivered to the laboratory on the same day as they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

Vinyl Chloride, 1,1-Dichloroethene, trans-1,2-Dichloroethene, cis-1,2-Dichloroethene, Benzene, Trichloroethene, Toluene, Tetrachloroethene, Ethylbenzene, m,p-Xylene, o-Xylene, and total Xylenes were not detected in the trip blank sample *TB-4-20211211* and are flagged “UJ” to identify the discrepancy from the headspace present in the VOA vials.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial and continuing calibration verifications exhibited low recovery for 4-Chlorophenylphenyl ether, 4-Nitrophenol, Fluorene, Hexachlorocyclopentadiene and Pentachlorophenol; and 2,4,6-Trichlorophenol, 2,4-Dinitrophenol, bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Fluoranthene, Pyrene, and surrogate p-Terphenyl-d14 were out of control high. All samples which contain these analytes have been flagged with a "Q". The concentration calibration verification was out of control low for 4-Dinitrophenol, 4,6-Dinitro-2-methylphenol, 4-Nitrophenol, Benzoic Acid, Hexachlorocyclopentadiene, and Pentachlorophenol. The laboratory flagged associated samples with a Q-flag to identify the QC failure. Refer to Section 4.d for further assessment.

The Method SW8270E Phenol-d5 surrogate recovery was low in project sample *MW-75-20211211* and the method blank.

The Method SW8270E blank spike and blank spike duplicate (BS/LCS and BSD/LCSD) spike recoveries and relative percent difference (RPD) were below control limits for 4-Chloroaniline and Hexachlorocyclopentadiene.

The Method 6020B dissolved chromium was out of control low in the matrix spike duplicate (MSD). A post preparation spike was performed with passing percent recovery. Refer to Section 6.c for further assessment.

The Method RSK175 propane surrogate recovery was low in project sample *MW-30-20211211* and the method blank.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

See above for corrective actions applied.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

See above.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

Sulfite samples were received outside hold time. Sample were not detected in the associated samples and the results are considered estimated and flagged "UJ" in the analytical tables.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Several VOC analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Benzyl alcohol and Diethyl phthalate were detected below the RL in the method blank associated with batch BJK0383.

Naphthalene, 2-methylnaphthalene, and 1-methylnaphthalene were detected below the RL in the method blank associated with batch BJK380.

Mercury was detected below the RL in the method blank associated with batch BJK0411.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

Benzyl alcohol was not detected in sample *MW-75-20211211* and qualification is not required.

Diethyl phthalate was detected in sample *MW-75-20211211* at a concentration less than 5 times that of the method blank and is flagged "UB" at the RL.

Naphthalene and 1-methylnaphthalene were detected at concentrations more than 10 times that of the method blank in sample *MW-58-20211211*. No qualification required.

Sample *MW-58-20211211* had a concentration of 2-methylnaphthalene more than five times but less than 10 times that of the method blank and is flagged "JH".

Samples *MW-58-20211211*, *MW-75-20211211*, and *MW-36-20211211* had concentration of mercury less than the RL and are flagged "UB" at the RL.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above for required qualification.

v. Data quality or usability affected?

Comments:

The data quality is not affected; see above.

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b. Laboratory Control Sample/Duplicate (LCS/LCSD)

- i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, DRO, and PCBs analyses.

- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for both total and dissolved isotopic metals, wet chemistry, and mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The LCS and LCSD recoveries for 4-Chloroaniline and Hexachlorocyclopentadiene are below the control limits.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

4-Chloroaniline and Hexachlorocyclopentadiene were not detected in sample *MW-75-20211211* and are flagged “UJ” to identify the low LCS/LCSD recoveries.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

No qualification required.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is not affected.

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c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for both total and dissolved isotopic metals and mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The MS for dissolved chromium in batch BJK0635 is below the control limits.

The MS for ferrous iron in batch BJK0350 is below the control limits.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Sample *MW-58-20211211* was used as a parent sample for the dissolved chromium MS analysis and is flagged “UJ” to identify the low MS recovery.The ferrous iron result in sample *MW-58-20211211* is high relative to the spiking levels and the sample is not considered affected. No qualification required.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above for required qualification.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The Method 8260D 1,2-Dichloroethane-d4 surrogate recovery was high in project sample *MW-58-20211211*.

The Method SW8270E Phenol-d5 surrogate recovery was low in project samples *MW-75-20211211* and the method blank.

The Method RSK175 propane surrogate recovery was low in project sample *MW-30-20211211* and the method duplicate.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Benzene in sample *MW-58-20211211* is flagged “JH” to identify the high 1,2-Dichloroethane-d4 surrogate recovery.

1,1-Dichloroethane, cis-1,2-Dichloroethene, trans-1,2-Dichloroethene, Trichloroethene, Vinyl Chloride were not detected in sample *MW-58-20211211* and no qualification is required.

1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2-Chlorophenol, 2-Methylphenol, 4-Methylphenol, Benzyl alcohol, Bis(2-Chloroethyl)ether, Hexachloroethane, N-Nitroso-di-n-propylamine, and Phenol were not detected in sample *MW-75-20211111* and are flagged “UJ” to identify the low Phenol-d5 surrogate recovery.

Methane in sample *MW-30-20211211* is flagged “JL” to identify the low propane surrogate recovery.

Ethane, ethene, and acetylene in sample *MW-30-20211211* are flagged “UJ” to identify the low propane surrogate recovery.

The surrogate recovery failure in the QC samples does not affect the associated project samples.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for qualification of results.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

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iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

No analytes were detected in the trip blank.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, the appropriate number of field duplicates has been submitted for the project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration

R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

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iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

An equipment/decontamination blank was not submitted with this work order. However, decontamination blanks were collected at the required frequency for the overall project.

i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment/decontamination blank was not submitted with this work order.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

An equipment/decontamination blank was not submitted with this work order.

iii. Data quality or usability affected?

Comments:

The data quality is not affected.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the p-Terphenyl-d14 surrogate in sample MW-75-20211211 and the LCS, LCSD, and method blank in batch BJK0383. The laboratory applied the Q-flag to 4-Chlorophenylphenyl ether, 4-Nitrophenol, Fluorene, Hexachlorocyclopentadiene and Pentachlorophenol; and 2,4,6-Trichlorophenol, 2,4-Dinitrophenol, bis(2-ethylhexyl)phthalate, Butylbenzylphthalate, Fluoranthene, Pyrene, 4-Dinitrophenol, 4,6-Dinitro-2-methylphenol, 2-Nitrophenol, and Benzoic Acid for the LCS/LCSD recoveries in batch BJK0383.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Dana Fjare / Validated by: Michael Jaramillo

Title:

Environmental Scientist / Senior Chemist

Date:

February 16, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21K0284

Laboratory Report Date:

December 3, 2021

Report Name:

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Project Number

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples MW-43-20211611, MW-44-20211611, MW-71-20211611, MW-63-20211611, MW-64-20211611, and EB-2-20211611. These containers were filtered at 0.45 µm and preserved with 0.75 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Three of the five volatile organic analysis (VOA) vials for the trip blank contained bubbles.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

The laboratory did not report any discrepancies.

e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

The laboratory used one of the trip blank VOA vials with headspace for analysis of vinyl chloride by SW8260D-SIM. The results are considered biased low, though we do not expect analyte detections in the trip blank. The project samples generally had low or not-detected results for vinyl chloride, and vinyl chloride was not detected in the equipment blank, supporting that the trip blank should not have been exposed to high contamination. The SW8260D-SIM trip blank vinyl chloride result is flagged 'J*' in the analytical data tables.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8082A initial calibration verification (ICV) in preparatory batch SJL0010 exhibited low recovery of surrogate decachlorobiphenyl on column zb-5.

The Method 8260D-SIM surrogate 1,2-dichloroethane-d4 exhibited low recovery in the laboratory control sample duplicate (LCSD) and has been flagged.

The Method 8270E ICV in preparatory batch SJL0050 exhibited low recovery for 4-chlorophenylphenyl ether, fluorene, hexachlorocyclopentadiene, and pentachlorophenol, and high recovery for 2,4-dinitrotoluene, 2-nitrophenol, butylbenzylphthalate, fluoranthene, pyrene, and surrogate p-terphenyl-d14.

The Method 8270E continuing calibration verification (CCV) in preparatory batch SJL0050 exhibited low recovery of hexachlorocyclopentadiene and pentachlorophenol, and high recovery for fluoranthene and pyrene.

The Method 8270E low concentration calibration verification (LCV) in preparatory batch SJL0050 exhibited low recovery for 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, benzo(g,h,i)perylene, benzoic acid, hexachlorocyclopentadiene, and pentachlorophenol, and high recovery for internal standard chrysene-d12.

The Method 8270E surrogate phenol-d5 exhibited low recovery in project sample *EB-2-20211611*.

The Method 8270E laboratory control sample (LCS) exhibited low recovery for benzoic acid, 4-chloroaniline, hexachlorocyclopentadiene, and 4-nitrophenol and the LCSD exhibited low recovery of 4-chloroaniline. The LCS/LCSD relative percent difference (RPD) exceeded laboratory control limits for 2,4-dinitrophenol, hexachlorocyclopentadiene, and 4-chlorophenylphenyl ether.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

For Method 8082A, data were reported from passing column zb-35.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory Q-flagged the surrogate p-terphenyl-d14 results.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium, dissolved chromium, and several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Analytes were not detected in the method blank at a concentration greater than the RL; however, some analytes were detected in the method blank below the RL.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

The method blank associated with batch BJK0539 had detections for PAH-analytes naphthalene and 2-methylnaphthalene. The project samples *MW-71-20211611*, *MW-64-20211611*, and *EB-2-20211611* are associated with batch BJK0539.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Naphthalene and 2-methylnaphthalene were detected in project samples *MW-71-20211611* and *EB-2-20211611*, and naphthalene was detected in project sample *MW-64-20211611*, at an estimated concentration less than the RL and within five times the concentration detected in the method blank. The project sample results for these analytes are considered estimated non-detections and are flagged 'B*' at the RL in the analytical data tables.

The 2-methylnaphthalene result in project sample *MW-64-20211611* was greater than ten times the 2-methylnaphthalene concentration detected in the method blank, and as a result the data did not require qualification.

v. Data quality or usability affected?

Comments:

The data quality/usability is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

An LCS/LCSD was reported for HVOC, BTEX, SVOC, PAH, GRO, DRO, and PCB analyses.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS was reported for total metals, dissolved metals, total mercury, and dissolved mercury analyses. No measure of method precision was provided.

Laboratory duplicate samples were reported for total metals, dissolved metals, total mercury, and dissolved mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The Method 8270E LCS exhibited low recovery for benzoic acid, 4-chloroaniline, hexachlorocyclopentadiene, and 4-nitrophenol, and the LCSD exhibited low recovery of 4-chloroaniline.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The Method 8270E LCS/LCSD relative percent difference (RPD) exceeded laboratory control limits for 2,4-dinitrophenol, hexachlorocyclopentadiene, and 4-chlorophenylphenyl ether.

The laboratory duplicate sample RPD exceeded laboratory control limits for copper.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The LCS/LCSD is a QC sample for project samples *MW-63-20211611* and *EB-2-20211611*.

The laboratory duplicate sample is a duplicate of project sample *EB-2-20211611*.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The analytes that exhibited low recovery in the LCS and LCSD were not detected in the associated project samples. The associated *MW-63-20211611* and *EB-2-20211611* results are considered estimated, biased low, and are qualified 'J*' in the analytical data tables.

The analytes with RPD failures in the LCS and LCSD were not detected in the associated project samples. Results are considered estimated, biased low, and are qualified 'J*' in the analytical data tables.

The copper result in the equipment blank sample is considered estimated due to the duplicate RPD failure and is flagged 'J*' in the analytical data tables.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality or usability are affected; see above.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for total metals, dissolved metals, total mercury, and dissolved mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and precision were demonstrated to be within acceptable limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E surrogate phenol-d5 exhibited low recovery in project samples *EB-2-20211611* and *MW-63-20211611*.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The analytes 1,2-dichlorobenzene and 1,4-dichlorobenzene are associated with the surrogate phenol-d5. These analytes were not detected in project samples *EB-2-20211611* and *MW-63-20211611*; consequently, the results are considered estimated non-detections and are flagged 'J*' to qualify the imprecision.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order. However, field duplicates have been collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

- i. All results less than RLs and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

All analyte results were less than the RL in the equipment blank; however, the analytes toluene, naphthalene, 2-methylnaphthalene, 1-methylnaphthalene, acenaphthene, copper, and selenium were detected in the equipment blank at estimated concentrations less than the RLs.

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

The equipment blank is a quality control sample for project samples *MW-43-20211611*, *MW-44-20211611*, *MW-71-20211611*, *MW-63-20211611*, and *MW-64-20211611*.

iii. Data quality or usability affected?

Comments:

The naphthalene and 2-methylnaphthalene detections in the equipment blank were previously qualified due to a method blank detection and do not require further qualification.

1-methylnaphthalene was detected at an estimated concentration within five times the concentration detected in the equipment blank in sample *MW-71-20211611*. The result is considered an estimated non-detection and is flagged 'B*' at the RL in the analytical data tables. 1-methylnaphthalene was detected in *MW-64-20211611* at greater than ten times the concentration detected in the equipment blank, and the remaining project samples were not analyzed for PAHs, so the data was unaffected by the equipment blank detection and did not require qualification.

The acenaphthene concentration detected in *MW-64-20211611* and *MW-71-20211611* was greater than five times but less than ten times the concentration detected in the equipment blank. The results are considered estimated, biased high, and are flagged 'JH*' in the analytical data tables. The remaining project samples were not analyzed for PAHs.

Copper was detected in *MW-63-20211611* and *MW-71-20211611* above the RL and within five times the concentration detected in the equipment blank. The result is considered estimated, biased high, and is flagged 'JH*' in the analytical data tables. Copper was either not detected or the analysis was not requested in the other project samples.

Selenium and toluene were not detected in the associated samples, so qualification for the equipment blank detection was not required.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒ Comments:

Other data flags and qualifiers were not required.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Veselina Yakimova / Validated by: Adam Wyborny, PE

Title:

Geology Staff / Senior Environmental Engineer

Date:

February 15, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21K0303

Laboratory Report Date:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

All analyses were performed by ARI.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples *MW-60-20211711*, *MW-72-20211711*, *MW-8-20211711*, and *MW-68-20211711*. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

The volume provided for ferrous iron analysis contained headspace for sample *MW-60-20211711*.

Air bubbles were documented in two of the five VOA vials for trip blank sample *TB-6-20211711*.

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that the sample listed as *MW-72-20211711* on the CoC was labeled *MW-70-20211711* on the container. The sample was logged in per the CoC.

Semi-volatile organic compounds (SVOC) analysis was requested for sample *MW-72-20211711* but specific volume was not provided. The laboratory used one of the containers mark for polynuclear aromatic hydrocarbons (PAH) analysis to run SVOCs.

- e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day as they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

The ferrous iron result of sample *MW-60-20211711* may be affected by the presence of significant headspace in the sample container. This result is considered estimated with a low analytical bias and is flagged JL* in the summary table.

One of the *TB-6-20211711* VOA vials with headspace was used for the vinyl chloride analysis associated with batch BJK0712. Vinyl chloride was not detected, and the result is flagged J* to identify the discrepancy.

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4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐

Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8082A initial calibration verification (ICV) analyzed with batch SJL0010 exhibited elevated recovery for the surrogate decachlorobiphenyl on column zb-5. The laboratory reported the data from the passing column zb-35.

The Method SW8270E ICV analyzed with batch SJL0050 exhibited low recovery for 4-chlorophenylphenyl ether, fluorene, hexachlorocyclopentadiene and pentachlorophenol; and high recovery for 2-nitrophenol, butylbenzylphthalate, fluoranthene, pyrene and the surrogate p-terphenyl-d14.

The Method SW8270E continuing calibration verification (CCV) analyzed with batch SJL0050 exhibited low recoveries for hexachlorocyclopentadiene and pentachlorophenol and high recoveries for fluoranthene and pyrene.

The first Method SW8270E low concentration calibration verification (LCV1) analyzed with batch SJL0050 exhibited low recoveries for 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, benzo(g,h,i)perylene, benzoic Acid, hexachlorocyclopentadiene and pentachlorophenol.

The second Method SW8270E low concentration calibration verification (LCV2) analyzed with batch SJL0050 exhibited low recoveries for 4,6-dinitro-2-methylphenol, hexachlorocyclopentadiene, benzoic Acid, pentachlorophenol and the internal standard Chysene-d12.

The Method SW8270E laboratory control sample (LCS) and/or LCS duplicate (LCSD) exhibited low recoveries for benzoic acid, 4-chloroaniline, hexachlorocyclopentadiene and 4-nitrophenol. The relative percent difference (RPD) was outside of laboratory limits for hexachlorocyclopentadiene, 2,4-dinitrophenol, and 4-chlorophenylphenyl ether. Deviations have been flagged. Refer to Section 6.b for further assessment.

The Method 6020B laboratory duplicate (DUP) relative percent difference (RPD) was above advisory control for manganese-55. The matrix spike/matrix spike duplicate (MS/MSD) spike recoveries below advisory control limits for manganese-55. A post digestion spike was performed for manganese-55, which met advisory control limits. Deviations have been flagged. Refer to Section 6.c for further assessment.

The holding time for sulfite was exceeded upon receipt at the laboratory.

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c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

See above.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

See above.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Several VOC and SVOC analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Naphthalene and 2-methylnaphthalene were detected below the RL in the method blank associated with batch BJK0539.

- iii. If above RL or project specified objectives, what samples are affected?

Comments:

Sample MW-60-20211711 did not contain detectable concentrations of naphthalene. No qualification required. 2-methylnaphthalene was detected at more than 10 times the method blank detection in sample MW-60-20211711. No qualification required.

- iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

No qualification required.

- v. Data quality or usability affected?

Comments:

The data quality is not affected; see above.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

- i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, DRO, and PCBs analyses.

- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for both total and dissolved isotopic metals, wet chemistry, and mercury analyses.

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- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The LCS exhibited low recovery for Benzoic Acid, 4-Chloroaniline, Hexachlorocyclopentadiene, and 4-Nitrophenol, and the LCSD exhibited low recovery for 4-Chloroaniline in batch BJK0540.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The RPD was outside laboratory limits for Hexachlorocyclopentadiene, 2,4-Dinitrotoluene and 4-Chlorophenylphenyl ether in batch BJK0540.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Benzoic Acid, 4-Chloroaniline, Hexachlorocyclopentadiene, and 4-Nitrophenol were not detected in samples *MW-72-20211711* and *MW-68-20211711* and are flagged 'UJ' to identify the low LCS/LCSD recoveries.

2,4-Dinitrotoluene and 4-Chlorophenylphenyl ether were not detected in samples *MW-72-20211711* and *MW-68-20211711* and are flagged 'UJ' to identify the high LCS/LCSD RPD.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

See above for applied qualifiers.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

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ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for both total and dissolved isotopic metals and mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The MS/MSD for dissolved manganese in batch BJK0730 are below the control limits.

The MS for ferrous iron in batch BJK0468 is below the control limits.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Sample MW-68-20211711 was used as a parent sample for the dissolved manganese MS/MSD analysis. The result is already qualified due to a laboratory duplicate RPD failure. See Section 7a.

The ferrous iron result in sample MW-60-20211711 is high relative to the spiking levels and the sample is not considered affected. No qualification required.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above for required qualification.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:The Method SW8270E Phenol-d5 surrogate recovery was low in project sample *MW-72-20211711*.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

1,2-Dichlorobenzene, 1,3-Dichlorobenzene, 1,4-Dichlorobenzene, 2-Chlorophenol, 2-Methylphenol, 4-Methylphenol, Bis(2-Chloroethyl)ether, Hexachloroethane, N-Nitroso-di-n-propylamine, and Phenol were not detected in *MW-72-20211711* and are flagged “UJ” to identify the low Phenol-d5 surrogate recovery.

Benzyl alcohol was detected in sample *MW-72-20211711* and is flagged “JL” to identify the low surrogate recovery.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for qualification of results.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

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ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

No analytes were detected in the trip blank.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

No field duplicates submitted with this work order. However, the appropriate amount of field duplicates was submitted for the project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

No field duplicates submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

An equipment/decontamination blank was not submitted with this work order. However, decontamination blanks were collected at the required frequency for the overall project.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment/decontamination blank was not submitted with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

An equipment/decontamination blank was not submitted with this work order.

- iii. Data quality or usability affected?

Comments:

The data quality is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the surrogate p-Terphenyl-d14 in samples *MW-72-20211711* and *MW-68-20211711*; and to 2,4-Dinitrotoluene, 2-Nitrophenol, Butylbenzylphthalate, Fluoranthene, Pyrene, surrogate p-Terphenyl-d14, 4-Chlorophenylphenyl ether, Florene, Hexachlorocyclopentadiene, Pentachlorophenol, 2-4-Dinitrophenol, 4,6-Dinitro-2-methylphenol, Benzo(g,h,i)perylene, and Benzoic Acid the LCS/LCSD recoveries in batch BJK0540.

Dissolved selenium was not detected in samples *MW-60-20211711* and *MW-72-20211711* and is flagged 'UJ' to identify the RPD failure in the laboratory duplicate.

Dissolved selenium in samples *MW-8-20211711* and *MW-68-20211711* is flagged 'J' to identify the RPD failure in the laboratory duplicate.

Dissolved manganese in samples *MW-60-20211711*, *MW-72-20211711*, and *MW-68-20211711* is flagged 'J' to identify the RPD failure in the laboratory duplicate.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Veselina Yakimova / Validated by: Adam Wyborny, PE

Title:

Geology Staff / Senior Environmental Engineer

Date:

February 15, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21K0322

Laboratory Report Date:

December 4, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21K0322

Laboratory Report Date:

December 4, 2021

Report Name:

Lower Duwamish

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

All analyses were performed by ARI.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples *MW-76-20211811*, *MW-45-20211811*, and *MW-55-20211811*. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

Air bubbles were documented in three of the five VOA vials for the trip blank sample *TB-7-20211811*.

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

- e. Data quality or usability affected?

Comments:

The data quality/usability is not affected. The samples were delivered to the laboratory on the same day as they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

One of the *TB-7-20211811* VOA vials with headspace was used for the vinyl chloride analysis associated with batch BJK0712. Vinyl chloride was not detected, and the result is flagged J* to identify the possible low bias.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial calibration verification (ICV) analyzed with batch SJL0050 exhibited low recovery for 4-chlorophenylphenyl ether, fluorene, hexachlorocyclopentadiene and pentachlorophenol; and high recovery for 2-nitrophenol, butylbenzylphthalate, fluoranthene, pyrene and the surrogate p-terphenyl-d14.

The Method SW8270E continuing calibration verification (CCV) analyzed with batch SJL0050 exhibited low recoveries for hexachlorocyclopentadiene and pentachlorophenol and high recoveries for fluoranthene and pyrene.

The first Method SW8270E low concentration calibration verification (LCV1) analyzed with batch SJL0050 exhibited low recoveries for 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, benzo(g,h,i)perylene, benzoic Acid, hexachlorocyclopentadiene and pentachlorophenol.

The second Method SW8270E low concentration calibration verification (LCV2) analyzed with batch SJL0050 exhibited low recoveries for 4,6-dinitro-2-methylphenol, hexachlorocyclopentadiene, benzoic Acid, pentachlorophenol and the internal standard Chrysene-d12.

The Method SW8270E surrogate recovery for Phenol-d5 was out of control low in sample MW-76-20211811 and has been flagged.

The Method SW8270E laboratory control sample (LCS) and/or LCS duplicate (LCSD) exhibited low recoveries for benzoic acid, 4-chloroaniline, hexachlorocyclopentadiene and 4-nitrophenol. The relative percent difference (RPD) was outside of laboratory limits for hexachlorocyclopentadiene, 2,4-dinitrophenol, and 4-chlorophenylphenyl ether. Deviations have been flagged. Refer to Section 6.b for further assessment.

The Method 6020B matrix spike duplicate (MSD) recovery was below the advisory control limit for total iron and has been flagged. Refer to Section 6.c for further assessment.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

No corrective actions were documented in the case narrative.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

See above, Section 4.b.

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5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Several VOC and SVOC analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Naphthalene and 2-methylnaphthalene were detected below the RL in the method blank associated with batch BJK0539.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

Sample *MW-76-20211811*, *MW-31-20211811*, and *MW-55-20211811* were analyzed with batch BJK0539 contained detectable concentrations of naphthalene and 2-methylnaphthalene.

Samples *MW-76-20211811* and *MW-55-20211811* contain 2-methylnaphthalene concentrations within 5X that of the concentration detected in the method blank. Sample *MW-31-20211811* contains a 2-methylnaphthalene concentration within 10X that of the concentration detected in the method blank.

Samples *MW-76-20211811*, *MW-31-20211811*, and *MW-55-20211811* all contain naphthalene concentrations roughly equivalent to that of the concentration detected in the method blank.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 2-methylnaphthalene results of samples *MW-76-20211811* and *MW-55-20211811* are assumed to be artifacts of laboratory contamination and are flagged B* in the summary table.

The 2-methylnaphthalene result of sample *MW-31-20211811* may be influenced by external analyte contributions. This result is considered estimated with a high analytical bias and is flagged JH* in the summary table.

The naphthalene results of samples *MW-76-20211811*, *MW-31-20211811*, and *MW-55-20211811* are assumed to be artifacts of laboratory contamination and are flagged B* in the summary table.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS and laboratory duplicate samples were reported for total/dissolved isotopic metals, total/dissolved mercury, and hexavalent chromium analyses.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The LCS reported with batch BJK0540 exhibited low recoveries for benzoic acid, 4-chloroaniline, hexachlorocyclopentadiene, and 4-nitrophenol. The corresponding LCSD exhibited low recovery for 4-chloroaniline.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The RPD was outside laboratory limits for hexachlorocyclopentadiene, 2,4-dinitrophenol, and 4-chlorophenylphenyl ether in batch BJK0540.

v. If %R or RPD is outside of acceptable limits, what samples are affected?
Comments:

Samples *MW-31-20211811* and *MW-76-20211811* are included in batch BJK0540. The non-detect benzoic acid, 4-chloroaniline, hexachlorocyclopentadiene, and 4-nitrophenol of these samples may be affected by low method recovery.

The 2,4-dinitrotoluene and 4-chlorophenylphenyl ether results of samples *MW-31-20211811* and *MW-76-20211811* may lack precision.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect benzoic acid, 4-chloroaniline, hexachlorocyclopentadiene, 4-nitrophenol, 2,4-dinitrotoluene and 4-chlorophenylphenyl results of samples *MW-31-20211811* and *MW-76-20211811* are considered estimated and flagged J* in the summary table.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses. Refer to section 6.b for assessment of method accuracy and precision.

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ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for total/dissolved isotopic metals and total/dissolved mercury analyses.

A MS sample was reported for hexavalent chromium analysis. See section 6.b for assessment of method precision.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The MSD recoveries for iron-54 and manganese-55 in batch BJK0067 were below their lower control limits.

The MS/MSD recoveries for dissolved manganese-55 in batch BJK0733 are below the lower control limit.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The MS/MSD samples reported for batches BJK0067 and BJK0733 were spiked from the field sample MW-76-20211811. The iron-54, manganese-55, and dissolved manganese-55 concentrations in the parent sample are high relative to the spiking concentrations added. The spikes were not distinguishable from background concentrations to the recovery could not be accurately quantified.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

No qualification required; see above.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:The Method SW8270E surrogate Phenol-d5 recovery was low in project sample *MW-76-20211811*.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

1,2-Dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-chlorophenol, 2-methylphenol, 4-methylphenol, bis(2-Chloroethyl)ether, hexachloroethane, n-nitroso-di-n-propylamine, benzyl alcohol, and phenol are associated with the surrogate phenol-d5 and were not detected in sample *MW-76-20211811*. These non-detect results are considered estimated and are flagged J* to identify the low surrogate recovery.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

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ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

No target analytes were detected in the trip blank.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

No field duplicates submitted with this work order. However, the appropriate amount of field duplicates was submitted for the project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

No field duplicates submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

An equipment/decontamination blank was not submitted with this work order. However, decontamination blanks were collected at the required frequency for the overall project.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment/decontamination blank was not submitted with this work order.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

An equipment/decontamination blank was not submitted with this work order.

- iii. Data quality or usability affected?

Comments:

The data quality is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the surrogate p-Terphenyl-d14 is samples *MW-31-20211811* and *MW-76-20211811*; and to 2,4-dinitrotoluene, 2-nitrophenol, butylbenzylphthalate, fluoranthene, pyrene, the surrogate p-Terphenyl-d14, 4-chlorophenylphenyl ether, florene, hexachlorocyclopentadiene, pentachlorophenol, 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, benzo(g,h,i)perylene, and benzoic acid the LCS/LCSD recoveries in batch BJK0540.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Veselina Yakimova / Validated by: Adam Wyborny, PE

Title:

Geology Staff / Senior Environmental Engineer

Date:

February 16, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

All analyses were performed by ARI.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

Several analyses were missed on the CoC by the samplers. These errors were corrected in the appended email correspondence during the sample login process. Attenuation parameters were added to the analysis request for MW-23 while hexavalent chromium and polychlorinated biphenyls (PCBs) were added to sample MW-47. Additionally, both of these samples were erroneously marked for hardness analysis. This analysis was canceled.

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples *MW-23-20211911*, *MW-15-20211911*, *MW-7-20211911*, and *MW-47-20211911*. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

The volume provided for ferrous iron analysis contained headspace for samples *MW-23-20211911* and *MW-15-20211911*.

Air bubbles were documented in one of the VOA vials for sample *MW-23-20211911* and four of the VOA vials for the trip blank *TB-8-20211911*.

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no additional discrepancies documented besides those noted above.

- e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day as they were collected. The laboratory adjusted the pH of the under-preserved sample volume upon receipt.

The ferrous iron results of samples *MW-23-20211911* and *MW-15-20211911* may be affected by the presence of significant headspace in the sample containers. These results are considered estimated with a low analytical bias and are flagged JL* in the summary table.

One of the *TB-8-20211911* VOA vials with headspace was used for the vinyl chloride analysis associated with batch BJK0712. Vinyl chloride was not detected, and the result is flagged J* to identify the discrepancy.

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4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial calibration verification (ICV) analyzed with batch SJL0050 exhibited low recovery for 4-chlorophenylphenyl ether, fluorene, hexachlorocyclopentadiene and pentachlorophenol; and high recovery for 2-nitrophenol, butylbenzylphthalate, fluoranthene, pyrene and the surrogate p-terphenyl-d14.

The Method SW8270E continuing calibration verification (CCV) analyzed with batch SJL0050 exhibited low recoveries for hexachlorocyclopentadiene and pentachlorophenol and high recoveries for fluoranthene and pyrene.

The first Method SW8270E low concentration calibration verification (LCV1) analyzed with batch SJL0050 exhibited low recoveries for 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, benzo(g,h,i)perylene, benzoic Acid, hexachlorocyclopentadiene and pentachlorophenol.

The second Method SW8270E low concentration calibration verification (LCV2) analyzed with batch SJL0050 exhibited low recoveries for 4,6-dinitro-2-methylphenol, hexachlorocyclopentadiene, benzoic Acid, pentachlorophenol and the internal standard Chrysene-d12.

The Method SW8270E internal standard Chrysene-d12 exhibited low recovery in the method blank sample reported with batch BJK0625. Refer to Section 6.d for further assessment.

The recovery of the Method SW8270E surrogate Phenol-d5 was out of control low in the method blank reported with batch BJK0625. Refer to Section 6.d for further assessment.

The Method SW8270E laboratory control sample (LCS) and LCS duplicate (LCSD) exhibited low recoveries and relative percent differences (RPD) outside acceptance criteria for chloroaniline and 4-nitrophenol. Deviations have been flagged. Refer to Section 6.b for further assessment.

The holding time for sulfite analysis was exceeded upon receipt at the laboratory.

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c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

See above.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory applied the Q-flag to the ,4-dinitrophenol, 4,6-dinitro-2-methylphenol, 4-chlorophenylphenyl ether, benzo(g,h,i)perylene, benzoic Acid, fluorene, hexachlorocyclopentadiene pentachlorophenol, 2-nitrophenol, butylbenzylphthalate, fluoranthene, pyrene and the surrogate p-terphenyl-d14 recoveries of the QC samples included with batch SJL0050.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The sulfite holding time was exceeded upon sample receipt for samples *MW-15-20211911* and *MW-23-20211911*.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Several VOC and SVOC analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

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e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

Sulfite was not detected in samples *MW-23-20211911* and *MW-15-20211911*. These non-detect results are considered estimated and are flagged J* to identify the holding time exceedance.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iii. If above RL or project specified objectives, what samples are affected?

Comments:

Target analytes were not detected in the method blank samples.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

No qualification required; see above.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, dissolved gases, SVOCs, and PCBs analyses.

A LCS was reported for DRO analysis. Refer to Section 6.c for assessment of method precision.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS and laboratory duplicate samples were reported for dissolved isotopic metals, chloride, sulfate, nitrate/nitrite, hexavalent chromium, ferrous iron, and sulfite analyses.

A LCS was reported for total isotopic metals analysis. No measure of method precision was provided.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E LCS reported with batch BJK0625 exhibited low recovery for 4-chloroaniline. The associated LCSD exhibited low recoveries for 4-chloroaniline and 4-nitrophenol.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for the total isotopic metals analysis.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Only sample *MW-47-20211911* is included in batch BJK0625. 4-Chloroaniline and 4-nitrophenol were not detected in sample *MW-47-20211911*. These non-detect results may be affected by low method recovery.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:The 4-chloroaniline and 4-nitrophenol results of sample *MW-47-20211911* are considered estimated non-detections and are flagged J* in the summary table.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were reported for DRO analysis.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for dissolved isotopic metals analysis.

A MS sample was reported for chlorite, sulfate, and nitrate/nitrite, and ferrous iron analyses. Refer to section 6.b for assessment of method precision.

A MS and post-spike sample were reported for hexavalent chromium analysis. Refer to section 6.b for assessment of method precision.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The MS/MSD recoveries for dissolved manganese-55 in batch BJK0584 are below the lower control limit.

The MS and post spike exhibited gross recovery failures for hexavalent chromium in batch BJK0550.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for the total isotopic metals analysis.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Sample MW-23-20211911 was used as the parent sample for the MS/MSD reported with batch BJK0584. The dissolved manganese concentration in the parent sample is high relative to the spiking concentration. This causes the spike to be indistinguishable from background levels. No qualification required.

Sample MW-23-20211911 was used as a parent sample for hexavalent chromium MS analysis. The gross MS/MSD recovery failures may imply that the matrix is adversely affecting method performance.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect hexavalent chromium result of sample MW-23-20211911 is rejected due to the gross recovery failures demonstrated by the MS and post-spike. This result is flagged R* in the summary table.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is affected; see above for applied qualifiers.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E surrogate Phenol-d5 exhibited low recovery in the method blank reported with batch BJK0625.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The surrogate recovery failure in the method blank does not affect the project samples. Surrogate recoveries for the project samples were within acceptable limits.

iv. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

No target analytes were detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

No field duplicates submitted with this work order. However, the appropriate amount of field duplicates was submitted for the project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

No field duplicates submitted with this work order.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

An equipment/decontamination blank was not submitted with this work order. However, decontamination blanks were collected at the required frequency for the overall project.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment/decontamination blank was not submitted with this work order.

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

An equipment/decontamination blank was not submitted with this work order.

iii. Data quality or usability affected?

Comments:

The data quality is not affected.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory applied the Q-flag to the surrogate p-Terphenyl-d14 is samples *MW-47-20211911*; and to 2,4-Dinitrotoluene, 2-Nitrophenol, Butylbenzylphthalate, Fluoranthene, Pyrene, surrogate p-Terphenyl-d14, 4-Chlorophenylphenyl ether, Florene, Hexachlorocyclopentadiene, Pentachlorophenol, 2-4-Dinitrophenol, 4,6-Dinitro-2-methylphenol, Benzo(g,h,i)perylene, and Benzoic Acid recoveries of the LCS/LCSD in batch BJK0625.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Dana Fjare / Validated by: Adam Wyborny, PE

Title:

Environmental Scientist / Senior Environmental Engineer

Date:

February 15, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21K0367

Laboratory Report Date:

December 17, 2021

Report Name:

Lower Duwamish Q4

Project Number

21-1-12596-035

21K0367

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples MW-46-20212211, MW-56-20212211, and EB-3-20212211. These containers were filtered at 0.45 µm and preserved with 0.75 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

No additional discrepancies were noted by the laboratory.

e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory chilled the samples and adjusted the pH of the under-preserved sample volume upon receipt.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial calibration verification (ICV) reported with batch SJL0050 exhibited low recovery for pentachlorophenol and high recoveries for butylbenzylphthalate and the surrogate p-terphenyl-d14.

The Method SW8270E continuing calibration verification (CCV) reported with batch SJL0050 exhibited low recovery for pentachlorophenol.

The Method SW8270E low concentration calibration verification (LCV) samples reported with batch SJL0050 exhibited low recoveries for benzoic acid and pentachlorophenol.

Internal standard areas were within limits except chrysene-d12, which was out of control high in sample *EB-3-20212211*, the second LCV, and method blank BLK0625-BLK1.

The Method SW8270E surrogate phenol-d5 exhibited low recovery in samples *EB-3-20212211*, *MW-46-20212211*, and method blank BLK0625-BLK1. Refer to section 6.d for further assessment.

The sulfite holding time was exceeded upon sample receipt.

The Method SW8270E-SIM ICV reported with batch SJL0008 exhibited low recovery for benzo(g,h,i)perylene and the surrogate dibenzo(a,h)anthracene-d14.

The Method SW8270E-SIM surrogate dibenzo(a,h)anthracene-d14 exhibited low recovery in sample *MW-46-20212211* (re-run) and in the ICV associated with batch SJL0008.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

Due to the internal standard recovery failure for chrysene-d12, sample *EB-3-20212211* was re-analyzed. The internal standard recoveries were within laboratory control limits for the re-analyzed sample.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory Q-flagged the pentachlorophenol, butylbenzylphthalate, and surrogate p-terphenyl-d14 results of the QC samples reported in batch SJL0050.

The laboratory flagged surrogate phenol-d5 results in samples *EB-3-20212211*, *MW-46-20212211*, and method blank BLK0625-BLK1.

The laboratory H-flagged the sulfite result that exceeded hold time.

The laboratory Q-flagged the benzo(g,h,i)perylene and surrogate dibenzo(a,h)anthracene-d14 results of the QC samples reported in batch SJL0008.

The laboratory flagged dibenzo(a,h)anthracene-d14 results in sample *MW-46-20212211* (rerun) and the ICV from batch SJL0008.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The sulfite holding time was exceeded upon receipt for sample *MW-56-20212211*.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

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e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

The non-detect sulfite result of sample *MW-56-20212211* is affected by the hold-time exceedance. It is considered estimated, biased low, and is flagged J* in the analytical data tables.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

2-Methylnaphthalene and naphthalene were detected at estimated concentrations below the RL in the method blank sample reported with preparation batch BJK0640.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

The samples *EB-3-20212211*, *MW-46-20212211*, and *MW-56-20212211* are associated with batch BJK0640.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

2-Methylnaphthalene and naphthalene were detected in samples *EB-3-20212211* and *MW-56-20212211* at concentrations less than the RL and within five times the concentration detected in the method blank. These results are assumed to be artifacts of laboratory contamination and are flagged B* at the RL in the analytical data tables.

The concentration of 2-methylnaphthalene and naphthalene in sample *MW-46-20212211* was greater than ten times the concentration detected in the method blank. The results are considered unaffected by the method blank detections.

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v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOC, dissolved gases, SVOC, PAH, and DRO analyses.

A laboratory duplicate sample was reported for dissolved gases.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS was reported for total mercury and hexavalent chromium analyses. No measure of method precision was provided.

A LCS and laboratory duplicate samples were reported for total/dissolved isotopic metals, dissolved mercury, ferrous iron, sulfite, sulfate, chloride, and nitrate/nitrite analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for the total mercury and hexavalent chromium analyses.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; LCS and LCSD accuracy and, where applicable, precision were within laboratory control limits.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for the total mercury and hexavalent chromium analyses.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

An MS/MSD was reported for DRO analysis.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for total/dissolved isotopic metals and dissolved mercury analyses.

A MS sample was reported for ferrous iron, chloride, sulfate, nitrate/nitrite, and hexavalent chromium analyses. Refer to section 6.b for assessment of method precision.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for the total mercury and hexavalent chromium analyses.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; where applicable, method accuracy and precision were demonstrated to be within acceptable limits.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for the total mercury and hexavalent chromium analyses.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:The Method SW8270E surrogate phenol-d5 exhibited low recovery in samples *EB-3-20212211*, *MW-46-20212211*, and the method blank associated with batch BJK0625.The Method SW8270E-SIM surrogate dibenzo(a,h)anthracene-d14 exhibited low recovery in the re-analysis of sample *MW-46-20212211*.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The SVOC analytes 1,2-dichlorobenzene, 1,4-dichlorobenzene, and n-nitrosodiphenylamine are associated with the surrogate phenol-d5. These analytes were not detected in project samples *EB-3-20212211* and *MW-46-20212211*. These non-detect results are considered estimated, biased low due to the low surrogate recovery, and are flagged J* in the analytical data tables.

The PAH results of sample *MW-46-20212211* are reported from the initial analysis, with one exception. The acenaphthene result exceeded the instruments calibration range and prompted reanalysis at a dilution. This result is not affected by the surrogate recovery failure in the second run because the recovery failure was a side effect of diluting the extract.

Surrogate recovery failures in laboratory QC samples generally do not affect the results. The low surrogate recovery in the method blank may imply that detectable results could be under-represented, had there been any. However, we do not expect to see detections in the method blank samples.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

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iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates have been collected at the required frequency for the overall project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration R_2 = Field Duplicate ConcentrationYes ☐ No ☐ N/A ☒ Comments:

Field duplicates were not submitted with this work order.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

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- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☒ No ☐ N/A ☐ Comments:

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☒ N/A ☐ Comments:

Barium-135 was detected in the equipment blank at a concentration of 1.67 µg/L.

The analytes naphthalene, 1-methylnaphthalene, 2-methylnaphthalene, and manganese-55 were detected in the equipment blank at estimated concentrations below the RL.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

The equipment blank is a QC sample for project samples *MW-46-20212211* and *MW-56-20212211*.

- iii. Data quality or usability affected?

Comments:

The project samples, including the equipment blank, were previously qualified due to a method blank detection for naphthalene and 2-methylnaphthalene. The sample results for these analytes do not require further qualification.

1-Methylnaphthalene was detected in project sample *MW-56-20212211* at a concentration less than the RL and within five times the concentration detected in the equipment blank. The sample result is assumed to be an artifact of equipment contamination and is flagged B* at the RL in the analytical tables. 1-Methylnaphthalene was detected in *MW-46-20212211* at a concentration greater than ten times the concentration detected in the equipment blank; consequently, this result is considered unaffected by the equipment blank detection.

Manganese-55 was detected in *MW-46-20212211* and *MW-56-20212211* at concentrations greater than ten times the concentration detected in the equipment blank; consequently, the data are considered unaffected by the equipment blank detection.

Barium-135 was detected in sample *MW-56-20212211* at a concentration within five times the concentration detected in the equipment blank. This result is assumed to be an artifact of equipment contamination and is flagged B* in the analytical data tables. Sample *MW-46-20212211* was not analyzed for barium.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the E-flag to PAH analyte acenaphthene which exceeded the instrument calibration range in sample *MW-46-20212211*. The laboratory re-analyzed the affected samples at a dilution. We have reported the re-analyzed results only for those analytes that were E-flagged, and otherwise report the original, undiluted sample results.

The equipment blank was re-analyzed for Method 8270E SVOC due to ICV, CCV, and LCV recovery failures. Analytes were not detected in either SVOC run. Nonetheless, we report the equipment blank results from the second run.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Dana Fjare / Validated by: Adam Wyborny, PE

Title:

Environmental Scientist / Senior Environmental Engineer

Date:

February 15, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21K0382

Laboratory Report Date:

December 10, 2021

Report Name:

Lower Duwamish Q4

Project Number

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples MW-14-20212311, MW-10R-20212311, and MW-11-20212311. These containers were filtered at 0.45 µm and preserved with 0.75 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Two of the VOA vials for the trip blank *TB-10-20212311* and one vial for sample *MW-11-20212311* had headspace.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

No additional discrepancies were noted by the laboratory.

e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory chilled the samples and adjusted the pH of the under-preserved sample volume upon receipt. The laboratory did not use the sample containers with headspace for analysis.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8082A initial calibration verification (ICV) reported with batch SJL0030 exhibited high recovery for the surrogate decachlorobiphenyl on column zb-5. Data were reported from the passing column zb-35.

The Method SW8270E-SIM ICV exhibited low recovery of benzo(g,h,i)perylene and the surrogate dibenzo(a,h)anthracene-d14.

The sulfite hold time was exceeded upon sample receipt.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

The laboratory did not specify any corrective actions.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory Q-flagged the benzo(g,h,i)perylene and surrogate dibenzo(a,h)anthracene-d14 results of the associated QC samples.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☐ No ☒ N/A ☐ Comments:

The sulfite holding time was exceeded upon receipt for sample *MW-14-20212311*.

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

The non-detect sulfite result of sample *MW-14-20212311* is affected by the hold-time exceedance and is considered estimated, biased low, and is flagged J* in the analytical data tables.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

2-Methylnaphthalene and naphthalene were detected at estimated concentrations below the RL in the method blank sample reported with preparation batch BJK0640.

- iii. If above RL or project specified objectives, what samples are affected?

Comments:

The sample *MW-10R-20212311* is associated with batch BJK0640. 2-Methylnaphthalene and naphthalene were detected in sample *MW-10R-20212311* at concentrations less than the RL and within five times the concentration detected in the method blank.

- iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The affected results are assumed to be artifacts of laboratory contamination and are flagged B* at the RL in the analytical data tables.

- v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

- i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOC, MTBE, dissolved gases, PAH, and PCB analyses.

An LCS was reported for DRO analysis. Refer to section 6.c for assessment of method precision.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS was reported for total isotopic metals analyses. No measure of method precision was provided.

A LCS and laboratory duplicate sample were reported for total/dissolved mercury, dissolved isotopic metals, sulfite, ferrous iron, chloride, sulfate, and nitrate/nitrite analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for the total isotopic metals analysis.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; LCS and LCSD accuracy and, where applicable, precision were within laboratory control limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for the total isotopic metals analysis.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

An MS/MSD were reported for DRO analysis.

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ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for total/dissolved mercury and dissolved metals analyses.

A MS sample was reported for ferrous iron, chloride, sulfate, and nitrate/nitrite analyses. Refer to section 6.b for assessment of method precision.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Dissolved manganese recovery exceeded the laboratory's upper control limit in the matrix spike sample for batch BJL0138.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for the total isotopic metals analysis.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

MS/MSD failures in accuracy and precision are considered only to affect the parent sample. The parent sample of the MS reported with batch BJL0138 is project sample MW-11-20212311.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☒ N/A ☐ Comments:

The concentration of dissolved manganese in the parent sample was much greater than the spiking concentration. As a result, it is not possible to accurately measure recovery of the spiked concentration in the sample and the dissolved manganese results do not require qualification.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for the total isotopic metals analysis.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Surrogate recoveries were within laboratory control limits.

iv. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

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iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates have been collected at the required frequency for the overall project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration

R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

Field duplicates were not submitted with this work order.

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iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank was not submitted with this work order.

i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted with this work order.

iii. Data quality or usability affected?

Comments:

We cannot assess whether equipment contamination affected the results.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory Q-flagged the benzo(g,h,i)perylene and surrogate dibenzo(a,h)anthracene-d14 results of the associated QC samples.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Dana Fjare / Validated by: Adam Wyborny, PE

Title:

Environmental Scientist / Senior Environmental Engineer

Date:

February 16, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21K0419

Laboratory Report Date:

December 15, 2021

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21-1-12596-035

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Laboratory Report Date:

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Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

No analyses were listed on the CoC for the trip blank sample. The laboratory ran the trip blank sample for the same volatiles analyses as the project samples as per the previous work orders.

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples MW-74-20212411, MW-3-20212411, and MW-4-20212411. These containers were filtered at 0.45 µm and preserved with 0.75 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

Two of the VOA vials for the trip blank *TB-11-20212411* had headspace.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

No additional discrepancies were noted by the laboratory.

e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory chilled the samples and adjusted the pH of the under-preserved sample volume upon receipt.

The laboratory used one of the trip blank VOA vials with headspace for analysis. The results are considered biased low, though we do not expect analyte detections in the trip blank. The project samples generally did not have detected results for volatile analytes, except for toluene in *MW-74-20212411*, supporting that the trip blank should not have been exposed to high VOC contamination. Non-detect results are flagged 'J*' and detected results are flagged 'JL*' in the analytical data tables.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E second source calibration verification (SCV) prepared with batch SJL0062 exhibited low recovery for pentachlorophenol.

The Method SW8270E surrogate phenol-d5 exhibited low recovery in project sample *MW-14-20212411*.

The Method SW8270E-SIM initial calibration verification (ICV) prepared with batch SJL0008 exhibited low recovery for benzo(g,h,i)perylene and the surrogate dibenzo(a,h)anthracene-d14.

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c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

The laboratory did not specify any corrective actions.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory Q-flagged the benzo(g,h,i)perylene and surrogate dibenzo(a,h)anthracene-d14 results of the associated QC samples.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Method blank results were less than the RL; however, 2-methylnaphthalene and naphthalene were detected at estimated concentrations less than the RL in the method blank sample reported with preparation batch BJK0716.

Dissolved mercury was detected at an estimated concentration less than the RL in the method blank sample reported with preparation batch BJK0716.

- iii. If above RL or project specified objectives, what samples are affected?

Comments:

The sample *MW-74-20212411* is associated with batch BJK0716. 2-Methylnaphthalene was detected in this sample at a concentration within 10X that of the method blank concentration. Similarly, naphthalene was detected at a concentration within 5X that of the method blank concentration.

The samples *MW-74-20212411* and *MW-4-20212411* are associated with preparation batch BJK0716 and contain dissolved mercury concentrations roughly equivalent to that of the method blank concentration.

- iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 2-methylnaphthalene result of sample *MW-74-20212411* is considered estimated with a high analytical bias. It has been flagged JH* to identify the external analyte contributions.

The naphthalene result of sample *MW-74-20212411* is assumed to be an artifact of laboratory contamination and is flagged B* in the summary table.

The dissolved mercury results of samples *MW-74-20212411* and *MW-4-20212411* are assumed to be artifacts of laboratory contamination and are flagged B* in the summary table.

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v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOC, and SVOC analyses.

An LCS was reported for DRO and PAH analyses. Refer to section 6.c for assessment of method precision.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☒ N/A ☐ Comments:

A LCS and laboratory duplicate samples were reported for total/dissolved mercury and total/dissolved metals analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

Selenium and copper precision was outside of laboratory control limits in the duplicate sample reported in preparation batch BJL0102.

Dissolved selenium precision was outside of laboratory control limits in the duplicate sample reported in preparation batch BJL0168.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

Project sample MW-74-20212411 is the laboratory duplicate sample for preparation batches BJL0102 and batch BJL0168.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The copper, selenium, and dissolved selenium results in sample *MW-74-20212411* are considered estimated due to the laboratory imprecision and are flagged J* in the analytical data tables.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

An MS/MSD was reported for GRO, VOC, PAH, and DRO analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for total/dissolved metals and total/dissolved mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

Manganese and dissolved manganese exhibited low recovery in the MS and MSD samples reported for batches B JL0102 and B JL0168, respectively.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

MS/MSD failures in accuracy and precision are considered only to affect the parent sample. The parent sample of the MS/MSDs reported for batches B JL0102 and B JL0168 is project sample *MW-74-20212411*.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☒ N/A ☐ Comments:

The concentration of manganese and dissolved manganese in the parent sample was much greater than the spiking concentration. As a result, it is not possible to accurately measure recovery of the spiked concentration in the project sample and the manganese/dissolved manganese results do not require qualification.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected; see above.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E surrogate phenol-d5 exhibited low recovery in project sample *MW-14-20212411*.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The project analytes 1,2-dichlorobenzene, 1,4-dichlorobenzene, and n-nitrosodiphenylamine are associated with the surrogate phenol-d5. These analytes were not detected in sample *MW-14-20212411*. Because the surrogate recovery was low, we consider the corresponding results of the project sample to be estimated with a low analytical bias. Affected results are flagged 'J*' in the analytical data tables.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

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e. Trip Blanks

- i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Trip blank results were less than the RL; however, toluene was detected in the trip blank at an estimated concentration less than the RL.

- iv. If above RL or project specified objectives, what samples are affected?

Comments:

Toluene was detected in project sample *MW-4-20212411* at an estimated concentration within five times the concentration detected in the trip blank. The toluene result is affected by the trip blank detection, considered an estimated non-detect result, and is flagged B* at the RL in the analytical data tables.

- v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates have been collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

Field duplicates were not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted with this work order.

- iii. Data quality or usability affected?

Comments:

We cannot assess whether equipment contamination affected the results.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory Q-flagged the benzo(g,h,i)perylene and surrogate dibenzo(a,h)anthracene-d14 results of the associated QC samples.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

February 11, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

There was ambiguity regarding the requested polynuclear aromatic hydrocarbon (PAH) and polychlorinated biphenyl (PCB) analyses and cobalt was erroneously omitted from the list of requested metals. These errors were corrected in the appended email correspondence during sample login.

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

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- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples *MW-70-20213011*, *MW-39-20213011*, and *MW-59-20213011*. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

- c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that the samples arrived in good condition.

- d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

No additional discrepancies were noted by the laboratory.

- e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory chilled the samples and adjusted the pH of the under-preserved sample volume upon receipt.

4. Case Narrative

- a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method NWTPH-g second source calibration verification (SCV) reported with batch SJK0348 exhibited low recovery for gasoline range organics (GRO).

The Method SW8260D-SIM SCV reported with batch SJK0392 exhibited low recovery for vinyl chloride.

The Method SW8260D-SIM surrogate 1,2-dichloroethane-d4 exhibited high recovery in the field sample MW-59-20213011.

The Method SW8270E initial calibration verification (ICV) reported with batch SJL0168 exhibited low recoveries for 2,4-dinitrophenol, benzoic acid, and hexachlorocyclopentadiene and elevated recovery for butylbenzylphthalate.

The Method SW8270E low concentration calibration verifications (LCV) reported with batch SJL0168 exhibited low recoveries for 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, 4-nitrophenol, benzoic acid, benzyl alcohol, hexachlorocyclopentadiene, and pentachlorophenol.

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the method blank reported in batch BJL0109. Refer to section 6.d for further assessment.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

No corrective actions were detailed in the case narrative.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory Q-flagged the 2,4-dinitrophenol, benzoic acid, hexachlorocyclopentadiene, pentachlorophenol, and butylbenzylphthalate results of the QC samples reported in batch SJL0168.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

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b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

1-Methylnaphthalene, 2-methylnaphthalene, chrysene, naphthalene, phenanthrene, and pyrene were detected at estimated concentrations below the RL in the method blank sample reported with preparation batch B JL0007.

Dissolved mercury was detected at an estimated concentration below the RL in the method blank sample reported with batch B JL0169.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

The samples *MW-59-20213011* and *MW-70-20213011* contain 1-methylnaphthalene, 2-methylnaphthalene, chrysene, naphthalene, phenanthrene, and pyrene concentrations within 5X those of the concentrations detected in the method blank reported with batch BJL0007.

None of the field samples reported in this work order were analyzed with batch BJL0169. The results are not affected by the method blank detection.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 1-methylnaphthalene, 2-methylnaphthalene, chrysene, naphthalene, phenanthrene, and pyrene results of samples *MW-59-20213011* and *MW-70-20213011* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS was reported for total and dissolved isotopic metals analyses. No measure of method precision was provided.

A LCS and laboratory duplicate samples were reported for total/dissolved mercury and hexavalent chromium analyses.

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- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The recoveries of 3,3'-dichlorobenzidine, 4-chloroaniline, 4-nitrophenol, and benzoic acid were below their lower control limits in the LCS and/or LCSD reported with preparation batch BJL0109.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The precision demonstrated by the 3,3'-dichlorobenzidine recoveries of the LCS and LCSD reported with preparation batch BJL0109 did not meet acceptance criteria.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The sample *MW-72-20213011* is included in preparation batches BJL0109. The 3,3'-dichlorobenzidine, 4-chloroaniline, 4-nitrophenol, and benzoic acid results of this sample may be affected by low method recovery.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect 3,3'-dichlorobenzidine, 4-chloroaniline, 4-nitrophenol, and benzoic acid results of sample *MW-72-20213011* are considered estimated and flagged J* in the summary table.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for total and dissolved mercury analyses.

A MS sample was reported for hexavalent chromium analysis.

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- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for the total nor dissolved isotopic metals analyses.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and, where applicable, precision were demonstrated to be within acceptable limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for total/dissolved isotopic metals.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the method blank reported in batch BJJ0109.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Surrogate recovery failures in laboratory QC samples generally do not affect the results. The low surrogate recovery in the method blank may imply that detectable results could be under-represented, had there been any. However, we do not expect to see detections in the method blank samples. The associated LCS and LCSD are used to gauge method performance.

iv. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates have been collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

Field duplicates were not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted with this work order.

iii. Data quality or usability affected?

Comments:

We cannot assess whether equipment contamination affected the results.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory Q-flagged the 2,4-dinitrophenol, benzoic acid, hexachlorocyclopentadiene, pentachlorophenol, and butylbenzylphthalate results of the QC samples reported in batch SJL0168.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

February 11, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21L0003

Laboratory Report Date:

December 16, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21L0003

Laboratory Report Date:

December 16, 2021

Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples *MW-42-20212911*, *MW-73-20212911*, and *MW-6-20212911*. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that one of the VOA vials for sample *MW-73-20212911* and the trip blank *TB-12-20212911* contained bubbles.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

No additional discrepancies were noted by the laboratory.

e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory chilled the samples and adjusted the pH of the under-preserved sample volume upon receipt.

The VOA vials containing headspace were not used for analysis.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The case narrative notes that samples *MW-73-20212911* and *MW-6-20212911* exhibited peaks that were identified as diesel range organics (DRO) but appeared to be a light oil. The peaks eluted early for an oil in the diesel range and did not have the di-isoprenoids or n-alkane peaks typical of a diesel sample.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

No corrective actions were detailed in the case narrative.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The case narrative does not specify an effect on data quality/usability. See subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Benzo(a)anthracene, benzo(b)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, naphthalene, and pyrene were detected at estimated concentrations below the RL in the method blank sample reported with batch BJL0066.

Dissolved mercury was detected at an estimated concentration below the RL in the method blank sample reported with batch BJL0169.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

The sample *MW-73-20212911* contains benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and naphthalene at concentrations roughly equivalent to those of the concentrations detected in the method blank. The remaining analytes were either not detected or detected at concentrations greater than 10X that of the concentrations detected in the method blank.

The method blank reported with batch BJL0169 is not applicable to the samples included in this work order.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The benzo(b)fluoranthene, indeno(1,2,3-cd)pyrene, and naphthalene results of sample *MW-73-20212911* are assumed to be artifacts of laboratory contamination. These results are flagged B* to identify the external analyte contributions.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, PAHs, DRO, and PCBs analyses.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS was reported for total/dissolved mercury and dissolved isotopic metals analyses. No measure of method precision was provided.

A LCS and laboratory duplicate samples were reported for total isotopic metals analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for the total/dissolved mercury and dissolved isotopic metals analyses.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and, where applicable, precision were demonstrated to be within acceptable limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for the total/dissolved mercury and dissolved isotopic metals analyses.

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c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for total isotopic metals analysis

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for dissolved isotopic metals nor total/dissolved mercury analyses.

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and, where applicable, precision were demonstrated to be within acceptable limits.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for dissolved isotopic metals and total/dissolved mercury.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

There are no surrogate recovery failures for the samples reported with this work order.

iv. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

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iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order. However, field duplicates have been collected at the required frequency for the overall project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration

R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

See above.

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iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank was not submitted with this work order.

i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted with this work order.

iii. Data quality or usability affected?

Comments:

We cannot assess whether equipment contamination affected the results.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

Samples MW-73-20212911 and MW-6-20212911 exhibited peaks that were identified as diesel range organics (DRO) but appeared to be a light oil. The peaks eluted early for an oil in the diesel range and did not have the di-isoprenoids or n-alkane peaks typical of a diesel sample. We consider the DRO results of these samples to be estimates and have assigned the J* qualifier.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

February 10, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21L0031

Laboratory Report Date:

December 21, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

21L0031

Laboratory Report Date:

December 21, 2021

Report Name:

Lower Duwamish

Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples MW-67-20210112, MW-24-20210112, MW-100-20210112, MW-52-20210112, MW-53-20210112, and MW-61-20210112. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

No additional discrepancies were noted by the laboratory.

e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory chilled the samples and adjusted the pH of the under-preserved sample volume upon receipt.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial calibration verification (ICV) reported with batch SJL0168 exhibited low recoveries for 1,2-dinitrophenol, benzoic acid, and hexachlorocyclopentadiene and elevated recovery for butylbenzylphthalate.

The Method SW8270E low concentration calibration verifications (LCV) reported with batch SJL0168 exhibited low recoveries for 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, 4-nitrophenol, benzoic acid, benzyl alcohol, hexachlorocyclopentadiene, and pentachlorophenol.

The second Method SW8270E LCV reported with batch SJL0168 exhibited low recoveries for 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, benzoic acid, hexachlorocyclopentadiene, and pentachlorophenol.

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the field sample *MW-67-20210112*, *MW-24-20210112*, *MW-100-20210112*, *MW-53-20210112*, and the method blank reported in batch BJL0109. Refer to section 6.d for further assessment.

The Method SW8270E laboratory control sample (LCS) and LCS duplicate (LCSD) reported with batch BJL0109 exhibited low recoveries for 3,3'-dichlorobenzidine, 4-chloroaniline, 4-nitrophenol, and benzoic acid. Refer to Section 6.b for further assessment.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The report was revised to correct narrative errors.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory Q-flagged the 1,2-dinitrophenol, 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, 4-nitrophenol, benzoic acid, benzyl alcohol, hexachlorocyclopentadiene, and pentachlorophenol results of the QC samples reported in batch SJL0168.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

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b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

Anthracene, benzo(a)anthracene, benzo(b)fluoranthene, chrysene, naphthalene, phenanthrene, and pyrene were detected at estimated concentrations below the RL in the method blank sample reported with preparation batch B JL0107.

Dissolved selenium was detected at an estimated concentration below the RL in the method blank sample reported with preparation batch B JL0296.

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iii. If above RL or project specified objectives, what samples are affected?

Comments:

The samples *MW-52-20210112* and *MW-61-20210112* contain anthracene and benzo(b)fluoranthene concentrations within 5X those of the concentrations detected in the method blank reported with batch BJL0107.

The sample *MW-61-20211312* contains benzo(a)anthracene at a concentration within 5X that of the concentration detected in the method blank reported with batch BJL0107.

The samples *MW-52-20210112*, *MW-53-20210112*, and *MW-61-20210112* contain chrysene concentrations within 5X that of the concentration detected in the method blank reported with batch BJL0107.

The samples *MW-52-20210112* and *MW-53-20210112* contain naphthalene, phenanthrene, and pyrene concentrations within 5X those of the concentrations detected in the method blank reported with batch BJL0107.

The sample *MW-61-20211312* contains pyrene at a concentration within 10X that of the concentration detected in the method blank reported with batch BJL0107.

The samples *MW-53-20210112* and *MW-61-20210112* contain dissolved selenium-78 concentrations within 5X that of the concentration detected in the method blank reported with batch BJL0296.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The anthracene and benzo(b)fluoranthene results of samples *MW-52-20210112* and *MW-61-20210112* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

The benzo(a)anthracene result of sample *MW-61-20210112* is assumed to be an artifact of laboratory contamination and is considered a false positive. This result is flagged B* to identify the external analyte contributions.

The chrysene results of samples *MW-52-20210112*, *MW-53-20210112*, and *MW-61-20210112* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

The naphthalene, phenanthrene, and pyrene results of samples *MW-52-20210112* and *MW-53-20210112* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

The pyrene result of sample *MW-61-20210112* may be influenced by laboratory contamination. This result is flagged JH* to identify the high analytical bias.

The dissolved selenium-78 results of samples *MW-53-20210112* and *MW-61-20210112* are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, DRO, and PCBs analyses.

A LCS was reported for PAHs analysis. No measure of method precision was provided.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

A LCS and laboratory duplicate samples were reported for total/dissolved isotopic metals and total/dissolved mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The recoveries of 3,3'-dichlorobenzidine, 4-chloroaniline, 4-nitrophenol, and benzoic acid were below their lower control limits in the LCS and/or LCSD reported with preparation batch BJL0109.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The relative precision demonstrated by the 3,3-dichlorobenzidine recoveries of the LCS and LCSD reported with preparation batch BJL0109 did not meet acceptance criteria.

The precision demonstrated by the cobalt-59 recovery of the laboratory duplicate sample reported with preparation batch BJL0294 did not meet acceptance criteria.

The precision demonstrated by the dissolved cobalt-59 and dissolved chromium-52 recoveries of the laboratory duplicate samples reported with preparation batch BJL0296 did not meet acceptance criteria.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The samples MW-24-20210112, MW-53-20210112, MW-67-20210112, and MW-100-20210112 are included in preparation batches BJL0109. The 3,3'-dichlorobenzidine, 4-chloroaniline, 4-nitrophenol, and benzoic acid results of these samples may be affected by low method recovery.

The laboratory duplicate sample reported with batch BJL0294 was analyzed from the field sample MW-67-20210112. The cobalt-59 result of this sample may lack precision.

The laboratory duplicate samples reported with batch BJL0296 were analyzed from the field sample MW-67-20210112. The dissolved cobalt-59 and dissolved chromium-52 result of this sample may lack precision.

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vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect 3,3'-dichlorobenzidine, 4-chloroaniline, 4-nitrophenol, and benzoic acid results of samples *MW-24-20210112*, *MW-53-20210112*, *MW-67-20210112*, and *MW-100-20210112* are considered estimated and flagged J* in the summary table.

The cobalt-59, dissolved cobalt-59, and dissolved chromium-52 results of sample *MW-67-20210112* are considered estimated and flagged J* in the summary table.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

MS/MSD samples were reported for total/dissolved isotopic metals and total/dissolved mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and precision were demonstrated to be within acceptable limits.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒

Comments:

See above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess the method precision for PAHs.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the field samples *MW-67-20210112*, *MW-24-20210112*, *MW-100-20210112*, *MW-53-20210112*, and the method blank reported in batch BJL0109.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

1,2-Dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, 2-chlorophenol, 2-methylphenol, benzyl alcohol, bis(2-chloroethyl)ether, hexachloroethane, n-nitrosodiphenylamine, n-nitroso-di-n-propylamine, and phenol are associated with the surrogate phenol-d5. The affected results of samples *MW-67-20210112*, *MW-24-20210112*, *MW-100-20210112*, and *MW-53-20210112* are considered estimated with a low analytical bias and are flagged J* in the summary table.

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iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐

Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐

Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐

Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐

Comments:

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ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

The field duplicate samples *MW-24-20210112* and *MW-100-20210112* were submitted with this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☒ No ☐ N/A ☐ Comments:

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank was not submitted with this work order.

i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted with this work order.

iii. Data quality or usability affected?

Comments:

We cannot assess whether equipment contamination affected the results.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory Q-flagged the 1,2-dinitrophenol, 2,4-dinitrophenol, 4,6-dinitro-2-methylphenol, 4-nitrophenol, benzoic acid, benzyl alcohol, hexachlorocyclopentadiene, and pentachlorophenol results of the QC samples reported in batch SJL0168.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

February 10, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21L0046

Laboratory Report Date:

December 21, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

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December 21, 2021

Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples MW-49-20210212 and MW-69-20210212. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

No additional discrepancies were noted by the laboratory.

e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory chilled the samples and adjusted the pH of the under-preserved sample volume upon receipt.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial calibration verification (ICV) reported with batch SJL0168 exhibited low recovery for benzoic acid and elevated recovery for butylbenzylphthalate.

The Method SW8270E low concentration calibration verifications (LCV) reported with batch SJL0168 exhibited low recoveries for benzoic acid and pentachlorophenol.

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the field samples MW-69-20210212, MW-51-20210212, and the method blank reported in batch BJL0109. Refer to section 6.d for further assessment.

The Method SW8270E laboratory control sample (LCS) and LCS duplicate (LCSD) reported with batch BJL0109 exhibited low recoveries for benzoic acid. Refer to Section 6.b for further assessment.

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c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

No corrective actions were detailed in the case narrative.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory Q-flagged the benzoic acid, pentachlorophenol, and butylbenzylphthalate results of the QC samples reported in batch SJL0168.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOC analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the method blank samples.

- iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

- i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, DRO, and PCBs analyses.

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- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS was reported for total isotopic metals and total mercury analyses. No measure of method precision was provided.

A LCS and laboratory duplicate samples were reported for dissolved isotopic metals and dissolved mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The recovery of benzoic acid was below the lower control limit in the LCS and LCSD reported with preparation batch BJL0109.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The samples *MW-51-20210212* and *MW-69-20210212* are included in preparation batches BJL0109. The benzoic acid results of these samples may be affected by low method recovery.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect benzoic acid results of samples *MW-51-20210212* and *MW-69-20210212* are considered estimated and flagged J* in the summary table.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

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c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses.

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for dissolved isotopic metals and dissolved mercury analyses.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for total isotopic metals and total mercury analyses.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and, where applicable, precision were demonstrated to be within acceptable limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

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vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for total isotopic metals and total mercury.

d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐

Comments:

ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐

Comments:

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the field samples *MW-69-20210212*, *MW-51-20210212*, and the method blank reported in batch B JL0109.

iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐

Comments:

1,2-Dichlorobenzene and 1,4-dichlorobenzene are associated with the surrogate phenol-d5. The affected results of samples *MW-69-20210212* and *MW-51-20210212* are considered estimated with a low analytical bias. Detected concentrations are flagged JL* while non-detect results are flagged J* in the summary table.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐

Comments:

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ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order. However, field duplicates have been collected at the required frequency for the overall project.

ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

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- iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration

R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted with this work order.

- iii. Data quality or usability affected?

Comments:

We cannot assess whether equipment contamination affected the results.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐ Comments:

The laboratory applied the Q-flag to the benzoic acid, pentachlorophenol, and butylbenzylphthalate results of the QC samples reported in batches SJL0168.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

February 10, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Analytical Resources, Inc. (ARI)

Laboratory Report Number:

21L0078

Laboratory Report Date:

December 22, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

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Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to ARI of Tukwila, Washington, a WA State Department of Ecology approved laboratory for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The analyses were not subcontracted to a network laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☐ No ☒ N/A ☐ Comments:

The volume provided for dissolved metals analysis arrived under preserved for samples MW-32-20210312, MW-101-20210312, MW-37-20210312, and MW-54-20210312. These containers were filtered at 0.45 um and preserved with 0.75 mL of HNO₃.

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form notes that one of the VOA vials provided for sample *MW-37-20210312* contained a bubble of unspecified size.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

No additional discrepancies were noted by the laboratory.

e. Data quality or usability affected?

Comments:

The samples were delivered to the laboratory on the same day they were collected. The laboratory chilled the samples and adjusted the pH of the under-preserved sample volume upon receipt.

The laboratory marked the VOA vial containing headspace. This vial was not used for analysis.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

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b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The Method SW8270E initial calibration verification (ICV) reported with batch SJL0191 exhibited low recovery for pentachlorophenol and elevated recoveries for butylbenzylphthalate and the surrogate p-terphenyl-d14.

The Method SW8270E ICV reported with batch SJL0168 exhibited low recovery for benzoic acid and elevated recovery for butylbenzylphthalate.

The Method SW8270E low concentration calibration verifications (LCV) reported with batches SJL0191 and SJL0168 exhibited low recoveries for benzoic acid and pentachlorophenol.

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the field sample *MW-32-20210312, MW-101-20210312, MW-54-20210312*, and the method blank reported in batch BJL0109. Refer to section 6.d for further assessment.

The Method SW8270E laboratory control sample (LCS) and LCS duplicate (LCSD) reported with batch BJL0109 exhibited low recoveries for benzoic acid. Refer to Section 6.b for further assessment.

c. Were all corrective actions documented?

Yes ☐ No ☐ N/A ☒ Comments:

No corrective actions were detailed in the case narrative.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The laboratory Q-flagged the benzoic acid, pentachlorophenol, butylbenzylphthalate; and p-terphenyl-d14 results of the QC samples reported in batches SJL0191 and SJL0168.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

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c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☐ No ☒ N/A ☐ Comments:

Chromium and several SVOC and PAH analytes were not detected in the included samples and reported at limits of detection (LODs) which are greater than their associated regulatory limits.

e. Data quality or usability affected?

We cannot assess if the analytes listed in section 5.d are present in the samples at concentrations less than the RL but greater than the PCUL. However, these analytes were identified in the project specific QAPP to have RLs greater than the PCUL for the requested analyses.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

2-Methylnaphthalene, benzo(b)fluoranthene, chrysene, naphthalene, and pyrene were detected at estimated concentrations below the RL in the method blank sample reported with preparation batch BJL0177.

iii. If above RL or project specified objectives, what samples are affected?

Comments:

The samples MW-32-20210312, MW-37-20210312, MW-54-20210312, and MW-101-20210312 contain 2-methylnaphthalene, benzo(b)fluoranthene, chrysene, naphthalene, and pyrene concentrations within 5X those of the concentrations detected in the method blank reported with batch BJL0177.

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iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The 2-methylnaphthalene, benzo(b)fluoranthene, chrysene, naphthalene, and pyrene results of samples MW-32-20210312, MW-37-20210312, MW-54-20210312, and MW-101-20210312 are assumed to be artifacts of laboratory contamination and are considered false positives. These results are flagged B* to identify the external analyte contributions.

v. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

LCS/LCSDs were reported for GRO, VOCs, SVOCs, PAHs, DRO, and PCBs analyses.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

A LCS was reported for total isotopic metals and total mercury analyses. No measure of method precision was provided.

A LCS and laboratory duplicate samples were reported for dissolved isotopic metals and dissolved mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☒ N/A ☐ Comments:

The recovery of benzoic acid was below the lower control limit in the LCS and LCSD reported with preparation batch BJL0109.

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☒ N/A ☐ Comments:

The precision demonstrated by the dissolved cobalt recovery of the laboratory duplicate sample reported with preparation batch BJL0365 did not meet acceptance criteria.

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v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

The samples *MW-32-20210312*, *MW-54-20210312*, and *MW-101-20210312* are included in preparation batches B JL0109. The benzoic acid results of these samples may be affected by low method recovery.

The laboratory duplicate sample reported with batch B JL0365 was analyzed from the field sample *MW-54-20210312*. The dissolved cobalt result of this sample may lack precision.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

The non-detect benzoic acid results of samples *MW-32-20210312*, *MW-37-20210312*, *MW-54-20210312*, and *MW-101-20210312* are considered estimated and flagged J* in the summary table.

The dissolved cobalt result of sample *MW-54-20210312* is considered estimated and flagged J* in the summary table.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality is affected; see above for applied qualifiers.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not reported for organic analyses.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

MS/MSD samples were reported for dissolved isotopic metals and dissolved mercury analyses.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

No measure of method precision was provided for total isotopic metals and total mercury analyses.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

None; method accuracy and, where applicable, precision were demonstrated to be within acceptable limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected. However, we cannot assess method precision for total isotopic metals and total mercury.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☐ No ☒ N/A ☐ Comments:

The Method SW8270E surrogate phenol-d5 exhibited low recovery in the field samples MW-32-20210312, MW-101-20210312, MW-54-20210312, and the method blank reported in batch BJL0109.

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

1,2-Dichlorobenzene and 1,4-dichlorobenzene are associated with the surrogate phenol-d5. The affected results of samples *MW-32-20210312*, *MW-101-20210312*, and *MW-54-20210312* are considered estimated with a low analytical bias and are flagged J* in the summary table.

iv. Data quality or usability affected?

Comments:

The data quality is affected; see above for applied qualifiers.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☒ No ☐ N/A ☐ Comments:

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

None; target analytes were not detected in the trip blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected; see above.

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

The field duplicate samples *MW-32-20210312* and *MW-101-20210312* were submitted with this work order.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☒ No ☐ N/A ☐ Comments:

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☒ N/A ☐ Comments:

An equipment blank was not submitted with this work order.

- i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

See above.

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; an equipment blank was not submitted with this work order.

iii. Data quality or usability affected?

Comments:

We cannot assess whether equipment contamination affected the results.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☒ No ☐ N/A ☐

Comments:

The laboratory applied the Q-flag to the benzoic acid, pentachlorophenol, butylbenzylphthalate; and p-terphenyl-d14 results of the QC samples reported in batches SJL0191 and SJL0168.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

January 18, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Eurofins Environment Testing

Laboratory Report Number:

320-81991-1

Laboratory Report Date:

December 6, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

320-81991-1

Laboratory Report Date:

December 6, 2021

Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to the Eurofins Environment Testing laboratory in Sacramento, CA. The laboratory is certified under the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The project samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no discrepancies noted in the sample receipt documentation.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The per- and poly-fluoroalkyl substances (PFAS) results of samples *MW-43-20211611*, *MW-64-20211611*, *MW-8-20211611*, and *MW-60-20211611* by EPA Method 537M were reported from the analysis of diluted extracts.

Insufficient sample volume was available to perform a matrix spike (MS) and MS duplicate (MSD) for PFAS analysis in conjunction with preparation batch 545464.

The samples *MW-43-20211611*, *MW-71-20211611*, *MW-63-20211611*, *MW-64-20211611*, *MW-8-20211711*, and *MW-60-20211711* exhibited a yellow hue and floating particulates in the sample bottle prior to extraction.

The extract for samples *MW-43-20211611*, *MW-64-20211611*, and *MW-8-20211711* exhibited a yellow hue after final voluming.

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c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The EPA Method 537M analyses of samples *MW-43-20211611*, *MW-64-20211611*, *MW-8-20211611*, and *MW-60-20211611* were conducted at a dilution due to the high concentrations of one or more target analytes in the undiluted extract. The dilution factor was applied to the internal standard area counts and these counts were within acceptance limits.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The case narrative does not specify an effect on data quality/usability. See subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☒ No ☐ N/A ☐ Comments:

e. Data quality or usability affected?

The data quality/usability is not affected.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; target PFAS were not detected in the method blank.

- iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Qualification is not required; see above.

- v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

- i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals/Inorganics analyses were not requested for the reported samples.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; method accuracy and precision were demonstrated to be within acceptable limits.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification is not required; see above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not required for this work order. Refer to section 6.b for assessment of method accuracy and precision.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals/Inorganics analyses were not requested for the reported samples.

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- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not analyzed with this work order.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not analyzed with this work order.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

See above.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not analyzed with this work order.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

There are no IDA recovery failures for the reported samples.

iv. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☐ No ☐ N/A ☒ Comments:

PFAS are not volatile compounds. Therefore, a trip blank is not required. However, the field blank sample *FB-1-20211711* was collected with the project samples.

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; target PFAS were not detected in the field blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

- ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

The equipment blank sample *EB-2-20211611* was collected with the project samples.

- i. All results less than RLs and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; target PFAS were not detected in the equipment blank sample.

iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒

Comments:

No additional data flags/qualifiers are required.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

January 18, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Eurofins Environment Testing

Laboratory Report Number:

320-82516-1

Laboratory Report Date:

December 14, 2021

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

320-82516-1

Laboratory Report Date:

December 14, 2021

Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to the Eurofins Environment Testing laboratory in Sacramento, CA. The laboratory is certified under the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The project samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no discrepancies noted in the sample receipt documentation.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:

The per- and poly-fluoroalkyl substances (PFAS) results of sample *MW-74-20210312* by EPA Method 537M were reported from the analysis of a diluted extract.

The sample *MW-74-20210312* contained floating particulates in the sample bottle prior to extraction.

The samples *MW-200-20210312*, *MW-36-20210312*, and *MW-74-20210312* exhibited a brown hue prior to extraction.

The samples *MW-200-20210312* and *MW-36-20210312* contained a thin layer of sediment at the bottom of the container prior to extraction.

The extract for samples *MW-200-20210312*, *MW-36-20210312*, and *MW-74-20210312* exhibited a yellow hue after final voluming.

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c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:

The EPA Method 537M analysis of sample MW-74-20210312 was conducted at a dilution due to the high concentrations of one or more target analytes in the undiluted extract. The dilution factor was applied to the internal standard area counts and these counts were within acceptance limits.

d. What is the effect on data quality/usability according to the case narrative?

Comments:

The case narrative does not specify an effect on data quality/usability. See subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☒ No ☐ N/A ☐ Comments:

e. Data quality or usability affected?

The data quality/usability is not affected.

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6. QC Samples

a. Method Blank

- i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

- iii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; target PFAS were not detected in the method blank.

- iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Qualification is not required; see above.

- v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

- i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals/Inorganics analyses were not requested for the reported samples.

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iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; method accuracy and precision were demonstrated to be within acceptable limits.

vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification is not required; see above.

vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not required for this work order. Refer to section 6.b for assessment of method accuracy and precision.

ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals/Inorganics analyses were not requested for the reported samples.

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- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not analyzed with this work order.

- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not analyzed with this work order.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

See above.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

MS/MSD samples were not analyzed with this work order.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

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iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

There are no IDA recovery failures for the reported samples.

iv. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples? (If not, enter explanation below.)

Yes ☐ No ☐ N/A ☒ Comments:

PFAS are not volatile compounds; therefore, a trip blank is not required. However, the field blank sample *FB-2-20210312* was collected with the project samples.

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☒ No ☐ N/A ☐ Comments:

iii. All results less than RL and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iv. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; target PFAS were not detected in the field blank sample.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

320-82516-1

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f. Field Duplicate

- i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Submitted blind to lab?

Yes ☒ No ☐ N/A ☐ Comments:

The field duplicate samples *MW-36-20210312* and *MW-200-20210312* were submitted with this work order.

- iii. Precision – All relative percent differences (RPD) less than specified project objectives? (Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☒ No ☐ N/A ☐ Comments:

The relative precision demonstrated between the detected PFAS results of the field duplicate samples was within the DQO of 30% for all analytes.

- iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

- g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

The equipment blank sample *EB-2-20210312* was collected with the project samples.

- i. All results less than RLs and project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; target PFAS were not detected in the equipment blank sample.

iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒

Comments:

No additional data flags/qualifiers are required.

Laboratory Data Review Checklist

Completed By:

Reviewed by: Adam Wyborny, PE / Validated by: Michael Jaramillo

Title:

Senior Environmental Engineer / Senior Chemist

Date:

January 18, 2022

Consultant Firm:

Shannon & Wilson, Inc.

Laboratory Name:

Eurofins Environment Testing

Laboratory Report Number:

320-83346-1

Laboratory Report Date:

January 6, 2022

Report Name:

Lower Duwamish

Project Number

21-1-12596-035

320-83346-1

Laboratory Report Date:

January 6, 2022

Report Name:

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Note: Any N/A or No box checked must have an explanation in the comments box.

1. Laboratory

- a. Did a WA State Ecology approved laboratory receive and perform all of the submitted sample analyses?

Yes ☒ No ☐ N/A ☐ Comments:

The project samples were submitted to the Eurofins Environment Testing laboratory in Sacramento, CA. The laboratory is certified under the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) for the requested analyses.

- b. If the samples were transferred to another “network” laboratory or sub-contracted to an alternate laboratory, was the laboratory performing the analyses WA State Ecology approved?

Yes ☐ No ☐ N/A ☒ Comments:

The project samples were not transferred to another laboratory.

2. Chain of Custody (CoC)

- a. CoC information completed, signed, and dated (including released/received by)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Correct analyses requested?

Yes ☒ No ☐ N/A ☐ Comments:

3. Laboratory Sample Receipt Documentation

- a. Sample/cooler temperature documented and within range at receipt (0° to 6° C)?

Yes ☒ No ☐ N/A ☐ Comments:

- b. Sample preservation acceptable – acidified waters, Methanol preserved VOC soil (GRO, BTEX, Volatile Chlorinated Solvents, etc.)?

Yes ☒ No ☐ N/A ☐ Comments:

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c. Sample condition documented – broken, leaking (Methanol), zero headspace (VOC vials)?

Yes ☒ No ☐ N/A ☐ Comments:

The sample receipt form indicates that the samples arrived in good condition.

d. If there were any discrepancies, were they documented? For example, incorrect sample containers/preservation, sample temperature outside of acceptable range, insufficient or missing samples, etc.?

Yes ☐ No ☐ N/A ☒ Comments:

There were no discrepancies noted in the sample receipt documentation.

e. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

4. Case Narrative

a. Present and understandable?

Yes ☒ No ☐ N/A ☐ Comments:

b. Discrepancies, errors, or QC failures identified by the lab?

Yes ☒ No ☐ N/A ☐ Comments:The per- and poly-fluoroalkyl substances (PFAS) results of sample *LDW-DRUM-5* by EPA Method 537M were reported from the analysis of diluted extracts.The samples *LDW-DRUM-1*, *LDW-DRUM-2*, *LDW-DRUM-3*, *LDW-DRUM-4*, *LDW-DRUM-5*, and *LDW-DRUM-6* exhibited a light orange hue with orange particulates in the sample bottle prior to extraction.

c. Were all corrective actions documented?

Yes ☒ No ☐ N/A ☐ Comments:The EPA Method 537M analysis of sample *LDW-DRUM-5* was conducted at a dilution due to the high concentrations of one or more target analytes in the undiluted extract. The dilution factor was applied to the internal standard area counts and these counts were within acceptance limits.

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d. What is the effect on data quality/usability according to the case narrative?

Comments:

The case narrative does not specify an effect on data quality/usability. See subsequent sections for further assessment.

5. Samples Results

a. Correct analyses performed/reported as requested on COC?

Yes ☒ No ☐ N/A ☐ Comments:

b. All applicable holding times met?

Yes ☒ No ☐ N/A ☐ Comments:

c. All soils reported on a dry weight basis?

Yes ☐ No ☐ N/A ☒ Comments:

Only water samples are reported in this work order.

d. Are the RLs less than the Cleanup Level or the minimum required detection level for the project?

Yes ☒ No ☐ N/A ☐ Comments:

e. Data quality or usability affected?

The data quality/usability is not affected.

6. QC Samples

a. Method Blank

i. One method blank reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

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ii. All method blank results less than RL or project specified objectives?

Yes ☒ No ☐ N/A ☐ Comments:

iii. If above RL or project specified objectives, what samples are affected?

Comments:

N/A; target PFAS were not detected in the method blank.

iv. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☒ No ☐ N/A ☐ Comments:

Qualification is not required; see above.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

b. Laboratory Control Sample/Duplicate (LCS/LCSD)

i. Organics – One LCS reported per matrix, analysis and 20 samples?

Yes ☐ No ☒ N/A ☐ Comments:

An LCS was reported for PFAS analysis by EPA Method 537M. Refer to the MS/MSD discussion for assessment of method precision.

ii. Metals/Inorganics – one LCS and one sample duplicate reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals/Inorganics analyses were not requested for the reported samples.

iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from LCS/LCSD, and or sample/sample duplicate.

Yes ☐ No ☐ N/A ☒ Comments:

An LCSD was not reported for this batch. Refer to section 6.c.iv for assessment of method precision.

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; method accuracy was demonstrated to be within acceptable limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification is not required; see above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

c. Matrix Spike/Matrix Spike Duplicate (MS/MSD)

- i. Organics – One MS/MSD reported per matrix, analysis and 20 samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Metals/Inorganics – one MS and one MSD reported per matrix, analysis and 20 samples?

Yes ☐ No ☐ N/A ☒ Comments:

Metals/Inorganics analyses were not requested for the reported samples.

- iii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable?

Yes ☒ No ☐ N/A ☐ Comments:

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- iv. Precision – All relative percent differences (RPD) reported and less than method or laboratory limits and project specified objectives, if applicable? RPD reported from MS/MSD, and or sample/sample duplicate.

Yes ☒ No ☐ N/A ☐ Comments:

- v. If %R or RPD is outside of acceptable limits, what samples are affected?

Comments:

N/A; method accuracy and precision were demonstrated to be within acceptable limits.

- vi. Do the affected sample(s) have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

Qualification is not required; see above.

- vii. Data quality or usability affected? (Use comment box to explain.)

Comments:

The data quality/usability is not affected.

- d. Surrogates – Organics Only or Isotope Dilution Analytes (IDA) – Isotope Dilution Methods Only

- i. Are surrogate/IDA recoveries reported for organic analyses – field, QC and laboratory samples?

Yes ☒ No ☐ N/A ☐ Comments:

- ii. Accuracy – All percent recoveries (%R) reported and within method or laboratory limits and project specified objectives, if applicable? (AK Petroleum methods 50-150 %R for field samples and 60-120 %R for QC samples; all other analyses see the laboratory report pages)

Yes ☒ No ☐ N/A ☐ Comments:

- iii. Do the sample results with failed surrogate/IDA recoveries have data flags? If so, are the data flags clearly defined?

Yes ☐ No ☐ N/A ☒ Comments:

There are no IDA recovery failures for the reported samples.

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iv. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

e. Trip Blanks

i. One trip blank reported per matrix, analysis and for each cooler containing volatile samples?
(If not, enter explanation below.)Yes ☐ No ☐ N/A ☒

Comments:

PFAS are not volatile compounds. Therefore, a trip blank is not required.

ii. Is the cooler used to transport the trip blank and VOA samples clearly indicated on the COC?

Yes ☐ No ☐ N/A ☒

Comments:

A trip blank is not required for PFAS analysis.

iii. All results less than RL and project specified objectives?

Yes ☐ No ☐ N/A ☒

Comments:

A trip blank is not required for PFAS analysis.

iv. If above RL or project specified objectives, what samples are affected?

Comments:

See above.

v. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

f. Field Duplicate

i. One field duplicate submitted per matrix, analysis and 10 project samples or required frequency for the project?

Yes ☒ No ☐ N/A ☐

Comments:

Field duplicate samples were not submitted with this work order. However, field duplicates were collected at the required frequency for the overall project.

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ii. Submitted blind to lab?

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

iii. Precision – All relative percent differences (RPD) less than specified project objectives?
(Recommended: 30% water, 50% soil)

$$\text{RPD (\%)} = \text{Absolute value of: } \frac{(R_1 - R_2)}{((R_1 + R_2)/2)} \times 100$$

Where R_1 = Sample Concentration
 R_2 = Field Duplicate Concentration

Yes ☐ No ☐ N/A ☒ Comments:

A field duplicate sample was not submitted with this work order.

iv. Data quality or usability affected? (Use the comment box to explain why or why not.)

Comments:

The data quality/usability is not affected.

g. Decontamination or Equipment Blank (If not applicable, a comment stating why must be entered below)?

Yes ☐ No ☐ N/A ☒ Comments:

The samples were not collected with reusable equipment. Since there is no practical potential for equipment-based cross contamination, an equipment blank is not required.

i. All results less than RLs and project specified objectives?

Yes ☐ No ☐ N/A ☒ Comments:

An equipment blank was not required.

ii. If above RL or project specified objectives, what samples are affected?

Comments:

See above.

iii. Data quality or usability affected?

Comments:

The data quality/usability is not affected.

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7. Other Data Flags/Qualifiers (ACOE, AFCEE, Lab Specific, etc.)

a. Defined and appropriate?

Yes ☐ No ☐ N/A ☒ Comments:

No additional data flags/qualifiers are required.

IMPORTANT INFORMATION

Important Information

About Your Geotechnical/Environmental Report

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors that were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining

your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary, because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims

being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

**The preceding paragraphs are based on information
provided by the GBA, Silver Spring, Maryland**