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ANNUAL PERFORMANCE REPORT
1 JANUARY 2022 – 31 DECEMBER 2022

EAST MULTNOMAH COUNTY, TROUTDALE SANDSTONE AQUIFER REMEDY
ECSI 1479

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LIST OF ACRONYMS AND ABBREVIATIONS

µg/m^3	micrograms per cubic meter
µg/L	micrograms per liter
BGal	billion gallons
BLA	Blue Lake Aquifer
Boeing	The Boeing Company
Cascade	Cascade Corporation
cNFA	Conditional NFA
CU1	Confining Unit 1
CSSWF	Columbia South Shore Well Field
CTS	Central Treatment System
DCE	1,2-dichloroethene
DEQ	Oregon Department of Environmental Quality
EMC	East Multnomah County
EPA	U.S. Environmental Protection Agency
EW	extraction well
ft	foot, feet
ft bgs	feet below ground surface
GETs	groundwater extraction treatment systems
gpm	gallons per minute
LAI	Landau Associates, Inc.
lbs	pounds
MCL	maximum contaminant level
NFA	No Further Action
NOAA	National Oceanic and Atmospheric Administration
OAR	Oregon Administrative Rule
OWRD	Oregon Water Resources Department
PCE	tetrachloroethene
PID	photoionization detector
PLC	programmable logistics controller
ppm	parts per million
PVC	polyvinyl chloride

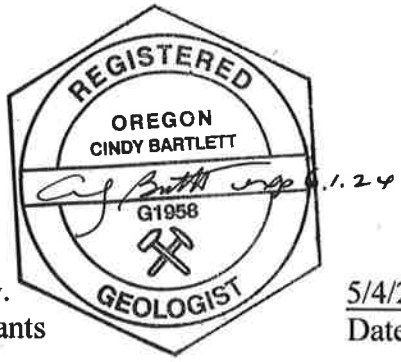
LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

PWB	Portland Water Bureau
ROD	Record of Decision
scfm	standard cubic feet per minute
SGA	Sand and Gravel Aquifer
SSPA	S.S. Papadopulos & Associates, Inc.
SU	standard units
SVE	soil vapor extraction
TCE	trichloroethene
TGA	Troutdale Gravel Aquifer
TSA	Troutdale Sandstone Aquifer
VC	vinyl chloride
VOC	volatile organic compound

Annual Performance Report
1 January 2022 – 31 December 2022

East Multnomah County Troutdale Sandstone Aquifer Remedy

Prepared by:



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1.0 INTRODUCTION

This report, submitted on behalf of Cascade Corporation (Cascade) and The Boeing Company (Boeing), summarizes performance and monitoring data for the East Multnomah County (EMC), Troutdale Sandstone Aquifer (TSA) remedy project. Data presented in this report were collected during the period of 1 January 2022 through 31 December 2022 as part of the joint remedy being implemented under the Oregon Department of Environmental Quality (DEQ) Consent Order No. WMCSR-NWR-96-08 (DEQ 1997) and conditions in the Record of Decision (ROD) (DEQ 1996) to remediate dissolved volatile organic compound (VOC)-comingled plumes in the direct vicinity of the Boeing and Cascade properties. The 1996 ROD and the Consent Order specify the following remedial action objectives:

- Restore the TSA to protective concentrations in a reasonable time, if feasible. If not feasible, minimize the extent of the TSA containing VOCs above maximum containment levels (MCLs), or $1x10^{-6}$ excess cancer risk levels, whichever is more stringent, and provide long-term containment of areas where concentrations are above the MCLs;
- Prevent ingestion of TSA groundwater that contains trichloroethene (TCE), tetrachloroethene (PCE), cis-1,2-dichloroethene (DCE) and 1,1-dichloroethane at concentrations above their respective MCLs;
- Protect environmental receptors by preventing surface water discharge of TSA groundwater with VOC concentrations that exceed surface water ambient water-quality criteria;
- Prevent the further spread of contamination in the TSA to the extent practicable;
- Protect groundwater quality in the Sand and Gravel Aquifer (SGA) and the Blue Lake Aquifer (BLA); and
- Allow existing uses of groundwater resources in eastern Multnomah County, or if not feasible, minimize the type and length of groundwater use restrictions.

EMC Site discovery and groundwater investigations of the TSA and underlying SGA began in 1986, and initial groundwater extraction using pump and treat methods commenced in 1993. Results of early investigations indicated the presence of groundwater VOC concentrations above U.S. Environmental Protection Agency (EPA) MCLs for TCE, PCE, DCE, 1,1-dichloroethane, and vinyl chloride (VC). However, TCE was determined to be the predominant contaminant and continues to be utilized to evaluate the progress of the remedy. Groundwater extraction and treatment systems (GETs) have been operational since 1997 (interim operation prior to 1997) and have been successful in removing VOC mass from the saturated zone and greatly decreasing the size of the dissolved VOC plume. In addition to GETs, a soil vapor extraction (SVE) system has been operational since 2015 with the goal of removing VOC mass from the unsaturated zone within the mound area, located along the eastern portion of the Site. The ROD defined the primary source of contamination to the TSA as contaminated groundwater from the overlying Troutdale Gravel

Aquifer (TGA), along with other secondary sources (i.e., natural springs and former supply wells screened across the Confining Unit 1 (CU1) between the TGA and the TSA).

Low-level TCE concentrations were discovered in areas of the SGA, underlying the TSA. The SGA-dissolved mass was remediated by the GETs between 1998 and 2007 and associated post-remedy groundwater monitoring ceased in 2013. All but one SGA well [BOP-44(usg)] have been decommissioned. In 2022, DEQ approved No Further Action (NFA) for the SGA and a conditional NFA for TSA Remedy Zone A, the area north of Sandy Boulevard (DEQ 2022a).

1.1 Purpose of Report

The reporting period for the TSA remedy Annual Performance Report presents data through calendar year 2022. This Annual Performance Report provides an evaluation of the TSA remedy performance, including:

- A summary of the remediation system operation, maintenance, and performance monitoring data;
- The GETs and the SVE system (remedy technique added after the Consent Order);
- An assessment of the aquifer restoration progress; and
- Recommendations and future planned activities.

The project area and Site are shown in Figure 1-1. The TSA remedial zones (Remedy Zones A, B, C, and D), the TSA remedy network of extraction wells and monitoring wells, and the current TSA remedy extraction system layouts are shown in Figure 1-2.

1.2 Background

The original study area for the EMC Site was an area of approximately 2,300 acres that is bound by the Columbia River to the north, Northeast Fairview Avenue and Northeast 223rd Avenue to the east, Northeast Halsey Street to the south, and Northeast 181st Avenue to the West (Figure 1-1). The EMC Site is located in Sections 19, 20, 28, and 29 in Township 1 North, Range 3 East. The ground surface elevation at the EMC Site is highest to the south and descends in a series of river/flood cut terraces northward to the Columbia River. The EMC Site discovery and groundwater investigations of the TSA and SGA began in 1986. Between 1994 and 1996, remedial investigations and a feasibility study were conducted that indicated groundwater VOC concentrations above the MCLs for TCE (5 micrograms per liter [µg/L]), PCE (5 µg/L), cis-1,2-DCE (70 µg/L), 1,1-DCE (7 µg/L), and VC (2 µg/L), with an aerial extent of approximately 400 acres in the TSA.

Four TSA remedial areas were described in the ROD and subsequently assigned letters, as shown in Figure 1-2. A summary of the TSA remedial zones is given below:

TSA Remedial Zone	Zone Location	Zone Status
Zone A	Area north of Sandy Boulevard	Conditional NFA (cNFA) closure certification received by DEQ. Well decommissioning pending.
Zone B	Area south of Sandy Boulevard in the western portion of the Boeing facility	cNFA approved by DEQ. Next step includes DEQ Staff Letter and public comment period before issuance of closure certificate.
Zone C	Area south of Sandy Boulevard, directly east of Zone B and west of N.E. 205th Avenue	Ongoing remedy
Zone D	Area south of Sandy Boulevard, directly east of Zone C and area east of N.E. 205th Avenue	cNFA approved by DEQ. Next step includes DEQ Staff Letter and public comment period before issuance of closure certificate.

Between 1993 and 2000, six GETs were installed to provide long-term containment of the dissolved VOC plume and remove VOC mass. The GETs systems have been successful at reducing VOC concentrations and shrinking the size of the dissolved plume to about 15 acres in the Upper TSA and about 14 acres in the Lower TSA. Treatment systems were sequentially shut down in areas of the Site once cleanup levels were achieved. With ODEQ approval, the systems were decommissioned, except for the Central Treatment System (CTS),[1] which captures groundwater in the TSA mound area in Zone C, and started operation in 1997. The approximate locations of the five former (decommissioned) GETs and the remaining GETs are shown in Figure 3-1. A total of 12 Lower TSA extraction wells (EW-1, -2, -4, -5, -8, -11, -12, -14, -15, -16, -18, and -23) routed groundwater to the CTS at system startup. Currently, EW-2 and EW-14 are actively operated, and the CTS continues to operate to provide long-term containment of the dissolved VOC plume (concentrations above MCL). EW-1 and EW-23 are in pilot shutdown mode, and along with EW-3, EW-5 (now CWMW-24dg), EW-11, EW-12, EW-13, and EW-16, are used as groundwater monitoring wells. EW-4, EW-8, EW-15, and EW-18 were decommissioned with DEQ approval.

In 2014, an SVE pilot study was commenced in the TSA mound area (Zone C) to evaluate enhanced removal of VOCs in the vadose zone that may contribute mass to the groundwater plume as extraction wells are shut down and the water table rises due to areas of the Site meeting groundwater cleanup levels. The pilot test was successful in removing VOC mass, and full-scale operation of the system was implemented in 2015 as an additional voluntary corrective measure.

[1] The GETs located in Zone B historically treated both Upper TSA and Lower TSA; however, in 2013, TSA extraction operation was no longer required to meet cleanup levels and the system currently operates for remediation of the Troutdale Gravel Aquifer (TGA) for Boeing.

The system was expanded in 2016, 2019, and February 2022. Five SVE wells were shut down after VOC concentrations reached asymptotic levels and did not rebound during the shutdown testing. By the end of 2022, approximately 93 pounds of VOCs had been removed (discussed in Section 3.5, below). The current SVE wells are shown in Figure 3-2.

2.0 SIGNIFICANT ISSUES, EVENTS, AND ACTIONS

This section summarizes significant issues, events, and actions taken during the reporting period. The TSA remedy criteria for well and system decommissioning, monitoring well modifications, and general criteria for proposing changes in sampling frequency are summarized in Table 2-1. The current groundwater monitoring schedule, along with recommended modifications (see Section 6.0), is summarized in Table 2-2. A summary of significant documents exchanged with DEQ during the period is presented in Table 2-3.

2.1 Monitoring Program and Schedule Modifications

Monitoring schedule modifications implemented during the reporting period were presented in the *Annual Performance Report 1 January 2021 – 31 December 2021 East Multnomah County, Troutdale Sandstone Aquifer Remedy ECSI 1479* (Geosyntec Consultants, Inc. [Geosyntec], Landau Associates, Inc [LAI], and S.S. Papadopulos & Associates, Inc. 2022). DEQ approved the modifications listed below on 30 August 2022 (DEQ 2022b):

- Continued pilot shutdown of EW-1 (since August 2018) and EW-23 (since April 2021);
- Decreased monitoring frequency in Remedy Zone B wells BOP-13(dg), BOP-31(ds), and BOP-31(dg), from quarterly to semi-annually;
- Decreased monitoring frequency in Remedy Zone B well BOP-20(dg) from annual to biennial;
- Decreased monitoring frequency in Lower TSA extraction EW-12 from quarterly to semi-annually;
- Decommissioned extraction well EW-16; and
- Proceeded with zone closure for Remedy Zone B and Remedy Zone D.

DEQ has previously provided approvals for well decommissioning that are still pending, including:

- Zone A: Upper TSA well BOP-44(ds), Lower TSA wells BOP-44(dg) and EMC-2(dg), and SGA well BOP-44(usg);
- Zone B Upper TSA wells BOP-21(ds) and BOP-42(ds) and Lower TSA wells BOP-42(dg) and BOP-60(dg); and
- Zone C: Lower TSA wells CMW-8(dg) and CMW-10(dg).

The wells pending decommissioning were removed from the monitoring network, and no samples were collected in 2022.

2.2 Municipal Well Field Operations

The City of Portland utilizes the Bull Run Reservoir as a primary drinking water source. Periodically, additional water is required, and the City of Portland augments supply from the Columbia South Shore Well Field (CSSWF) municipal production wells (shown in Figure 1-1). The CSSWF is operated by the Portland Water Bureau (PWB).

During 2022, the CSSWF was operated for the five pumping events listed in the table below (PWB 2022).

Reason for CSSWF Pumping	Pumping Start Date	Pumping End Date	Total Volume Pumped (BGal)	Aquifer	Percent of Total Volume Pumped	Aquifer-Specific Pumping (BGal)
Response to potential staffing shortages	2/2/2022	2/6/2022	0.24	TSA	12%	0.029
				SGA	58%	0.14
				BLA	30%	0.072
Maintenance operation; groundwater was blended with surface water from Bull Run for approximately 10 hours/day M-F for the 23-day duration at an approximate rate of 40 MGD	8/2/2022	8/25/2022	0.30	TSA	9%	0.027
				SGA	40%	0.12
				BLA	5%	0.015
Bull Run water supply augmentation	10/13/2022	11/4/2022	0.83	TSA	22%	0.18
				SGA	47%	0.39
				BLA	31%	0.26
Turbidity exceedances in the Bull Run water supply	11/5/2022	11/22/2022	1.2	TSA	16%	0.19
				SGA	59%	0.71
				BLA	26%	0.31
Bull Run water supply equipment failure	11/22/2022	11/24/2022	0.03	TSA	13%	0.0039
				SGA	65%	0.020
				BLA	22%	0.0066

Notes:
BGal: Billions of gallons
BLA: Blue Lake Aquifer
MGD: Millions of gallons per day
SGA: Sand and Gravel Aquifer
TSA: Troutdale Sandstone Aquifer

Due to the close vicinity of the CSSWF to the EMC Site, PWB pumping events are closely monitored, and additional contingency monitoring is established pursuant to the PWB Contingency Monitoring Plan (LAI 2019) and approved by DEQ (DEQ 2020). Water levels were

collected continuously using pressure transducers with periodic manual checks to confirm data. In 2022, the longest duration CSSWF pumping event was 24 days, which did not trigger short-term response monitoring (pumping events lasting between 30 and 90 days). Per the PWB Contingency Monitoring Plan, no additional groundwater samples were collected by EMC related to the PWB pumping events due to the limited timeframe of each event.

2.3 1,4-Dioxane Reconnaissance-Level Investigation

In March 2021, DEQ requested a reconnaissance-level groundwater sampling event for 1,4 dioxane to evaluate if it is present at concentrations above the DEQ risk-based cleanup standards (DEQ 2018, DEQ 2021c). The results were below the risk-based concentrations, as reported in the 2021 Annual Report (2022).

In early 2022, DEQ approved the results of the 1,4-dioxane reconnaissance-level investigation, but requested additional confirmation sampling at BOP-44(ds) and CMW-17(ds) due to the laboratory reporting estimated values below the method reporting limit but above the method detection limit (DEQ 2022c). Geosyntec provided a revised laboratory report, indicating non-detect results below the method reporting limit and requested that DEQ reconsider their request for resampling (Geosyntec 2022). DEQ responded in a letter on 5 July 2022 indicating that no further 1,4-dioxane sampling would be necessary based on the revised laboratory report (DEQ 2022d).

3.0 EXTRACTION AND TREATMENT SYSTEMS

The CTS operates to remove VOC mass and maintain long-term containment of the remaining TSA plume (about 15 acres in the Upper TSA, and about 14 acres in the Lower TSA) in the mound area (Figure 1-2). Current operating extraction wells are Lower TSA wells EW-2 and EW-14, which are both located in the mound area near the CTS. The locations of the current and former GETs, treated water lines, and extraction and monitoring wells are shown in Figure 3-1. This section also summarizes the mound area SVE system. The SVE piping and well network are shown in Figure 3-2. Well construction and location details for current remedy wells are summarized in Table 3-1.

3.1 CTS Operational Summary

In 2022, the CTS was operated to treat and capture groundwater through the operation of two Lower TSA extraction wells (EW-2 and EW-14). Daily flow data from each well are recorded by the automated programmable logistics controller (PLC) system. Data from the PLC are downloaded, and manual inspections and field system field checks are conducted weekly. Routine system inspections include manual collection of total flowmeter readings, filter pressure monitoring, system inspection and maintenance, and collection of temperature and pH data.

The CTS and the extraction wells were operated during the 12-month reporting period, except as discussed below. Planned shutdowns for system maintenance occurred as follows:

- 18 March 2022: New manual flowmeter was installed in EW-14;
- 3 October 2022: EW-2 shut down to replace drive belts;
- 2 November 2022: EW-2 shut down for sonar cleaning; and
- 15 November 2022: EW-2 flowrate was observed to be low, following sonar cleaning. The pump was shut down, and the flowmeter and Y-strainer were disassembled to clear small amounts of debris that had accumulated.

Unplanned extraction well shutdowns occurred during the reporting period, as follows:

- 14 July 2022: The electronic flowmeter for EW-14 failed. A new electronic flowmeter was not installed due to lack of equipment availability and manual measurements continue.
- 2 October 2022: EW-2 flowrate went past its setpoint, and the controller began to cycle the pump on/off. The flow controller was reset on 3 October 2022.
- 30 October 2022: EW-2 flowrate again went past its setpoint, and the controller began to cycle the pump on/off. The flow controller was reset on 31 October 2022.
- 19 November 2022: High winds resulted in a poplar tree falling onto the main Site power line, which cut off power to the CTS and SVE system. Electricity was restored, and

connections were reset on 21 November. Weather-damaged components were replaced or repaired. Pumps were restarted on 22 November 2022.

- 25 November 2022: Additional damaged system components and electricity fluctuations from the power outage were discovered, resulting in blown fuses, switches, and inconsistent/variable incoming power. As a result, EW-14 went offline and EW-2 was shut down to avoid further damage to the system. The CTS remained offline for the remainder of 2022 in order to diagnose incoming power fluctuations with the power provider (Portland General Electric), persisting electrical issues and damage to the system, and to replace damaged components. The SVE system was brought back online on 6 December 2022, and the CTS was eventually brought back on line on 19 January 2023. A detailed timeline of events related to the power outage and response actions is summarized in Table 3-2. Work is being completed to remove other nearby poplar trees to prevent a similar incident in the future.

Repair and cleaning events for the operating TSA extraction wells in 2022 are noted in Figures A-1 through A-3 of Appendix A. Upgrades to the CTS and PLC in recent years have included significant updates to the computer programs (2017 and 2019), power supply protection for stability during power surges from lightning and power grid fluctuations (2018 and 2022), and water level controls (new water level monitoring equipment in 2019 and 2020).

3.2 Groundwater Extraction Rates

Target flow rates for the extraction wells have been established to maintain long-term containment of the dissolved VOC plume. The minimum target extraction rate for EW-2 is 25 gallons per minute (gpm), and EW-14 is 20 gpm, although flow rates are set to achieve the maximum flow rate possible for each well.

Flows at EW-2 and EW-14 averaged 27 and 20 gpm, respectively. From fall 2021 to fall 2022, the EW-2 pumping rate steadily declined, which prompted sonar cleaning of the well as part of the routine extraction well maintenance program. After the sonar cleaning event, EW-2 exhibited an increased flow rate once pumping resumed in January 2023[2] (Figures A-1). Flow trends in EW-14 remained relatively consistent through 2022 (Figure A-2). The 2022 flow rates were sufficient to maintain long-term containment of the dissolved VOC plume in the mound area, as demonstrated by groundwater elevations and gradients (discussed in Section 4.2) and TCE concentrations in nearby wells (discussed in Section 4.3). TCE was not detected in the additional samples collected (samples collected in addition to the Performance Monitoring Schedule summarized in Table 2-2) during the CTS shutdown period (November 2022 to January 2023) in the sentinel wells, located downgradient of the mound area. Data from this shutdown period will be more fully evaluated and presented in a pending report to DEQ.

[2] The increase in flow rate following sonar cleaning does not appear in Figure A-1, as the system was off line in December 2022 and early 2023.

Flow rate and water level data for the extraction wells are provided in Appendix A, with average monthly extraction well flow rates over previous six-year period for EW-2 and EW-14 provided in Figures A-1 and A-2, respectively, and combined average monthly flow for all wells in Figure A-3. In general, the combined flow gradually declined during 2022, due mainly to the reduced flow rate at EW-2 prior to the routine sonar cleaning event. Average flow data for the 12-month reporting period[3] for individual wells and the total combined system are summarized in Appendix A, Table A-1.

3.3 Treatment System Effluent Compliance

CTS performance data consist of weekly flow, pH, and temperature measurements. In addition, influent and effluent samples are collected from the CTS quarterly. The permit to discharge treated groundwater effluent to the Columbia Slough from the CTS is presented in Attachment C to the TSA Remedy Consent Order (DEQ 1997). Flow, pH, temperature, and influent and effluent VOC data for the reporting period, including compliance (or discharge) limits, are presented in Appendix A (Table A-2).

CTS data for the reporting period are as follows:

- The total average flow during the 12-month period was 47 gpm (Appendix A, Table A-1). The average flow rate was affected by the shutdown of EW-2 and EW-14 from 25 November to the end of the year. There is no minimum flow rate criterion in the discharge permit.
- Effluent pH ranged from 7.58 to 7.92 standard units (SU) and remained within the discharge permit effluent limits of 6 to 9 SU.
- Effluent temperature ranged from 59 to 61 degrees Fahrenheit. There is no temperature operating limit in the discharge permit.
- VOCs were not detected at concentrations above the respective laboratory reporting limits in 2022 quarterly effluent samples. Discharge permit limits for VOC concentrations are set at the MCL (5 µg/L).

As shown in Table A-2, performance data for 2022 were in compliance with discharge permit limits.

3.4 Well Decommissioning

Two groundwater wells, EW-8 and EW-15 were decommissioned in February 2022. DEQ approval was received via email on 18 May 2021 (DEQ 2021a).

[3] The reporting period is 12 months; however, due to the November 2022 power failure, only 11 months are included in the 2022 average.

EW-8 was decommissioned on 8 February 2022 by over-drilling using a truck-mounted sonic drilling rig in accordance with Oregon Administrative Rule (OAR) 690-240-0510(1) (Oregon Water Resources Department [OWRD] Start Card 1055365). Aboveground features (concrete pad and steel vault) along with the belowground well material (steel casing, well screen, filter pack, and bentonite) were removed down to the total depth of the well (111 feet below ground surface [ft bgs]). The borehole was backfilled to 3 ft bgs with hydrated bentonite slurry (approximately 1,250 pounds [lbs] of bentonite grout) that met the requirements of OAR 690-240-0475. The top 3 ft of the well was located within a subsurface vault that was filled with gravel (approximately 500 lbs). The ground surface was restored to match surrounding terrain (topsoil with landscaped vegetation), the drill rig and equipment were decontaminated, and the drill cuttings and wastewater were transported to the CTS yard for temporary storage prior to disposal. The subsurface vault was removed and disposed of off site on 10 February 2022.

EW-15 was decommissioned on 11 February 2022 by over-drilling using a truck-mounted sonic drilling rig in accordance with OAR 690-240-0510(1) (OWRD Start Card 1055594). Aboveground features (concrete pad and steel vault) along with the belowground well material (steel casing, screen, filter pack, and bentonite) were removed down to the total depth of the well (180 ft bgs). The borehole was backfilled to 3 ft bgs with hydrated bentonite slurry (approximately 2,250 lbs of bentonite grout) that met the requirements of OAR 690-240-0475. The existing well vault, which extended 3 ft bgs, was backfilled with Quikrete concrete (approximately 750 lbs). The drill rig and equipment were decontaminated, and the drill cuttings and wastewater were transported to the CTS yard for temporary storage prior to disposal.

Wastewater generated from the decommissioning activities was discharged into the CTS system. Drums containing solids generated during the EW-8 and EW-15 decommissioning activities are staged at the Cascade Site and are pending disposal.

3.5 Soil Vapor Extraction

The SVE system is an additional voluntary corrective measure that has been implemented in the TSA mound area where VOC concentrations in the groundwater have not decreased in a predictable manner compared to other areas of the Site. Beginning in 2014, SVE was pilot tested at three vapor monitoring wells (VW-17D-42.5, VW-17D-75, and VW-17D-95.5), and following favorable results, full-scale SVE commenced at these vapor wells in 2015. The SVE system was expanded in 2016 with four vapor extraction wells (VMW-A through VMW-D), again in spring 2019 with the installation of three wells (VMW-E, VMW-F, and VMW-G) that are angled towards groundwater monitoring well CMW-18(ds) and one vertical well (VMW-H) to the west of VMW-C. In 2022, VMW-J2 and VMW-K were connected to the SVE system (Geosyntec 2021; DEQ 2021b).

The operation of the SVE was discontinued at five wells after mass removal reached asymptotic levels and did not rebound during the shutdown testing: VW-17D-42.5 and VW-17D-75 (decommissioned in 2018), VMW-A, VMW-B, and VMW-D (used for groundwater monitoring).

The SVE system wells and underground piping are shown in Figure 3-2.

3.5.1 SVE System Operation

The SVE system consists of a 15-horsepower TurboTron regenerative blower and a knock-out tank situated in a shed within the chain-link fence that surrounds the CTS. The system is connected to VW-17D-95.5 by aboveground polyvinyl chloride (PVC) piping and 10 vapor extraction wells (VMW-C though VMW-K) via belowground PVC piping. Extracted vapors are sampled quarterly and discharged into the atmosphere through a PVC exhaust stack at a height of approximately 8 ft. The SVE system maintained an average flow rate of around 377 standard cubic feet per minute (scfm) in 2022, and average weekly flow rates are shown in Table C-1 and Figure C-2.

3.5.2 SVE System Monitoring

Routine SVE system monitoring was conducted in eight of the 11 SVE wells (VMW-C, VMW-E, VMW-F, VMW-G, VMW-H, VMW-J2, VMW-K, and VW-17D-95.5). The 2022 monitoring schedule is summarized in the table below:

Well Name	Vapor Monitoring (PID)	Vapor Sampling (Summa)	Temperature, Pressure, Flow Rate
VMW-17D-95.5 (soil vapor only)	Quarterly	Quarterly	Weekly
VMW-A	NM[4]	NM[1]	NM[1]
VMW-B	NM[1]	NM[1]	NM[1]
VMW-C	Quarterly	Quarterly	Weekly
VMW-D	NM[1]	NM[1]	NM[1]
VMW-E	Quarterly	Quarterly	Weekly
VMW-F	Quarterly	Quarterly	Weekly
VMW-G	Quarterly	Quarterly	Weekly
VMW-H	Quarterly	Quarterly	Weekly
VMW-J2	Quarterly	Quarterly	Weekly
VMW-K	Quarterly	Quarterly	Weekly
Effluent	Monthly	Monthly	Weekly

The monitoring for the eight actively operated SVE wells and the system outlet consisted of the following:

- Weekly Monitoring: collect field measurements of temperature, pressure, and flow rates from the system and individual operating SVE wells, as well as effluent field vapor sampling readings;
- Monthly Sampling: collect VOC vapor samples from system effluent; and
- Quarterly Sampling: collect VOC samples (vapor and groundwater) from the individual operating SVE wells.

[4]NM = not monitored for vapor. Vapor extraction at well is currently shut down. Well is utilized for groundwater monitoring.

VOC vapor results from photoionization detector (PID) measurements in parts per million (ppm) (outlet only) and laboratory testing in micrograms per cubic meter (µg/m^3) (outlet and wells) are summarized in Tables C-1 and C-2, and the analytical results are shown in Figure C-1. Analytical laboratory reports and data validation memoranda are provided in Appendix F.

3.5.3 SVE System Monitoring Results

The 2022 quarterly analytical results for the actively operated SVE wells are shown in Figure 3-3. Of the operating SVE wells, VMW-K had the highest average TCE vapor concentration over the operating year and ranged from 74 to 2,100 µg/m³. The average TCE vapor concentration for the SVE system effluent was 750 µg/m³, which represents roughly a 100 µg/m³ increase relative to the 2021 average (652 µg/m³), due to the addition of high concentration wells VMW-K and VMW-J2 to the system. For 2022, the vast majority of the SVE mass was removed from VMW-K, VMW-J2, and VMW-95.5.

The SVE well screens extend into the top of the Upper TSA static water table to allow for the collection of groundwater samples. Groundwater samples collected from the SVE wells in 2022 indicate that the highest TCE concentrations were detected at VMW-J2 and ranged from 3.36 to 48.2 µg/L (groundwater results are discussed in Section 4.3, below). The vapor extraction operational values and manual PID measurements are presented in Table C-1 (outlet), vapor analytical results are summarized in Table C-2 (outlet and wells), and groundwater analytical results are summarized in Table E-1.

3.5.4 SVE System Mass Removal

The SVE system removed approximately 9.2 lbs of VOCs (8.1 lbs of TCE) in 2022 (based on laboratory analyses) and a total of approximately 93.4 lbs of VOCs (80.5 lbs of TCE) from the TSA mound area since the startup of the SVE Pilot Study in 2014 (Table C-3). The VOC mass removal rate in 2022 (9.2 lbs/year) increased relative to the 2021 removal rate (8.2 lbs/year) and the 2020 removal rate (7.6 lbs/year), due to the addition of two high VOC concentration wells, VMW-J2 and VMW-K. Operational data for the SVE system and mass removal data are provided in Appendix C. Flow rates, vapor concentrations (field and laboratory), and estimated mass extracted are summarized in Appendix C, Tables C-1 through C-3, and in Figures C-1 through C-3.

4.0 REMEDY PERFORMANCE SUMMARY

This section summarizes remedy performance data obtained during this reporting period, including groundwater elevation data and groundwater quality data. Groundwater elevation data are summarized in Appendix D, and groundwater quality data are summarized in Appendix E. Laboratory reports, along with data validation memoranda, are presented in Appendix F.

4.1 Groundwater Elevations

Groundwater elevations were measured either monthly, quarterly, semi-annually, annually, or biennially based on the Performance Monitoring Schedule (Table 2-2). Depth to groundwater is measured using a portable electric tape meter in the monitoring wells and with pressure transducers at select wells (Figure D-2). Pressure transducers are utilized in wells selected as part of the PWB contingency monitoring plan (currently seven wells). Water level data are downloaded monthly from the pressure transducers.

Groundwater depths and groundwater elevations are summarized in Appendix D, Table D-1. Groundwater elevation hydrographs and precipitation data for the wells with pressure transducers, along with precipitation data, are included in Appendix D in Figures D-1 and D-2. Precipitation during the 2022 12-month reporting period was approximately 40.0 inches, which is slightly above the average 36.9 inches of annual precipitation at the Portland Airport (National Oceanic and Atmospheric Administration [NOAA], 2021; NOAA, 2022).

4.2 Groundwater Flow and Long-Term Containment

As defined in the ROD, the objectives of the TSA-dissolved VOC plume remedy are to: maintain long-term containment of the dissolved VOC plume and prevent further vertical and horizontal spread of VOC contaminants to allow existing uses of groundwater resources in the eastern Multnomah County (DEQ 1996). Groundwater elevations near the TSA mound area, located within Remedy Zone C, indicate that inward horizontal gradients toward the operating extraction wells continued for most of 2022 due to ongoing remedy pumping. Groundwater contours for the semiannual water level measurement event (February 2022) and the annual event (August 2022) are provided in Figures 4-1a,b and 4-2a,b.

Groundwater flow in the Upper TSA exhibits a radial flow pattern in the vicinity of the TSA mound area with localized flow to the south. Lower TSA inward hydraulic gradients towards the extraction wells are indicative of long-term containment and demonstrate the effectiveness of Lower TSA extraction wells EW-2 and EW-14 in achieving and maintaining capture of the dissolved VOC plume. Groundwater flow directions in the Lower TSA in the mound area do not vary significantly from the wet to dry seasons and are strongly influenced by the operating extraction wells. These extraction wells capture groundwater from areas with VOC concentrations above cleanup levels. Long-term containment of the dissolved VOC plume is also exhibited by spatial VOC concentration trends, as discussed in the following subsections.

The electrical system outage in November 2022 through January 2023 resulted in both extraction wells being shut down for two months (19 November 2022 to 19 January 2023). Additional groundwater and SVE sampling were completed in January 2023 at select mound area wells to provide data to monitor VOC concentrations when groundwater extraction was not occurring. In addition, water level data from transducers deployed in most mound area wells were collected to evaluate water level rebound and groundwater flow patterns. Evaluation of water level and VOC data from the shutdown period is ongoing and will be reported to DEQ in a separate report.

4.3 Groundwater Quality

Groundwater quality is evaluated against the MCL for the Site chemicals of concern. TCE, the predominant chemical by mass, is used to evaluate remedy progress and has an MCL of 5 µg/L.

Groundwater samples are collected for analytical testing on a quarterly, semi-annual, annual, or biennial frequency, based on the DEQ-approved Performance Monitoring Schedule (Table 2-2). Sampling events occur in February, May, August, and November of each year, with August (Annual/Biennial event) being the most inclusive sampling event. Biennial monitoring events are conducted in August of odd number calendar years (e.g., 2021 and 2023); therefore, biennial sampling was last conducted in 2021. The Performance Monitoring Schedule is reviewed annually to ensure compliance with the ROD and develop recommendations for the monitoring program for DEQ approval.

Analytical results for groundwater samples collected during this reporting period are summarized in Appendix E, Table E-1. Plots of time versus TCE concentrations for select monitoring wells in or near the mound area and the two operating extraction wells are presented in Appendix E, Figures E-1 through E-6. TCE concentration contours for the February and August sampling events are shown in Figures 5-1a,b and 5-2a,b for the Upper and Lower TSA wells, respectively.

4.3.1 Upper TSA

TCE concentrations remained above the MCL in the Upper TSA mound area (located in Remedy Zone C) during the monitoring period (January through December 2022). TCE concentrations in the Upper TSA wells located outside of the mound area were either non-detect at the laboratory reporting limit or below the MCL. TCE concentrations in the western portion of the site (Remedy Zone B) have consistently been below the MCL since 2019. TCE concentration contours for February and August 2022 are shown in Figures 5-1a and 5-2a. The current area of the Upper TSA TCE plume with concentrations over the MCL (5 µg/L) is estimated at 15 acres.

Below is a brief discussion of changes in TCE concentrations during the reporting period for Upper TSA mound area (Remedy Zone C) wells that continue to have the highest concentrations. Long-term trends in TCE concentrations in mound area wells are depicted in Figures E-1 through E-4.

- CMW-17(ds): TCE concentrations generally decreased in 2022 from a maximum of 33.4 J µg/L in May to 4.0 µg/L in November (Figure E-1);[5]
- CMW-10(ds): TCE concentrations generally decreased in 2022 from a maximum of 8.9 µg/L in February to 5.7 µg/L in August (Figure E-2);
- CMW-18(ds): TCE concentrations continued to fluctuate in 2022 with concentrations ranging from 50.2 µg/L in February to 98.6 µg/L in November (Figure E-3);
- VMW-I: TCE concentrations remained relatively consistent throughout 2022 with concentrations ranging from 35.3 µg/L in both February and November to 29.7 J µg/L in May;
- VMW-K: TCE concentrations in 2022 decreased from a maximum of 18 µg/L in February to 9.8 µg/L in November;
- VMW-J2: TCE concentrations in 2022 decreased from 48.2 µg/L in February to 3.36 µg/L in November (below the MCL); and
- SVE wells with partial saturated screens, allow for the co-location sampling for vapor and groundwater. Groundwater TCE concentrations in SVE wells (VMW-A through VMW-H, and VMW-L through VMW-N) were generally below the MCL, non-detect, or slightly above the MCL with the exception of well VMW-J2 where the maximum TCE concentration was reported at 48.2 µg/L in February.

4.3.2 Lower TSA

In 2022, TCE concentrations remained above the MCL in wells located in the mound area, while the other remaining wells were either non-detect at the laboratory reporting limit or below the MCL

In the mound area, Remedy Zone C, well D-17(ds) continued to exhibit the highest TCE concentration in the Lower TSA with concentrations ranging from 13.7 to 31.5 µg/L (Appendix E, Figure E-4) in 2022. TCE concentrations at D-17(ds) generally decreased after aquifer resaturation in 2009 through 2016. However, TCE concentrations steadily increased starting in May 2017 and reached a maximum concentration of 61.2 µg/L in May 2019. Since reaching that maximum, TCE concentrations decreased to 22.2 µg/L in August 2021 but was observed to fluctuate in subsequent monitoring events with periods of decreasing and increasing trends. Monitoring well D-17(ds) is screened at the top of the Lower TSA across the water table (110 to 120 ft bgs), while well D-17(dg) is screened in the lower portion of the Lower TSA (152 to 172 ft bgs). TCE concentrations at D-17(dg) have been consistently below the MCL since August 2016. These results indicate that groundwater impacts in this area are localized to the upper portion of the Lower TSA.

[5] J is a data qualifier assigned to indicate that the analytical result is detected above the method detection limit but below the reporting limit and is therefore estimated.

In 2022, TCE concentrations at EW-1 (in pilot shutdown mode) remain below the MCL and were below the laboratory reporting limit (0.5 ug/L) for three of the quarterly sampling events (low-level detection of 1.11 µg/L in February 2022). TCE concentrations at EW-12 (pilot shutdown mode) remain below the laboratory reporting limit (0.5 ug/L). TCE concentrations at operating extraction wells EW-2 (7.11 to 8.70 J µg/L) and EW-14 (4.51 to 5.91 µg/L) decreased slightly compared to 2021 and were above the TCE MCL, with the exception of EW-14 in May 2022 (4.51 µg/L) (Figure E-7).

In the eastern portion of the Site (Remedy Zone D), TCE concentrations in the Lower TSA former extraction wells (currently used for monitoring purposes only) were below the MCL at EW-11 (since 2009) and below the MCL at EW-16 (since 2013). In 2021, EW-11 could not be sampled, so it was sampled in 2022 (off-cycle). The TCE concentration at EW-11 was 1.87 µg/L in August 2022.

TCE concentrations for the Lower TSA wells sampled in 2022 are shown in Figures 5-1b and 5-2b. The approximate area of the Lower TSA TCE plume with concentrations over the MCL (5 µg/L), as shown in the figures, is about 14 acres (same as 2020 and 2021), a 97% decrease from the initial 400-acre plume area.

4.4 TCE Mass Removal in Saturated TSA

TCE mass removal estimates are based on groundwater VOC concentrations and average quarterly groundwater extraction flow. In 2022, approximately 1.4 lbs of TCE was removed through the GETs. Since startup of the GETs in 1996, an estimated total of 503 lbs of VOCs has been removed from the TSA and SGA. Mass removal rates declined markedly after the initial operational peak during the first decade following startup and have continued to decline, although more gradually, year after year (Figure E-9). The tailing off of mass removal is expected and likely due to low pore volume exchange in the low transmissive Upper TSA where the VOC mass remains present in the mound area. The consistent VOC removal rates could be the result of migration of Upper TSA VOC mass down into the higher transmissive Lower TSA (conglomerate/gravel) due to strong downward hydraulic gradients created by the operation of extraction wells EW-2 and EW-14. TCE annual mass removal estimates for the TSA remedy are summarized in Appendix E (Table E-2 and Figure E-8), and TCE mass removal estimates for each extraction well are summarized in Appendix E (Table E-3 and Figure E-9).

5.0 PERFORMANCE SUMMARY

The EMC TSA remedy has been effective at reducing VOC plume size and magnitude since implementation in 1993. The VOC plume in the TSA has reduced in size from an approximately 400 acres in the mid-1990s to approximately 14 acres in the Lower TSA and 15 acres in the Upper TSA in 2022. The remaining VOC plume is located in the groundwater mound area in Remedy Zone C. The mound area is an area of low hydraulic conductivity consisting of more cemented sandstone (as compared to other areas of the Site) where groundwater extraction has not been as effective at removing VOC mass as in other areas with higher hydraulic conductivity. Information related to the relative hydraulic conductivity of the mound area is discussed in more detail in the *Data Gaps Investigation Report* (Geosyntec and LAI, 2021).

VOC mass removal in the mound area remains ongoing; however, the mass removal rate is slow, and the CTS is operated primarily to provide the ROD remedy objection of long-term containment of the dissolved VOC plume. The EMC TSA groundwater and SVE systems removed 1.4 lbs and 8.1 lbs of TCE, respectively, in 2022. The total remedy TCE mass removal since remedy implementation is estimated at 503 lbs from the saturated zone and 80.5 lbs from the unsaturated zone.

In 2022, TCE concentrations were above the groundwater MCL at:

- Four out of 31 total groundwater monitoring wells: CMW-10ds, CMW-17ds, CMW-18ds, and D-17ds. These wells are located in the Remedy Zone C mound area;
- Two extraction wells: EW-14 and EW-2, located in the Remedy Zone C mound area; and
- Eight out of 14 total vapor/groundwater monitoring wells located in the mound area: VMW-B, VMW-E, VMW-I, VMW-F, VMW-J2, VMW-K, VMW-M, and VMW-N. These wells are located in the Remedy Zone C mound area

Significant remedy performance findings are summarized below.

- ROD remedy objectives for long-term containment were achieved in 2022 based on groundwater flow directions in the Upper and Lower TSA that indicate ongoing inward and downward flow towards the operating extraction wells (Figures 4-1a,b and 4-2a,b) and TCE concentrations that continue to decline or are below laboratory reporting limits in wells outside of the mound area.
- Average flow rates at operational extraction wells continue to operate at or above target levels as follows: EW-2 (26.7 gpm versus target of 25 gpm) and EW-14 (20.3 gpm versus target of 20 gpm). Historically, as the dissolved VOC plume size decreased from successful treatment, extraction wells were identified for shutdown and approved by DEQ. Accordingly, the total 12-month average flow rate from the extraction wells decreased as pumps were shut down. In 2022, the average flow rate from two active pumping wells was 47 gpm versus 60 gpm during the previous reporting period (2021).

The combined flow rate decline was caused by reduced extraction rates in EW-2 caused by preferential flow pathways in the surrounding formation silting up over time, which reduced pumping efficiency prior to the sonar cleaning event, the electrical shutdown of the CTS from 29 November to the end of the year, and the shutdown of EW-23 in 2021.

- Upgrades to the CTS and PLC in recent years have strengthened the GETs against outages related to power surges and aging infrastructure. However, despite tree removals in 2020, one poplar tree fell on the main power line. Removal of the remaining poplar trees is underway, since they continue to represent a physical threat to the CTS (and are beyond their functional lifespan). It should be noted that the poplar trees were installed as a phytoremediation features for the Cascade TGA cleanup project (ECSI #635), which was closed in 2015.
- TCE concentrations in the Upper TSA wells, except those in the mound area (Remedy Zone C), are either non-detect at the reporting limit or below the MCL. TCE concentrations were above the MCL in 11 of the mound area Upper TSA wells (CMW-17(ds), CMW-10(ds), CMW-18(ds), VMW-B, VMW-E, VMW-I, VMW-F, VMW-J2, VMW-K, VMW-M, and VMW-N). The highest concentrations were at CMW-18(ds), VMW-I, and VMW-J2, consistent with the 2021 data.
- In the Lower TSA, the highest TCE concentrations remaining are located in the mound area at well D-17(ds). TCE concentrations at Lower TSA wells located outside the mound area are either non-detect at the laboratory reporting limit or below the MCL.
- TCE concentrations for Lower TSA extraction wells EW-2 and EW-14 have had a slight downward trend since 2017; however, TCE concentrations remained above the MCL at EW-2 and EW-14 in 2022. Consistent with the last 10 years, the highest TCE concentrations measured in the extraction wells during this reporting period were at EW-2 (Figure E-7). TCE concentrations remain below the MCL at extraction well EW-23.
- In 2022, the GETs removed approximately 1.4 lbs of TCE. For comparison, 1.7 lbs were removed in 2021 when one additional extraction well was operated, and 2.5 lbs were removed in 2020 when two additional extraction wells were operated. The system has removed a total of 503 lbs of TCE from the saturated zone since pumping began in 1997.
- In 2022, the SVE system removed approximately 8.1 lbs of TCE. The SVE system has removed a total of approximately 80.5 lbs of TCE from the unsaturated zone near the mound area since pilot test startup in 2014.

6.0 RECOMMENDATIONS AND FUTURE PLANNED ACTIVITIES

6.1 Recommended Changes for Treatment Systems

The CTS continues to operate and maintain long-term containment of the dissolved VOC plume. Continued operation of wells EW-2 and EW-14 is recommended until pilot testing of the remedy modification have been submitted for approval by DEQ. Pilot shutdown of EW-1 and EW-23, as previously approved by DEQ, will continue through 2023 as the VOC concentrations in the area of these two extractions wells continue to be below the MCL.

Potential remedy modifications continue to be evaluated in the mound area. Data from the 2-month power outage in late 2022 are being evaluated as part of the remedy modification process. Results of the shutdown period and rebound data (groundwater elevation and groundwater quality) along with recommended remedy modifications will be submitted to DEQ in 2023.

The SVE continues to remove VOC mass from the Upper TSA, and continued operation will be voluntary. The mass removal rates at all the vapor extraction wells will continue to be monitored to optimize performance.

6.2 Recommend Changes to Monitoring Program and Schedule Modifications

The following monitoring program and sampling schedule modifications are for wells that meet TSA Remedy Criteria (Table 2-1). The recommendations are summarized in Table 2-2 and include the following:

- Decrease monitoring frequency for groundwater elevation and groundwater quality monitoring for Remedy Zone C well CMW-10ds from quarterly to semiannually. VOC concentrations in this well have been steadily declining since 2010 and are now only slightly above the MCL. Thus, semiannual sampling frequency would be sufficient to monitor low-level VOC concentrations.
- Discontinue the groundwater elevation and groundwater quality monitoring at the majority of the wells located in Zone B, with the exception of wells located directly downgradient of the mound area. Wells located directly downgradient of the mound area (BOP-13(ds), BOP-13(dg), BOP-31(ds), and BOP-31(dg)) will continue to be monitored to evaluate long-term containment; however, the monitoring frequency is recommended to be reduced from semiannually to annually for the four wells. DEQ has previously approved the Partial NFA determination for Zone B, located along the western portion of the Site. VOC concentrations continue to be reported below the laboratory reporting limits in many of these wells, and no wells located in Zone B have VOC concentrations above the MCL. As a result, continued monitoring is unnecessary.
- Discontinue the routine remedy monitoring program at the sentinel wells selected for the PWB Contingency Plan. These wells will continue to be monitored as part of the PWB Contingency Plan only.

7.0 REFERENCES

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DEQ. 2022c. Letter from K. Thiessen. Re: 1,4-Dioxane Reconnaissance-Level Investigation, Summary Technical Memorandum East Multnomah County Cleanup Project, Portland, Oregon. ECSI #1479. 24 January.

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TABLES

Table 2-1
Remedy Well Network Criteria
TSA Remedy - East Multnomah County

This table summarizes TSA remedy criteria for extraction well pilot shutdown, well and system decommissioning, monitoring well network modifications, and changes in sampling frequency. These criteria were presented in Section 5 of the eighth TSA annual performance report[1] and are summarized below for ongoing reference.

1. PILOT SHUTDOWN CRITERIA

The following criteria are for TSA extraction well(s) currently in pilot shutdown mode:

- *If TCE concentrations in these pilot shutdown wells increase to levels equal to or above the MCL for two consecutive quarters, extraction at individual wells shall resume.*
- *If TCE remains below the MCL cleanup level for 2 years, DEQ will evaluate potential decommissioning of these wells.*

2. MONITORING WELL NETWORK MODIFICATION

Wells may be removed from the monitoring program if a well meets one or more of the following criteria:

- *TCE concentrations have been consistently below detection limits for 2 or more years.*
- *The well is located outside the limits of the plume and is no longer needed to monitor hydraulic plume control or restoration progress.*
- *The location of a well duplicates another well better suited to evaluate hydraulic control and restoration progress.*

3. SAMPLING FREQUENCY MODIFICATIONS

The following criteria serve to standardize current and future monitoring adjustments as restoration progresses over the coming years:

Criteria for Increasing Sampling Frequency:

- *The sampling frequency will be increased at a well if TCE concentrations increase to detected levels for two consecutive sampling events where they have been below detection limits for 2 or more years.*
- *The sampling frequency will be increased at a well if TCE concentrations increase above the MCL for two consecutive sampling events where they have been below the MCL for 2 or more years.*

Criteria for Reducing Sampling Frequency:

- *If TCE has been consistently below detection limits for the prior 2 years, the sampling frequency may be reduced.*
- *If TCE has been stable to declining for the prior 2 years, the sampling frequency may be reduced.*

4. CRITERIA FOR WELL DECOMMISSIONINGS

Extraction and monitoring well decommissionings will be proposed to DEQ if the following criteria are met:

- *Extraction well decommissioning may be proposed to DEQ if TCE concentrations remain consistently below the MCL in that well for 2 years following pilot shutdown; two consecutive TCE detections at or above the MCL may prompt resumed operation.*
- *Monitoring well decommissioning will be proposed to DEQ if TCE concentrations remain below the MCL for 2 consecutive years.*

[1]Landau Associates, Prowell Environmental, Pegasus Geoscience, 2006. Troutdale Sandstone Aquifer Remedial Action Annual Performance Evaluation, 04/01/05 through 03/31/06. 30 June 2006.

Table 2-2
Performance Monitoring Schedule - 1 January 2022 through 31 December 2022
TSA Remedy - East Multnomah County

Well	Aquifer	Water Level Measurements	Water Quality Sampling	Responsibility
Groundwater Systems				
CTS Influent	–	–	Quarterly	Cascade
CTS Effluent	–	–	Quarterly	Cascade
TSA Extraction Wells				
EW-1 (pilot shutdown)	Lower TSA	Monthly	Quarterly	Cascade
EW-2 (on)	Lower TSA	Monthly	Quarterly	Cascade
EW-14 (on)	Lower TSA	Monthly	Quarterly	Cascade
EW-23 (pilot shutdown)	Lower TSA	Monthly	Semiannually	Cascade
TSA Monitoring Wells				
BOP-13(ds)	Upper TSA	Semiannually to Annually	Semiannually to Annually	Boeing
BOP-13(dg)	Lower TSA	Semiannually to Annually	Semiannually to Annually	Boeing
BOP-20(ds)	Upper TSA	Annually to Discontinue PWB Monitoring	Biennial to Discontinue PWB Monitoring	Boeing
BOP-20(dg)	Lower TSA	Annually to Discontinue PWB Monitoring	Biennial to Discontinue PWB Monitoring	Boeing
BOP-23(dg)	Lower TSA	Biennial to Discontinue PWB Monitoring	Biennial to Discontinue PWB Monitoring	Boeing
BOP-31(ds)	Upper TSA	Semiannually to Annually	Semiannually to Annually	Boeing
BOP-31(dg)	Lower TSA	Semiannually to Annually	Semiannually to Annually	Boeing
BOP-61(ds)	Upper TSA	Annually to Discontinue	Annually to Discontinue	Boeing
BOP-61(dg)	Lower TSA	Annually to Discontinue	Annually to Discontinue	Boeing
BOP-62(ds)	Upper TSA	Biennial to Discontinue PWB Monitoring	Biennial to Discontinue PWB Monitoring	Boeing
BOP-65(ds)	Upper TSA	Biennial to Discontinue PWB Monitoring	Biennial to Discontinue PWB Monitoring	Boeing
BOP-66(ds)	Upper TSA	Annually to Discontinue	Annually to Discontinue	Boeing
D-17(ds)	Lower TSA	Quarterly	Quarterly	Cascade
D-17(dg)	Lower TSA	Quarterly	Quarterly	Cascade
EW-3 (monitoring only)	Upper TSA	Biennial to Discontinue	Biennial to Discontinue	Boeing
EW-11 (monitoring only)	Lower TSA	Annually	Biennial	Cascade
EW-12 (monitoring only)	Lower TSA	Semiannually	Semiannually	Cascade
EW-13 (monitoring only)	Lower TSA	Biennial to Discontinue PWB Monitoring	Biennial to Discontinue PWB Monitoring	Boeing
CMW-10(ds)	Upper TSA	Quarterly to Semiannually	Quarterly to Semiannually	Cascade
CMW-14R(ds)	Lower TSA	Semiannually	Semiannually	Cascade
CMW-17(ds)	Upper TSA	Quarterly	Quarterly	Cascade
CMW-18(ds)	Upper TSA	Quarterly	Quarterly	Cascade
CMW-19(ds)	Upper TSA	Quarterly	Quarterly	Cascade
CMW-20(ds)	Upper TSA	Semiannually	Annually	Cascade
CMW-22(dg)	Lower TSA	Semiannually PWB Monitoring	Biennial PWB Monitoring	Cascade
CMW-24(dg)/EW-5	Lower TSA	Semiannually	Semiannually	Cascade
CMW-25(dg)	Lower TSA	Semiannually	Semiannually	Cascade
CMW-36(dg)	Lower TSA	PWB Monitoring	PWB Monitoring	Cascade
Soil Vapor and Groundwater Monitoring Wells				
VMW-17d-95.5 (soil vapor only)	Upper TSA	Quarterly	Quarterly	Cascade

Table 2-2
Performance Monitoring Schedule - 1 January 2022 through 31 December 2022
TSA Remedy - East Multnomah County

Well	Aquifer	Water Level Measurements	Water Quality Sampling	Responsibility
VMW-A	Upper TSA	Quarterly	Quarterly	Cascade
VMW-B	Upper TSA	Quarterly	Quarterly	Cascade
VMW-C	Upper TSA	Quarterly	Quarterly	Cascade
VMW-D	Upper TSA	Quarterly	Quarterly	Cascade
VMW-E	Upper TSA	Quarterly	Quarterly	Cascade
VMW-F	Upper TSA	Quarterly	Quarterly	Cascade
VMW-G	Upper TSA	Quarterly	Quarterly	Cascade
VMW-H	Upper TSA	Quarterly	Quarterly	Cascade
VMW-I	Upper TSA	Quarterly	Quarterly	Cascade
VMW-J2	Upper TSA	Quarterly	Quarterly	Cascade
VMW-K	Upper TSA	Quarterly	Quarterly	Cascade
VMW-L	Upper TSA	Quarterly	Quarterly	Cascade
VMW-M	Upper TSA	Quarterly	Quarterly	Cascade
VMW-N	Upper TSA	Quarterly	Quarterly	Cascade

NOTES:

Annual monitoring performed in August; semiannual in February and August; quarterly in February, May, August, and November. Next biennial sampling event planned for August 2023.

Recommendations for modifications to the Monitoring Schedules are indicated in red text.

Table 2-3
Significant Remedy Documents – 1 January 2022 through 31 December 2022
TSA Remedy – East Multnomah County Oregon

Date	Document Type	Author	Title	Comments
1/24/2022	Email	DEQ	1,4-Dioxane Reconnaissance-Level Investigation, Summary Technical Memorandum East Multnomah County Cleanup Project, Portland, Oregon. ECSI #1479	Approval of 1,4-Dioxane Reconnaissance-Level Investigation, Summary Technical Memorandum for the East Multnomah County Cleanup Project, dated November 3, 2021. The email also requests additional 1,4-dioxane sampling at BOP-44(ds) and CMW-17(ds).
5/11/2022	Report	Geosyntec, Landau, S. S. Papadopulos & Associates	Annual Performance Report 1 January 2021 – 31 December 2021 East Multnomah County, Troutdale Sandstone Aquifer Remedy ECSI 1479	In summary, the Annual Report proposes decreasing monitoring at BOP-13(ds), BOP-13(dg), BOP-31(ds), and BOP-31(dg), from quarterly to semi-annually; decrease groundwater quality monitoring frequency at Lower TSA well BOP-20(dg) from annual to biennial; reduce groundwater quality monitoring frequency from quarterly to semi-annually at Lower TSA extraction well EW-12; conduct water quality monitoring at former extraction well EW-11 in August 2022 due to accessibility issues; decommission former extraction well EW-16, proposed conditional NFA for Zones B and D of the TSA.
7/1/2022	Letter	Geosyntec	1,4-Dioxane Resampling Request East Multnomah County, Troutdale Sandstone Aquifer Remedy Fairview, Oregon ECSI No. 1479	Request DEQ to reconsider 1,4-dioxane testing requirements at BOP-44(ds) and CMW-17(ds) based on updated laboratory report with analytical data compared to the MRL instead of the MDL.
7/5/2022	Email	DEQ	RE: 1, 4-Dioxane Resampling Request East Multnomah County Cleanup Project, Portland, Oregon. ECSI #1479	DEQ approves the letter entitled 1,4-Dioxane Resampling Request. DEQ concludes no further testing of 1,4-dioxane is required for the EMC project at this time.

Table 2-3
Significant Remedy Documents – 1 January 2022 through 31 December 2022
TSA Remedy – East Multnomah County Oregon

Date	Document Type	Author	Title	Comments
8/30/2022	Email	DEQ	RE: Annual Performance Report for 1 Jan. – 31 Dec. 2021. East Multnomah County, Troutdale Sandstone Aquifer Remedy. ECSI #1479	2021 Annual Report Approval. Approval of all project changes, except DEQ will follow up on Zones B and D closure proposal.
10/5/2022	Memorandum	DEQ	East Multnomah County, Troutdale Sandstone Aquifer (TSA) Remedy. Staff Memorandum in support of a Conditional No Further Action Determination for Zone A of the TSA and a No Further Action Determination for the site Sand and Gravel Aquifer (SGA). ECSI # 1479	DEQ determined remedial action objectives of the 1996 ROD have been met in the TSA Zone A and SGA. DEQ is comfortable issuing a NFA for the SGA. A CNFA is recommended by DEQ for the Zone A of the TSA. Groundwater monitoring will need to continue under the CNFA at the PWB well cluster. Monitoring of sentinel EMC wells will also continue under the 2019 PWB, Contingency Monitoring Plan.
11/10/22	Letter	DEQ	East Multnomah County, Troutdale Sandstone Aquifer (TSA) Remedy. Conditional No Further Action Determination for Zone A of the TSA and a No Further Action Determination for the Site-Related Sand and Gravel Aquifer (SGA). ECSI # 1479	NFA determination for the SGA and CNFA for Zone A.
11/23/22	Letter	DEQ	RE: Annual Performance Report for 1 Jan. – 31 Dec. 2021. East Multnomah County, Troutdale Sandstone Aquifer Remedy. Zones B and D Closure Requests. ECSI #1479	DEQ approval of the additional recommendations proposed in Section 6.4 of the 2021 Annual Report to proceed with regulatory closure for Remedy Zones B and D.

Table 3-1
Well Construction Data - 1 January 2022 through 31 December 2022
TSA Remedy - East Multnomah County

		NAD 1983 State Plane Oregon (ft)		Elevations (ft MSL)				
Well	**Aquifer Screened**	**X Coordinate**	**Y Coordinate**	**Ground Surface**	**Measuring Point**	**Top of Screen**	**Bottom of Screen**	**Depth of Boring (ft bgs)**
Extraction Wells								
EW-2	Lower TSA	7700692.2	689205.9	126.2	126.01	-6.8	-46.8	179
EW-14	Lower TSA	7699952.7	689329.7	128.4	127.63	-21.9	-51.9	230
Monitoring Wells & Former Extraction Wells Approved for Monitoring Use								
BOP-13(ds)	Upper TSA	7699461.3	689388.4	126.7	128.94	9.0	-1.0	132
BOP-13(dg)	Lower TSA	7699465.9	689375.4	127.5	128.71	-41.0	-61.0	193
BOP-20(ds)	Upper TSA	7698395.4	691041.6	78.2	77.45	9.0	-11.0	97
BOP-21(ds)	Upper TSA	7697591.5	691105.0	77.1	78.02	-88.0	-108.0	192
BOP-20(dg)	Lower TSA	7698381.4	691042.6	78.1	77.32	-105.0	-125.0	209
BOP-23(dg)	Lower TSA	7699526.6	690832.2	75.2	76.96	-26.0	-46.0	125
BOP-31(ds)	Upper TSA	7699322.2	690090.6	97.1	99.04	17.0	7.0	91
BOP-31(dg)	Lower TSA	7699323.6	690105.1	96.5	98.51	-34.0	-54.0	154
BOP-42(ds)	Upper TSA	7698251.0	689588.3	129.3	130.74	-8.0	-28.0	159
BOP-42(dg)	Lower TSA	7698236.8	689588.9	129.5	130.71	-92.0	-112.0	243
BOP-44(ds)	Upper TSA	7698995.4	691938.6	32.5	35.24	-23.0	-43.0	76
BOP-44(dg)	Lower TSA	7699014.1	691938.6	32.6	35.15	-104.0	-124.0	166
BOP-60(dg)	Lower TSA	7697704.8	690369.9	93.8	93.59	-165.0	-185.0	280
BOP-61(ds)	Upper TSA	7698640.8	690240.7	96.3	94.64	6.0	-4.0	100
BOP-61(dg)	Lower TSA	7698632.5	690246.1	96.2	94.43	-60.0	-70.0	171
BOP-62(ds)	Upper TSA	7697855.5	689987.2	112.1	112.29	-42.0	-51.9	166
BOP-65(ds)	Upper TSA	7698234.0	690115.0	104.4	104.22	2.0	-8.0	113
BOP-66(ds)	Upper TSA	7698670.7	690111.4	103.3	102.97	13.0	3.0	102
D-17(ds)	Lower TSA	7699886.2	689530.7	121.9	123.28	12.0	2.0	121
D-17(dg)	Lower TSA	7699869.5	689532.2	121.8	124.61	-30.0	-50.0	178
EMC-2(dg)	Lower TSA	7701014.5	692008.0	44.8	43.51	-75.0	-85.0	140
EW-1	Lower TSA	7699560.1	689504.6	124.1	124.04	-27.8	-57.8	183
EW-3	Upper TSA	7697737.4	690313.3	97.1	94.26	-77.9	-102.9	205
EW-11	Lower TSA	7702091.6	689192.5	115.4	114.73	-22.8	-62.8	235
EW-12	Lower TSA	7699532.9	689992.8	94.4	94.14	-16.1	-46.1	197
EW-13	Lower TSA	7698486.3	690082.6	104.5	103.59	-33.5	-73.5	234
EW-16	Lower TSA	7702424.1	689665.5	84.2	83.71	-40.3	-80.3	198
EW-23	Lower TSA	7698806.9	690524.7	83.8	83.93	-26.2	-66.2	157
CMW-8(dg)	Lower TSA	7700075.7	689028.3	137.0	136.21	-41.0	-56.0	199
CMW-10(ds)	Upper TSA	7700599.9	688922.1	135.2	134.54	21.0	6.0	135
CMW-10(dg)	Lower TSA	7700589.4	688923.9	135.3	135.05	-53.0	-68.0	210
CMW-14R(ds)	Lower TSA	7700852.9	689866.6	83.9	83.48	29.0	9.0	76
CMW-17(ds)	Upper TSA	7700547.4	689425.5	120.0	121.89	24.0	14.0	110
CMW-18(ds)	Upper TSA	7700889.2	689267.3	118.2	117.66	16.0	6.0	118
CMW-19(ds)	Upper TSA	7700297.2	688642.8	144.3	144.08	10.0	0.0	170
CMW-20(ds)	Upper TSA	7699683.6	688990.1	150.5	152.72	6.0	-4.0	158
CMW-22(dg)	Lower TSA	7701545.4	689850.7	82.1	81.65	-42.0	-52.0	142
CMW-24(dg)/EW-5	Lower TSA	7700192.8	689918.9	80.5	77.74	8.0	-42.1	127
CMW-25(dg)	Lower TSA	7699797.3	690022.8	75.7	75.28	-34.0	-44.0	131
CMW-26(dg)	Lower TSA	7703189.8	689303.5	106.3	108.98	-59.0	-69.0	238
CMW-36(dg)	Lower TSA	7701389.7	690792.4	79.1	78.84	-31.0	-41.0	162
BOP-44(usg)	SGA	7698996.3	691888.8	24.6	34.25	-181.0	-191.0	219

Table 3-1
Well Construction Data - 1 January 2022 through 31 December 2022
TSA Remedy - East Multnomah County

		NAD 1983 State Plane Oregon (ft)		Elevations (ft MSL)				
Well	**Aquifer Screened**	**X Coordinate**	**Y Coordinate**	**Ground Surface**	**Measuring Point**	**Top of Screen**	**Bottom of Screen**	**Depth of Boring (ft bgs)**
Soil Vapor and Groundwater Monitoring Wells								
VW-75d-95.5	Upper TSA-Vapor only	7700536.9	689410.4	120.0	-------	*44.5*	*24.5*	130
VMW-A	Upper TSA + Vapor	7700436.7	689423.9	121.0	-------	34.5	14.5	114
VMW-B	Upper TSA + Vapor	7700630.8	689380.7	120.7	-------	36.2	16.2	111
VMW-C	Upper TSA + Vapor	7700339.8	689398.9	122.0	-------	34.5	14.5	110
VMW-D	Upper TSA + Vapor	7700693.2	689302.0	120.6	-------	33.1	13.1	110
VMW-E*	Upper TSA + Vapor	7700720.3	689167.7	130.6	-------	30.7	9.49	171
VMW-F*	Upper TSA + Vapor	7700742.7	689252.3	126.4	-------	32.5	11.28	163
VMW-G*	Upper TSA + Vapor	7700722.3	689335.1	121.9	-------	30.05	8.83	160
VMW-H	Upper TSA + Vapor	7700240.9	689484.6	124.1	-------	37.76	17.76	106
VMW-J2	Upper TSA + Vapor	7700421.0	689306.9	123.8	-------	-25.8	-45.8	121
VMW-K	Upper TSA + Vapor	7700281.1	689359.2	123.5	-------	13.2	3.2	121

NOTES:
1. Monitoring wells indicated in red text were recommended for sampling frequency modifications (Table 2-2). Wells indicated in red text and green shading are recommended for decommissioning. Wells indicated in black text and green shading were previously approved for decommissioning but have not yet been decommissioned.

ft = feet
MSL = mean sea level
bgs = below ground surface
*Angled well

Table 3-2
Electrical System Outage Timeline
TSA Remedy - East Multnomah County

Week No:	**1**					
System Status	11/21/2022	11/22/2022	11/23/2022	11/24/2022	11/25/2022	11/26/2022
SVE	Initial Incident (or prior weekend)					
EW-2						
EW-14						

System Online
System Offline

Notes	A tree branch from one of the nearby poplar trees snapped due to a windstorm and fell onto the powerline which powers the Central Treatment System (CTS) and soil-vapor extraction (SVE) system. This shut-off power to the systems resulting in both SVE and groundwater extraction wells to go offline. Pat Yadon coordinated with Capital Electrical (Capital) and Portland General Electric (PGE) to address the damage caused by the fallen tree branch. Capital arrived at the Site and repaired the damaged electrical components observed. PGE disabled the transformer routing power to the CTS and SVE system. By the end of the day, necessary electrical repairs were made by Capital. PGE restored power to the Site. No blown fuses in the electrical system were observed.	CTS and SVE systems were restarted the morning of November 22. SVE system and EW-14 were operating normally. EW-2 operated for approximately 15 minutes before shutting off. Capital was contacted to return to the Site to diagnose the problems. By early afternoon, necessary repairs were made, and EW-2 was brought online.			Numerous fuses have blown throughout the electrical system. EW-14 and SVE have gone offline. EW-2 is still running but was shut down in order to prevent any damage from potential surges in the electrical system. Pat is coordinating with PGE and Capital to return to the Site to inspect the electrical systems and transformer to ensure incoming power is stable.	

Table 3-2
Electrical System Outage Timeline
TSA Remedy - East Multnomah County

Week No:															
	2							**3**							
System Status	11/27/2022	11/28/2022	11/29/2022	11/30/2022	12/1/2022	12/2/2022	12/3/2022	12/4/2022	12/5/2022	12/6/2022	12/7/2022	12/8/2022	12/9/2022	12/10/2022
SVE														
EW-2														
EW-14														

System Online
System Offline

Notes		PGE returned to Site to inspect the transformer and concluded that unit was still working normally. Tests Site electrical system were completed by PGE while system was offline and determined that everything appeared functional and incoming power stable.	The CTS and SVE system were restarted. The EW-14 pump and motor were non-functional. The SVE system is still offline, and a new transformer is required to replace the inoperable transformer in the SVE drive panel. Observed damage likely due to either brown outs (reduction of power) or surges of power, something which is not tracked by PGE meters.		EW-2 has failed. Blown fuses and suspected damage to motor and pump.	Capital returned to the Site to troubleshoot the system using megger testing. EW-14 pump/motor had completely failed. SVE motor appears to be still be functional. Capitol recommended that PGE be contacted again to evaluate power fluctuation from their electrical lines.				SVE system brought back online after variable frequency drive (VFD) was repaired.		EW-2 Pump and Motor replaced; system functional; after testing turned off. Electrical tests of system appear to indicate that are no identified issues in the Cascade electrical system.		

Table 3-2
Electrical System Outage Timeline
TSA Remedy - East Multnomah County

Week No:																						
	4							**5**														**6**
System Status	12/11/2022	12/12/2022	12/13/2022	12/14/2022	12/15/2022	12/16/2022	12/17/2022	12/18/2022	12/19/2022	12/20/2022	12/21/2022	12/22/2022	12/23/2022	12/24/2022	12/25/2022	12/26/2022	12/27/2022	12/28/2022	12/29/2022	12/30/2022	12/31/2022
SVE																					
EW-2																					
EW-14																					

System Online
System Offline

Notes		Geosyntec and Landau have a conference call with DEQ to notify them of the power issue. DEQ verbally approves the temporary shutdown of the CTS until a stable power source can be provided and restart procedures can be conducted without risk of damage to equipment.		Pump and motor have been replaced in EW-14. Testing indicated that EW-14 is functioning correctly. EW-2 appears to be functioning correctly. Both extraction wells are ready to be restarted. Electrical tests of system appear to indicate that are no identified issues in the Cascade electrical system.						Download mound well transducers											

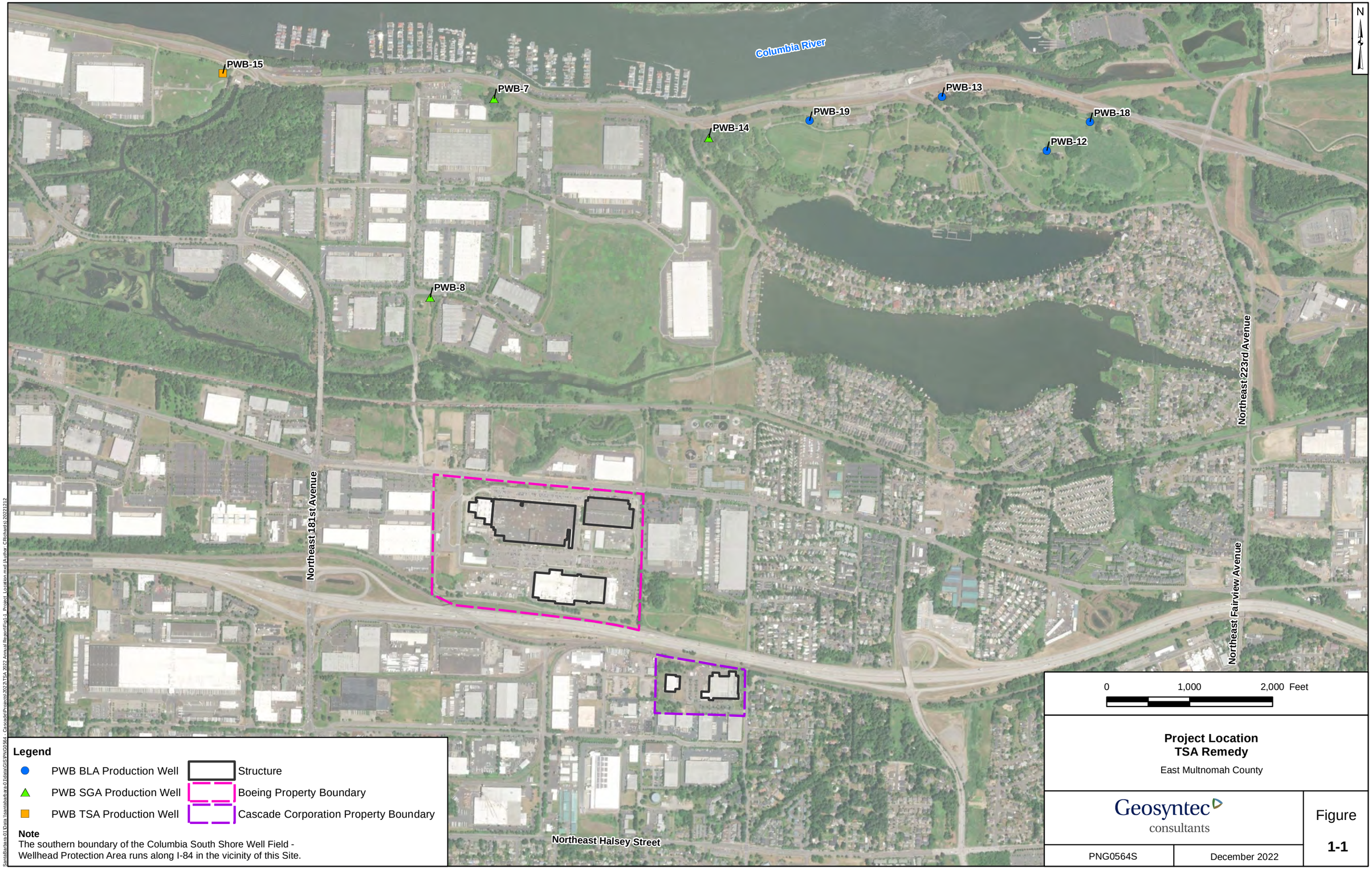
Table 3-2
Electrical System Outage Timeline
TSA Remedy - East Multnomah County

Week No:	**7**							**8**								**9**				
System Status	1/1/2023	1/2/2023	1/3/2023	1/4/2023	1/5/2023	1/6/2023	1/7/2023	1/8/2023	1/9/2023	1/10/2023	1/11/2023	1/12/2023	1/13/2023	1/14/2023	1/15/2023	1/16/2023	1/17/2023	1/18/2023	1/19/2023	1/20/2023
SVE																				
EW-2																				
EW-14																				

System Online
System Offline

Notes				1) Data logger downloads 2) Collect vapor samples VMW-E, VMW-K, VMW-J2 3) Sample Upper TSA wells (D-17ds, MW-18ds, MW-17ds) 4) Sample Lower TSA wells (MW-24dg, MW-25dg, EW-1, MW-10dg)															Extraction wells were restarted after electrical issues were addressed	

FIGURES



Project Location
TSA Remedy

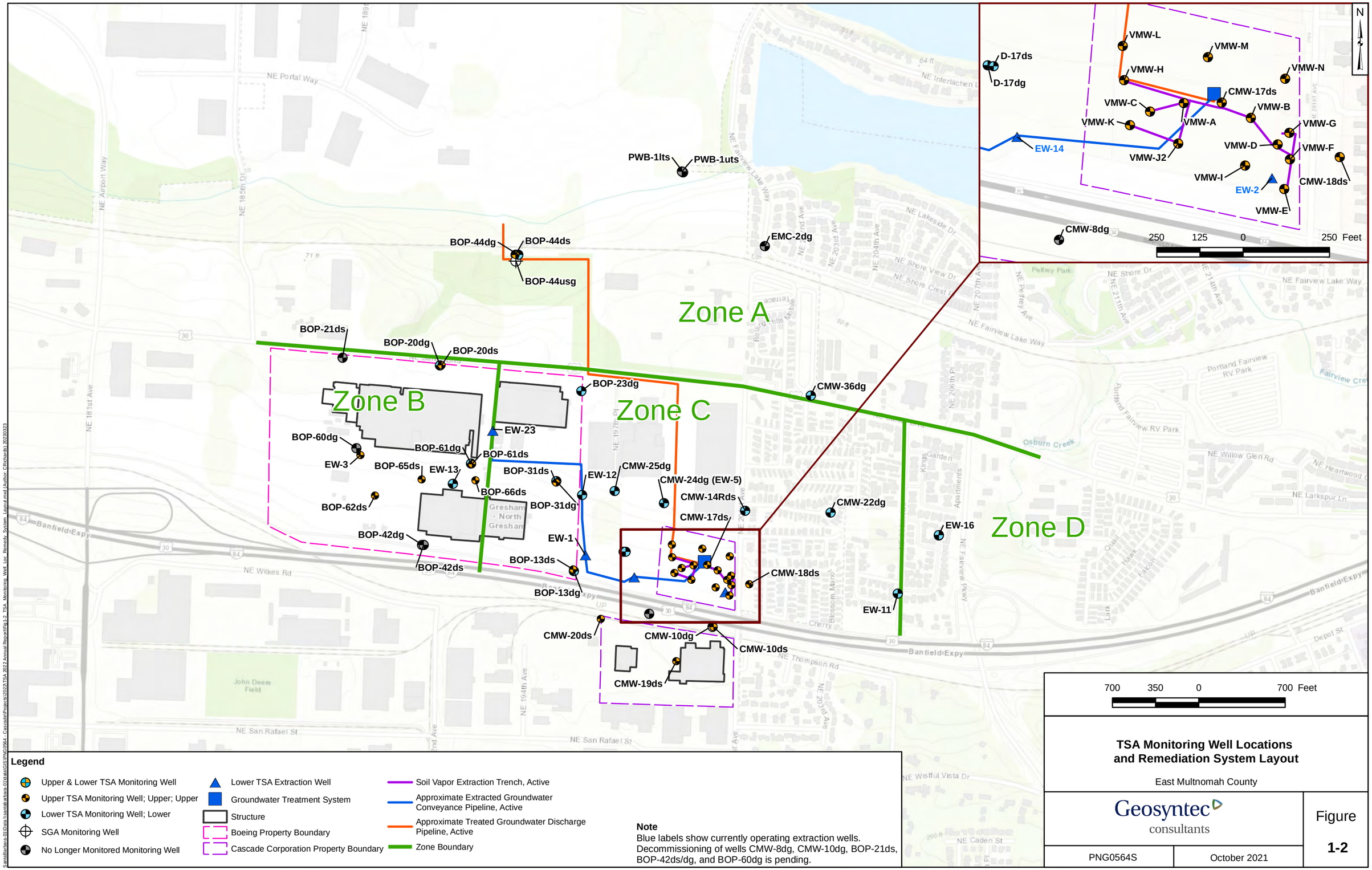
East Multnomah County

Geosyntec consultants

PNG0564S | December 2022

Figure **1-1**

SantaBarbara-01\Data \\santabarbara-01\data\GIS\PNG0564 - Cascade\Projects\2022\TSA 2022 Annual Report\Fig1-1_Project_Location.mxd (Author: CRichards) 20221212


Zone A
Zone B
Zone C
Zone D
PWB-1lts
PWB-1uts
BOP-44dg
BOP-44ds
BOP-44usg
EMC-2dg
BOP-21ds
BOP-20dg
BOP-20ds
BOP-23dg
CMW-36dg
BOP-60dg
EW-23
BOP-61dg
BOP-61ds
EW-3
BOP-65ds
EW-13
BOP-31ds
EW-12
CMW-25dg
CMW-24dg (EW-5)
BOP-66ds
BOP-62ds
BOP-31dg
CMW-14Rds
CMW-17ds
CMW-22dg
EW-16
BOP-42dg
EW-1
BOP-42ds
BOP-13ds
CMW-18ds
BOP-13dg
EW-11
CMW-20ds
CMW-10dg
CMW-10ds
CMW-19ds
VMW-L
VMW-M
D-17ds
VMW-H
VMW-N
D-17dg
CMW-17ds
VMW-C
VMW-B
VMW-K
VMW-A
VMW-G
EW-14
VMW-D
VMW-F
VMW-J2
VMW-I
CMW-18ds
EW-2
VMW-E
CMW-8dg
250 125 0 250 Feet
N
700 350 0 700 Feet
NE Portal Way
NE Airport Way
NE 181st Ave
NE 185th Dr
NE 18th Pl
NE Fairview Lake Way
NE Lakeside Dr
NE Shore View Dr
NE Shore Crest Dr
NE 203rd Ave
NE 204th Ave
NE 207th Ave
NE Shore Dr
NE 211th Ave
NE 214th Ave
NE Palfrey Park
NE Palfrey Ave
Palfrey Park
Portland Fairview RV Park
Fairview Creek
Osburn Creek
NE Willow Glen Rd
NE Heartwood Dr
NE Larkspur Ln
NE 206th Pl
NE 197th Pl
NE 194th Ave
NE 202nd Ave
Kings Garden Apartments
NE Fairview Pkwy
Quail Hawk Falcon Lark
Blossom Manor Cherry
Banfield Expy
NE Wilkes Rd
NE San Rafael St
NE Thompson Rd
NE Westfall Vista Dr
NE Caden St
Depot St
John Deere Field
Gresham - North Gresham
Rolling Hills Mobile Terrace
71 ft
64 ft
50 ft
200 ft
Legend
Upper & Lower TSA Monitoring Well
Upper TSA Monitoring Well; Upper; Upper
Lower TSA Monitoring Well; Lower
SGA Monitoring Well
No Longer Monitored Monitoring Well
Lower TSA Extraction Well
Groundwater Treatment System
Structure
Boeing Property Boundary
Cascade Corporation Property Boundary
Soil Vapor Extraction Trench, Active
Approximate Extracted Groundwater Conveyance Pipeline, Active
Approximate Treated Groundwater Discharge Pipeline, Active
Zone Boundary
Note
Blue labels show currently operating extraction wells.
Decommissioning of wells CMW-8dg, CMW-10dg, BOP-21ds, BOP-42ds/dg, and BOP-60dg is pending.
TSA Monitoring Well Locations and Remediation System Layout
East Multnomah County
Geosyntec consultants
PNG0564S
October 2021
Figure 1-2
SantaBarbara-01\Data\santabarbara-01\Vault\GIS\PNG\0564 - Cascade\Projects\2022\TSA 2022 Annual Report\Fig1-2_TSA_Monitoring_Well_Loc_Remedy_System_Layout.mxd (Author: CRichards) 20230323

Zone A

Zone B

Zone C

Zone D

Legend

- Upper & Lower TSA Monitoring Well
- Upper TSA Monitoring Well
- Lower TSA Monitoring Well
- Decommissioned Upper TSA Monitoring Well
- Decommissioned Lower TSA Monitoring Well
- Decommissioned or No Longer Monitored Monitoring Well
- Decommissioned Soil Vapor Monitoring Well
- Lower TSA Extraction Well
- Decommissioned Extraction Well
- Groundwater Treatment System
- Decommissioned Groundwater Treatment System
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary
- Approximate Soil Vapor Extraction Trench, Active
- Approximate Extracted Groundwater Conveyance Pipeline, Active
- Approximate Treated Groundwater Discharge Pipeline, Active
- Approximate Extracted Groundwater Conveyance Pipeline, No Longer in Use
- Approximate Extracted Groundwater Conveyance Pipeline, Decommissioned
- Approximate Treated Groundwater Discharge Pipeline, Decommissioned
- Zone Boundary

700 350 0 700 Feet

Decommissioned TSA Monitoring Wells and Remediation System Components

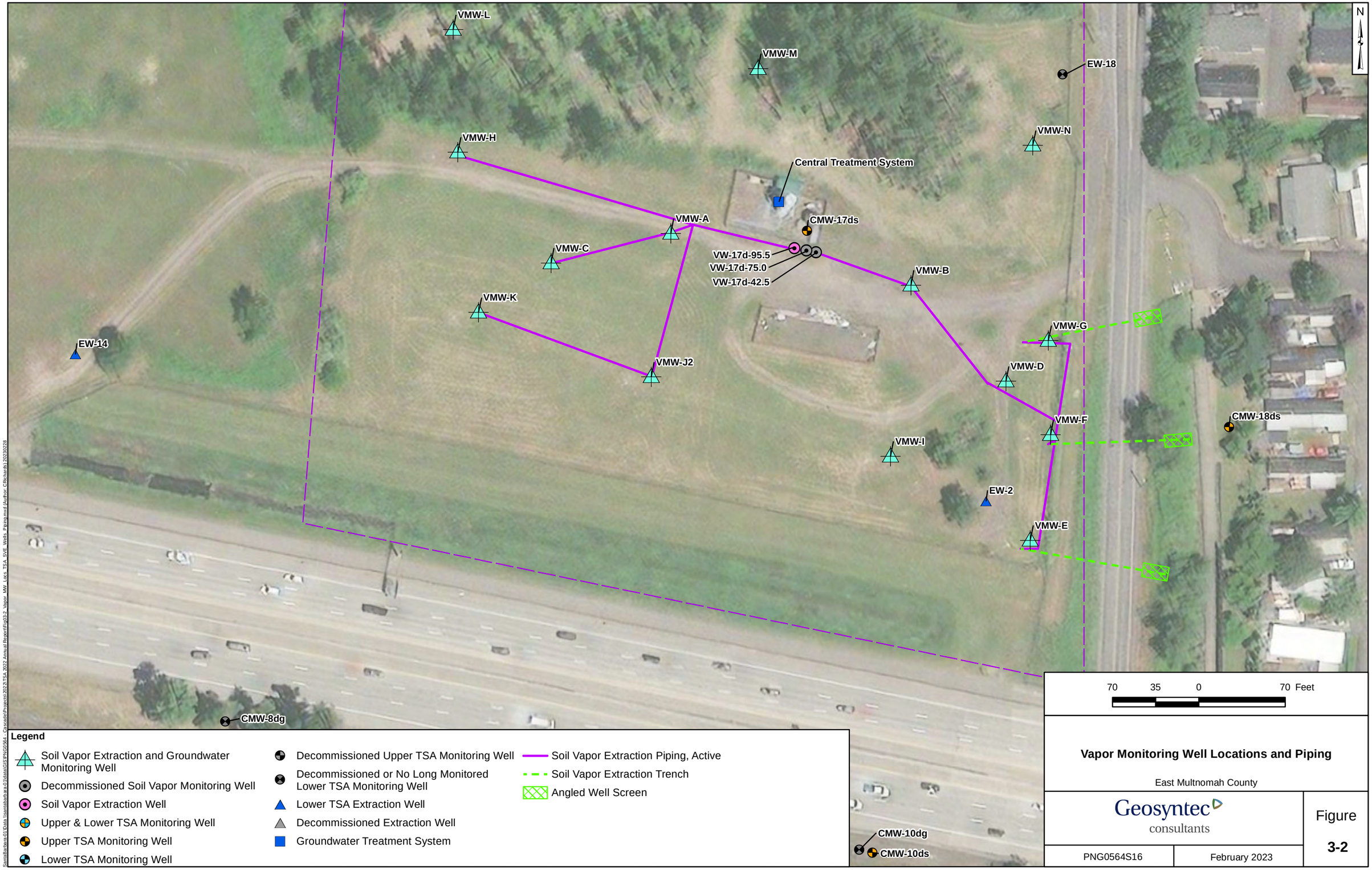
East Multnomah County

Geosyntec consultants

PNG0564S | March 2023

Figure 3-1

SantaBarbara-01\Data\santabarbara-01\data\GIS\PNG0564 - Cascade\Projects\2022\TSA 2022 Annual Report\Fig03-1_Decom_TSA_Monitoring_Well_Loc_Remedy_System_Layout.mxd (Author: CRichards) 20230323



Legend

- Soil Vapor Extraction and Groundwater Monitoring Well
- Decommissioned Soil Vapor Monitoring Well
- Soil Vapor Extraction Well
- Upper & Lower TSA Monitoring Well
- Upper TSA Monitoring Well
- Lower TSA Monitoring Well
- Decommissioned Upper TSA Monitoring Well
- Decommissioned or No Long Monitored Lower TSA Monitoring Well
- Lower TSA Extraction Well
- Decommissioned Extraction Well
- Groundwater Treatment System
- Soil Vapor Extraction Piping, Active
- Soil Vapor Extraction Trench
- Angled Well Screen

Vapor Monitoring Well Locations and Piping

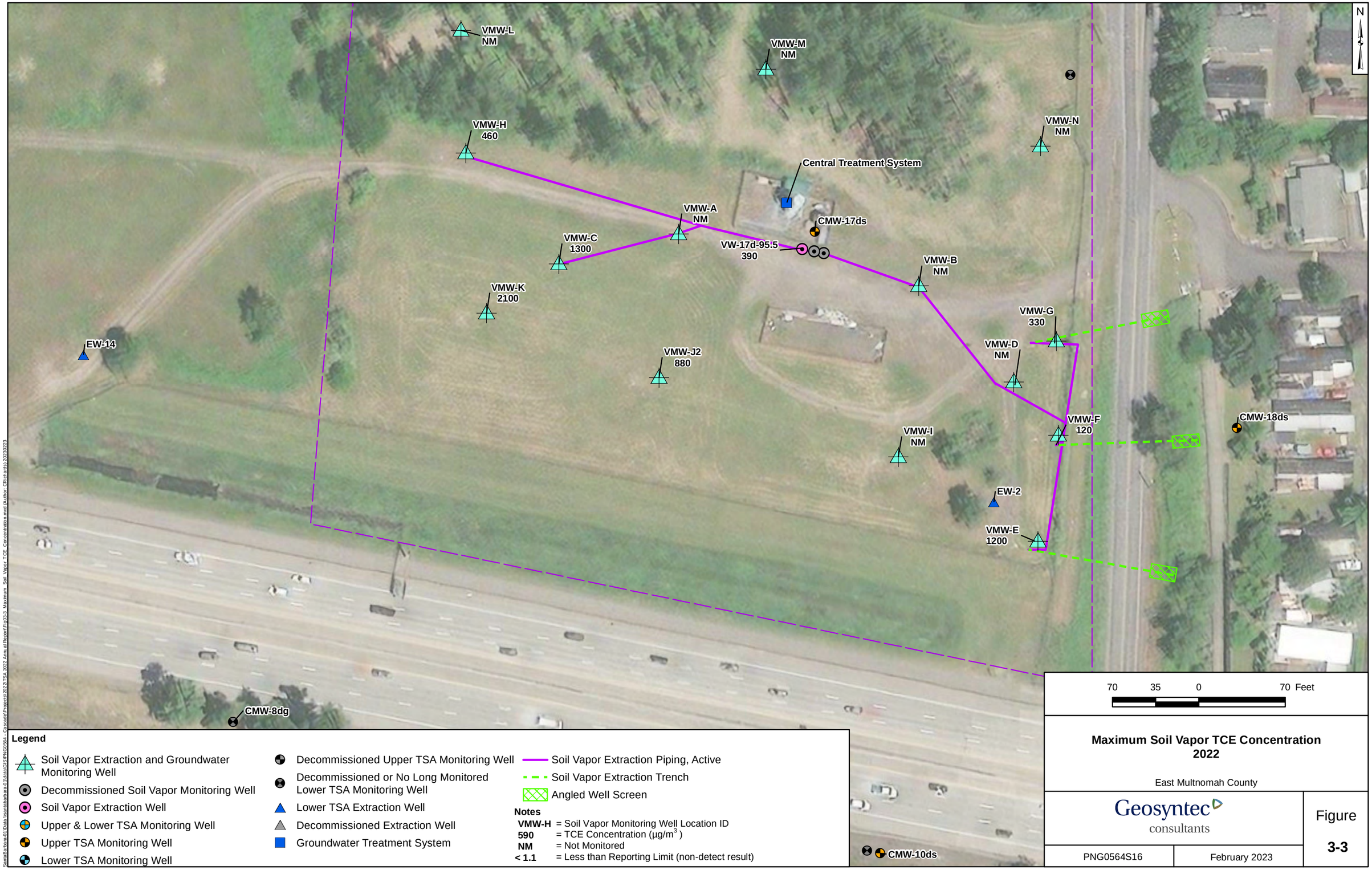
East Multnomah County

Geosyntec consultants

PNG0564S16 | February 2023

Figure 3-2

S:\antaBarbara-01\Data \\santabarbara-01\data\GIS\PNG0564 - Cascade\Projects\2022\TSA 2022 Annual Report\Fig03-2_Vapor_MW_Locs_TSA_SVE_Wells_P&mg.mxd (Author: CRichards) 20230228



Legend

- Soil Vapor Extraction and Groundwater Monitoring Well
- Decommissioned Soil Vapor Monitoring Well
- Soil Vapor Extraction Well
- Upper & Lower TSA Monitoring Well
- Upper TSA Monitoring Well
- Lower TSA Monitoring Well
- Decommissioned Upper TSA Monitoring Well
- Decommissioned or No Long Monitored Lower TSA Monitoring Well
- Lower TSA Extraction Well
- Decommissioned Extraction Well
- Groundwater Treatment System
- Soil Vapor Extraction Piping, Active
- Soil Vapor Extraction Trench
- Angled Well Screen

Notes

VMW-H	= Soil Vapor Monitoring Well Location ID
590	= TCE Concentration (µg/m^3)
NM	= Not Monitored
< 1.1	= Less than Reporting Limit (non-detect result)

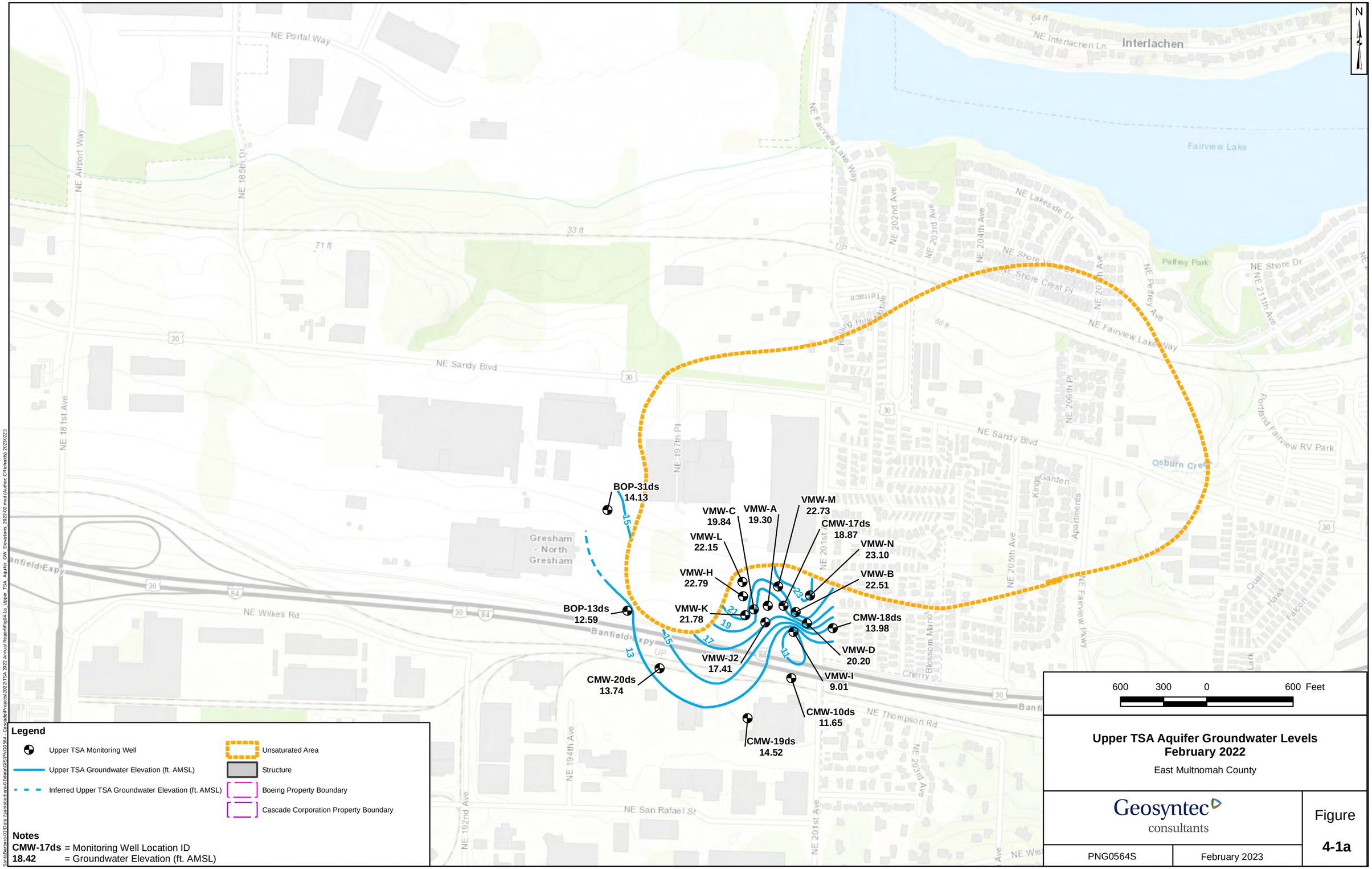
Maximum Soil Vapor TCE Concentration 2022

East Multnomah County

Geosyntec consultants

PNG0564S16 | February 2023

Figure **3-3**



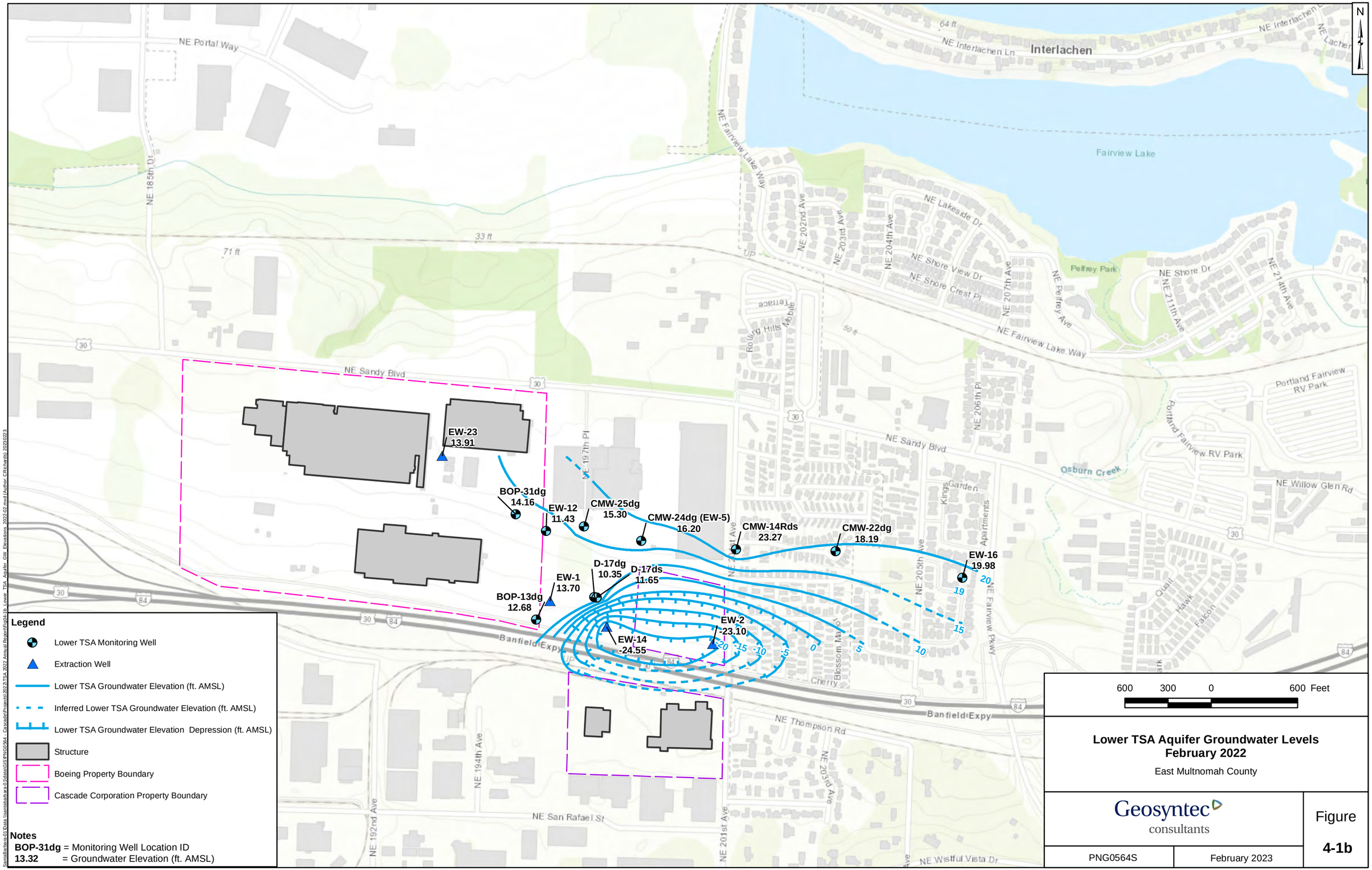
Upper TSA Aquifer Groundwater Levels February 2022

East Multnomah County

Geosyntec consultants

PNG0564S | February 2023

Figure 4-1a



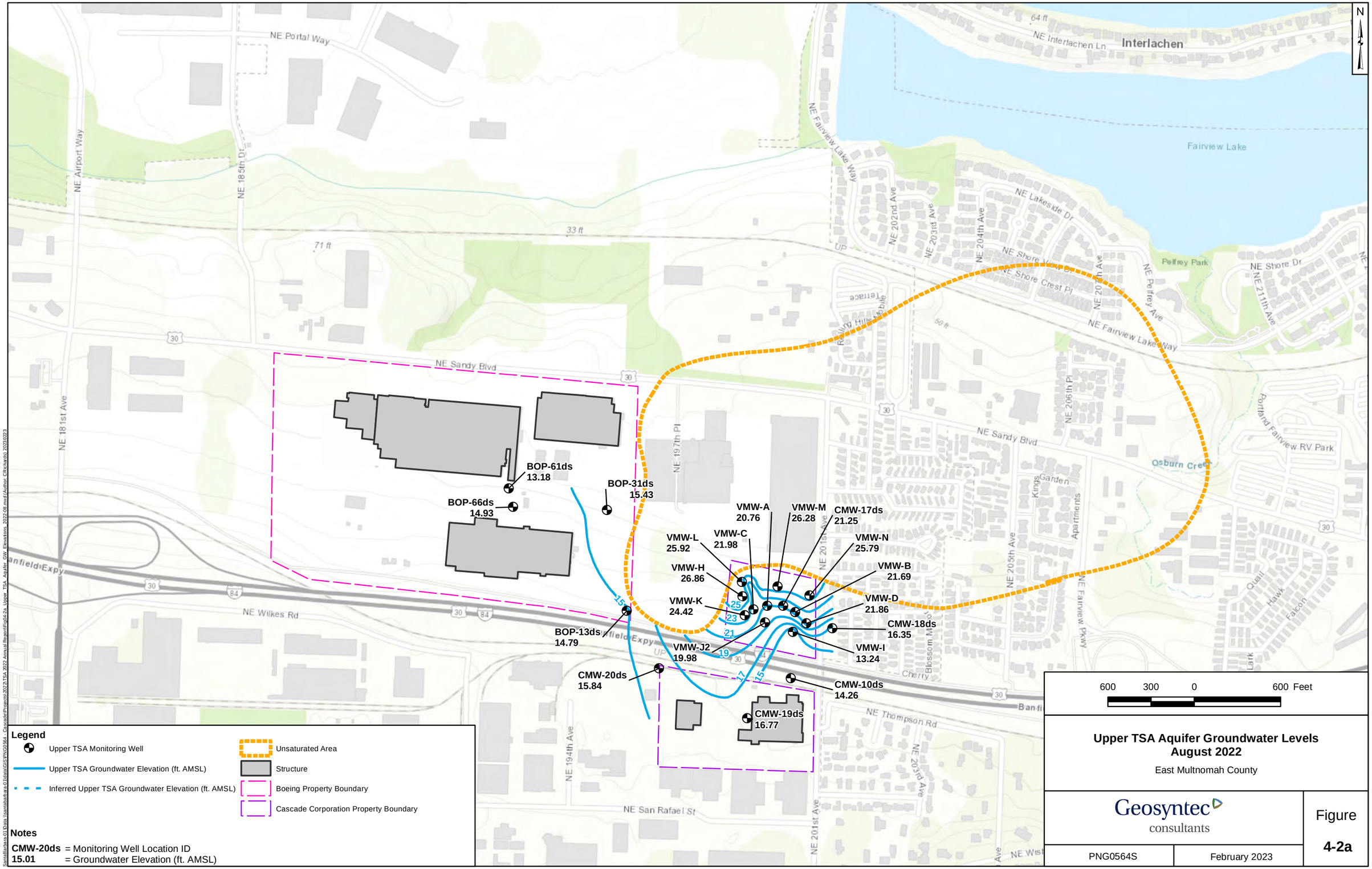
SantaBarbara-01\Data \\santabarbara-01\data\GIS\PNG\564 - Cascade\Projects\2022\TSA 2022 Annual Report\Fig04-1b_Lower_TSA_Aquifer_GW_Elevations_2022-02.mxd (Author: CRichards) 20230223

Lower TSA Aquifer Groundwater Levels
February 2022

East Multnomah County

Geosyntec consultants

PNG0564S	February 2023	Figure 4-1b



Upper TSA Aquifer Groundwater Levels
August 2022

East Multnomah County

Geosyntec consultants

PNG0564S | February 2023

Figure **4-2a**

N

NE Portal Way
NE Airport Way
NE 185th Dr
NE Fairview Lake Way
64 ft
NE Interlachen Ln
Interlachen
Fairview Lake
33 ft
71 ft
UP
NE 202nd Ave
NE 203rd Ave
NE 204th Ave
NE Lakeside Dr
NE Shore View Dr
NE Shore Crest Pl
NE 207th Ave
NE Pelfrey Ave
Pelfrey Park
NE Shore Dr
NE 211th Ave
NE Fairview Lake Way
50 ft
Rolling Hills Mobile Terrace
30
BOP-20dg
15.21
NE Sandy Blvd
NE 206th Pl
Portland Fairview RV Park
Osburn Creek
Kings Garden Apartments
NE 205th Ave
NE Fairview Pkwy
NE 181st Ave
NE 197th Pl
EW-23
14.22
BOP-61dg
12.91
BOP-31dg
15.34
CMW-25dg
16.71
CMW-24dg (EW-5)
18.46
CMW-14Rds
24.14
EW-12
15.66
Gresham - North Gresham
EW-1
15.82
D-17ds
14.71
D-17dg
14.46
BOP-13dg
14.81
EW-14
-24.88
EW-2
-22.55
CMW-22dg
19.49
EW-16
22.19
EW-11
20.81
20
15
10
5
0
-5
-10
-15
-20
Banfield Expy
84
Cherry Blossom Manor
NE Thompson Rd
NE 194th Ave
NE 192nd Ave
NE San Rafael St
NE 201st Ave
NE 203rd Ave
Quail Hawk Falcon Lark

Legend

- Lower TSA Monitoring Well
- Extraction Well
- Lower TSA Groundwater Elevation (ft. AMSL)
- Inferred Lower TSA Groundwater Elevation (ft. AMSL)
- Lower TSA Groundwater Elevation Depression (ft. AMSL)
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary

Notes

EW-23 = Monitoring Well Location ID
11.71 = Groundwater Elevation (ft. AMSL)

600 300 0 600 Feet

Lower TSA Aquifer Groundwater Levels
August 2022

East Multnomah County

Geosyntec consultants

PNG0564S	March 2023

Figure **4-2b**

S:\antaBarbara-01\Data\santaBarbara-01\data\GIS\PNG0564 - Cascade\Projects\2022\TSA 2022 Annual Report\Fig04-2b Lower TSA Aquifer GW Elevations 2022-08.mxd (Author: CRichards) 20230323

BOP-31ds
< 0.20

BOP-13ds
2.9

VMW-A
2.63

VMW-M
5.81

CMW-17ds
31.8

VMW-C
2.71

VMW-B
16.5

VMW-L
< 0.500

VMW-N
8.78

VMW-H
< 0.500

VMW-G
1.94

VMW-K
18.0

VMW-D
0.519

VMW-J2
48.2

CMW-18ds
50.2

VMW-F
< 0.500

VMW-E
24.4

VMW-I
35.3

CMW-10ds
8.93

CMW-19ds
< 0.500

Legend

- Upper TSA Monitoring Well
- Upper TSA Trichloroethene Contour (µg/L)
- Inferred Upper TSA Trichloroethene Contour (µg/L)
- Unsaturated Area
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary

Notes

CMW-18ds = Monitoring Well Location ID
59.7 = TCE Concentration (µg/L)

Maximum values are reported for locations with field duplicates and/or multiple depths.
If analyte was not detected, the minimum reporting limit was shown.

500 250 0 500 Feet

Upper TSA Aquifer Trichloroethene Concentrations February 2022

East Multnomah County

Geosyntec consultants

PNG0564S | March 2023

Figure **5-1a**

SantaBarbara-01\Data\santabarbara-01\data\GIS\PNG0564 - Cascade\Projects\2022\TSA 2022 Annual Report\Fig5-1a Upper TSA Aquifer TCE Contours 2022-02_CSR.mxd (Author: CRichards) 20230323

EW-23
0.586

BOP-31dg
2.8

EW-12
2.00

CMW-25dg
< 0.500

CMW-24dg (EW-5)
< 0.500

CMW-14Rds
< 0.500

D-17dg
4.02

D-17ds
31.5

EW-1
1.11

25

5

EW-14
5.68

EW-2
8.02

BOP-13dg
0.35

Legend

- Lower TSA Monitoring Well
- Extraction Well
- Decomissioned or No Longer Monitored Monitoring Well
- Lower TSA Trichloroethene Contour (µg/L)
- Inferred Lower TSA Trichloroethene Contour (µg/L)
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary

Notes

D-17dg = Monitoring Well Location ID
3.69 = TCE Concentration (µg/L)

Maximum values are reported for locations with field duplicates and/or multiple depths.
If analyte was not detected, the minimum reporting limit was shown.

500 250 0 500 Feet

Lower TSA Aquifer Trichloroethene Concentrations
February 2022
East Multnomah County

Geosyntec consultants

PNG0564S | March 2023

Figure **5-1b**

SantaBarbara-01\Data \\santabarbara-01\data\GIS\PNG\0564 - Cascade\Projects\2022\TSA 2022 Annual Report\Fig5-1b_Lower_TSA_Aquifer_TCE_Contours_2022-02.mxd (Author: CRichard) 20230323

BOP-61ds
4.1

BOP-66ds
1.1

BOP-31ds
< 0.20

BOP-13ds
2.9

CMW-20ds
< 0.500

CMW-19ds
< 0.500

CMW-10ds
5.70

VMW-A
1.93

VMW-M
3.88

CMW-17ds
24.3

VMW-N
0.744

VMW-L
< 0.500

VMW-H
< 0.500

VMW-B
12.1

VMW-C
2.06

VMW-G
1.83

VMW-K
12.8

VMW-D
0.650

VMW-J2
18.0

CMW-18ds
91.6

VMW-I
32.1

VMW-F
10.2

VMW-E
17.5

5
25
45
65
85

Legend

- Upper TSA Monitoring Well
- Upper TSA Trichloroethene Countour (µg/L)
- Inferred Upper TSA Trichloroethene Countour (µg/L)
- Unsaturated Area
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary

Notes

CMW-10ds = Monitoring Well Location ID
8.67 = TCE Concentration (µg/L)

Maximum values are reported for locations with field duplicates and/or multiple depths.
If analyte was not detected, the minimum reporting limit was shown.

N

500 250 0 500 Feet

Upper TSA Aquifer Trichloroethene Concentrations August 2022

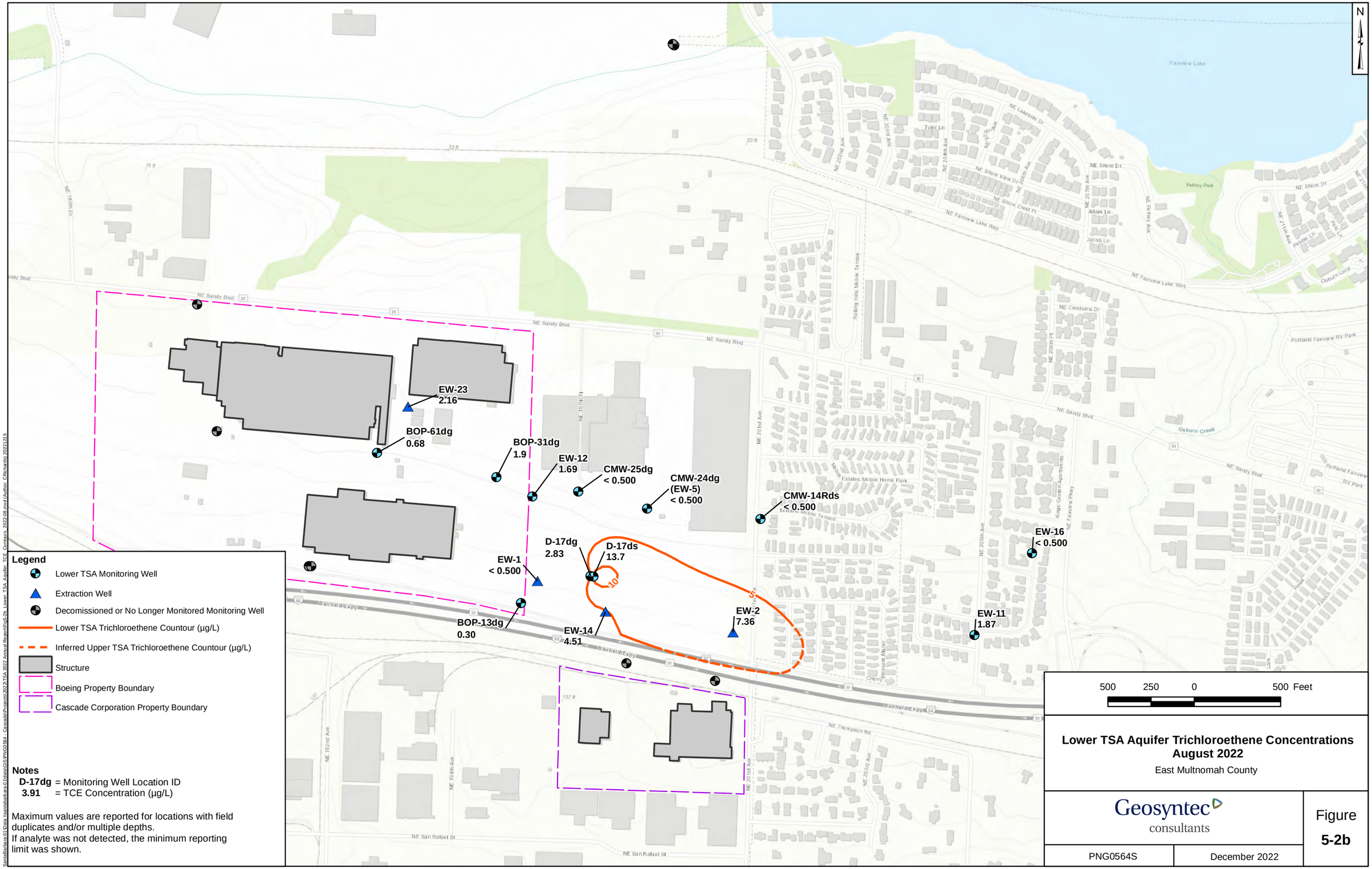
East Multnomah County

Geosyntec consultants

Figure **5-2a**

PNG0564S | March 2023

SantaBarbara-01\Data\santabarbara-01\data\GIS\PNG\0564 - Cascade\Projects\2022\TSA 2022 Annual Report\Fig5-2a Upper TSA Aquifer TCE Contours 2022-08.mxd (Author: CRichards) 20230327



SantaBarbara-01\Data \\santabarbara-01\data\GIS\PNG\0564 - Cascade\Projects\2022\TSA 2022 Annual Report\Fig5-2b Lower TSA Aquifer TCE Contours 2022-09.mxd (Author: CRichard) 20221215

APPENDIX A
Extraction Rates

Table A-1
TSA Extraction Rates 1 January 2022 through 31 December 2022 and
12-Month Averages through 31 December 2022[3]
East Multnomah County TSA Remedy

Zone	12-Mo. Avg.	01/2022	02/2022	03/2022	04/2022	05/2022	06/2022	07/2022	08/2022	09/2022	10/2022	11/2022	12/2022
EW-2	*27*	*37*	*28*	*33*	*31*	*30*	*30*	*28*	*27*	*26*	*24*	*26*	*0*
EW-14	*20*	*20*	*21*	*23*	*24*	*23*	*23*	*23*	*23*	*23*	*21*	*20*	*0*
Total Avg Flow TSA	**47**	**57**	**49**	**56**	**55**	**53**	**52**	**51**	**50**	**49**	**45**	**45**	**0**

NOTES:

1. Monthly average flow rates are shown in gallons per minute for each well.
2. Wells that have not operated during the last 12 months are not shown.
3. EW-2 and EW-14 were shutdown on 11.25.2022 due to electrical issues in the system. The average flow for EW-2 and EW-14 is calculated for January through December and includes the shutdown period.

Table A-2
Discharge Monitoring Summary - Cental Treatment System
1 January 2022 through 31 December 2022
East Multnomah County TSA Remedy

Parameter	Discharge Limitations[1]	Unit	Sample Date	System Discharge			Number of Exceedances	Sample Frequency
				Min	Avg	Max		
Jan-22								
pH	6.0 – 9.0	su	—	7.81	7.86	7.88	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	51	--	—	Daily
Feb-22								
Trichloroethene	5.0	µg/L	2/1/2022	--	< 0.500	--	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	2/1/2022	--	< 0.500	--	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	2/1/2022	--	< 0.500	--	0	Quarterly
Tetrachloroethene	5.0	µg/L	2/1/2022	--	< 0.500	--	0	Quarterly
Vinyl Chloride	2.0	µg/L	2/1/2022	--	< 0.500	--	0	Quarterly
pH	6.0 – 9.0	su	—	7.86	7.88	7.89	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	49	--	—	Daily
Mar-22								
pH	6.0 – 9.0	su	—	7.84	7.88	7.91	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	56	--	—	Daily
Apr-22								
pH	6.0 – 9.0	su	—	7.84	7.86	7.88	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	55	--	—	Daily
May-22								
Trichloroethene	5.0	µg/L	5/3/2022	--	< 0.500	--	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	5/3/2022	--	< 0.500	--	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	5/3/2022	--	< 0.500	--	0	Quarterly
Tetrachloroethene	5.0	µg/L	5/3/2022	--	< 0.500	--	0	Quarterly
Vinyl Chloride	2.0	µg/L	5/3/2022	--	< 0.500	--	0	Quarterly
pH	6.0 – 9.0	su	—	7.85	7.87	7.88	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	53	--	—	Daily
Jun-22								
pH	6.0 – 9.0	su	—	7.86	7.88	7.89	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	52	--	—	Daily
Jul-22								
pH	6.0 – 9.0	su	—	7.83	7.86	7.92	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	51	--	—	Daily
Aug-22								
Trichloroethene	5.0	µg/L	8/2/2022	--	< 0.500	--	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	8/2/2022	--	< 0.500	--	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	8/2/2022	--	< 0.500	--	0	Quarterly
Tetrachloroethene	5.0	µg/L	8/2/2022	--	< 0.500	--	0	Quarterly
Vinyl Chloride	2.0	µg/L	8/2/2022	--	< 0.500	--	0	Quarterly
pH	6.0 – 9.0	su	—	7.85	7.87	7.90	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	50	--	—	Daily

Table A-2
Discharge Monitoring Summary - Cental Treatment System
1 January 2022 through 31 December 2022
East Multnomah County TSA Remedy

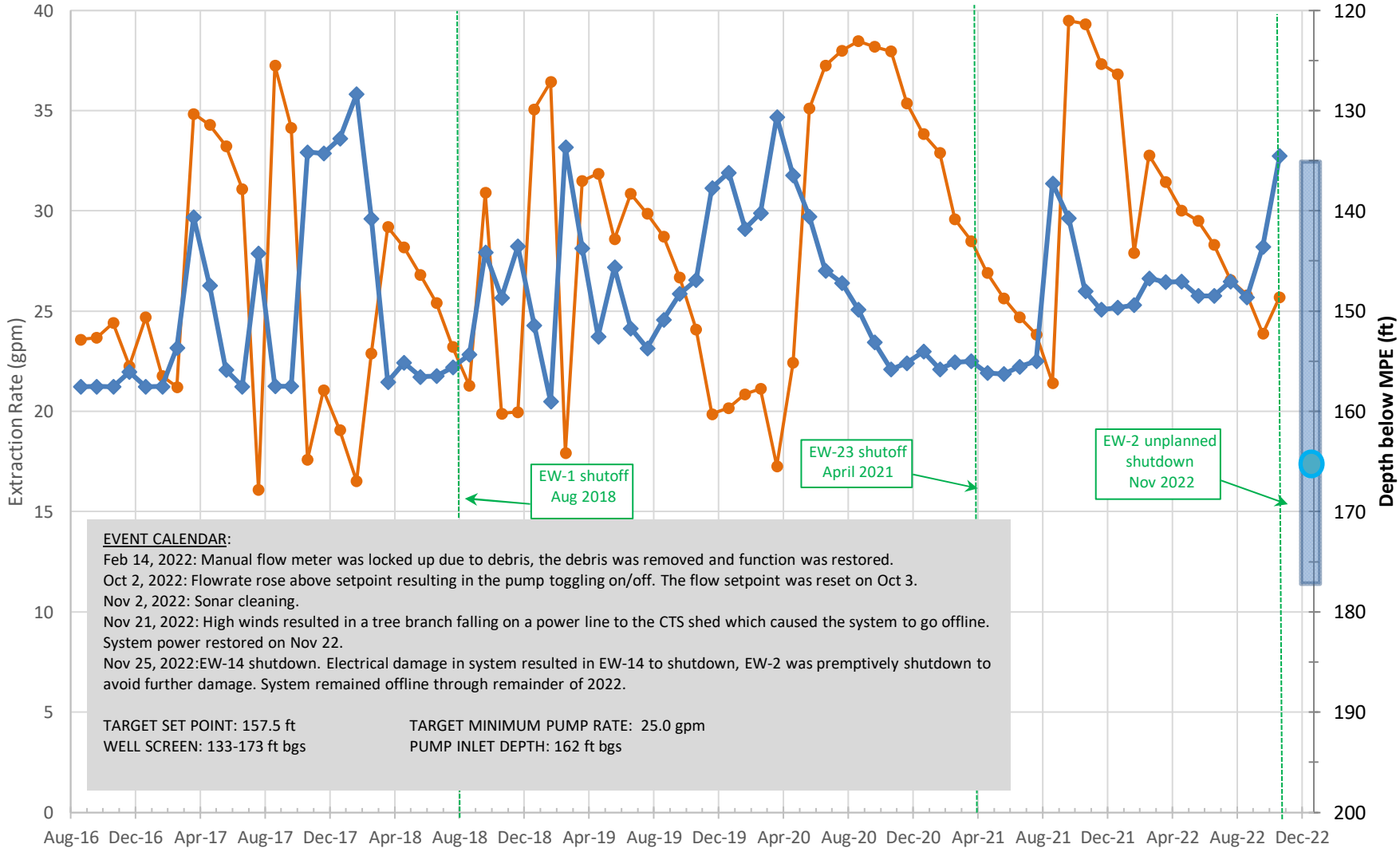
Parameter	Discharge Limitations[1]	Unit	Sample Date	System Discharge			Number of Exceedances	Sample Frequency
				Min	Avg	Max		
Sep-22								
pH	6.0 – 9.0	su	—	7.84	7.86	7.87	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	49	--	—	Daily
Oct-22								
pH	6.0 – 9.0	su	—	7.58	7.75	7.85	0	Weekly
Temperature	—	ºF	—	59	60	61	—	Weekly
Flow	—	gpm	—	--	45	--	—	Daily
Nov-22								
Trichloroethene	5.0	µg/L	11/3/2022	--	< 0.500	--	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	11/3/2022	--	< 0.500	--	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	11/3/2022	--	< 0.500	--	0	Quarterly
Tetrachloroethene	5.0	µg/L	11/3/2022	--	< 0.500	--	0	Quarterly
Vinyl Chloride	2.0	µg/L	11/3/2022	--	< 0.500	--	0	Quarterly
pH	6.0 – 9.0	su	—	7.81	7.82	7.84	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow	—	gpm	—	--	45	--	—	Daily
Dec-22								
pH	6.0 – 9.0	su	—	--	--	--	—	Weekly
Temperature	—	ºF	—	--	--	--	—	Weekly
Flow	—	gpm	—	--	0	--	—	Daily

NOTES:

1. Discharge limitations for the CTS are per Attachment C to DEQ Consent Order No. WMCSR-NWR-96-08 dated 2/14/97.
2. Flow includes EW-2 and EW-14. System was shutdown on 11.25.2022 due to sustained damage to the electrical system.

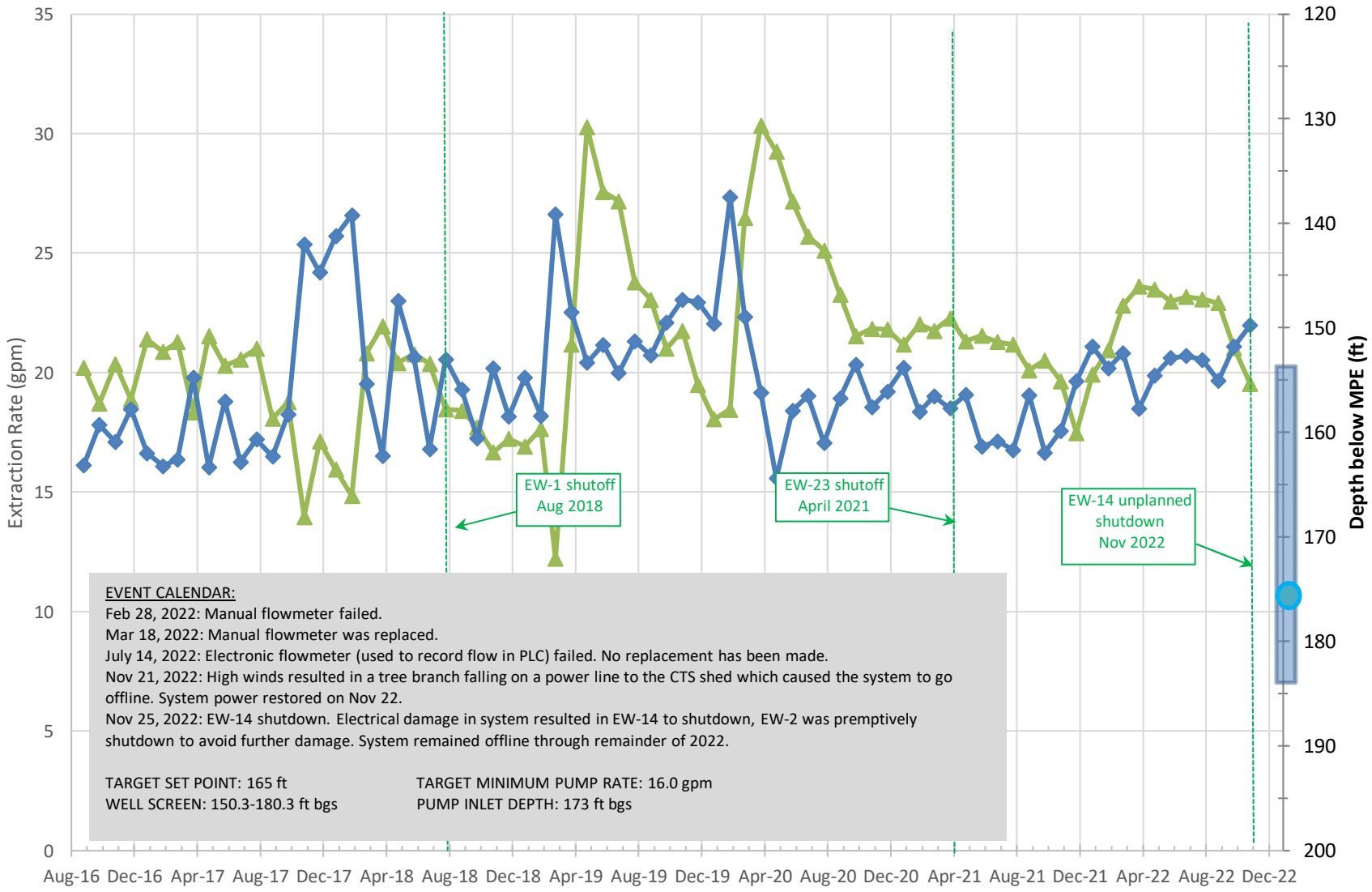
ACRONYMS:

µg/L = micrograms/liter; ºF = degrees Fahrenheit; gpm = gallons per minute; su = standard units.



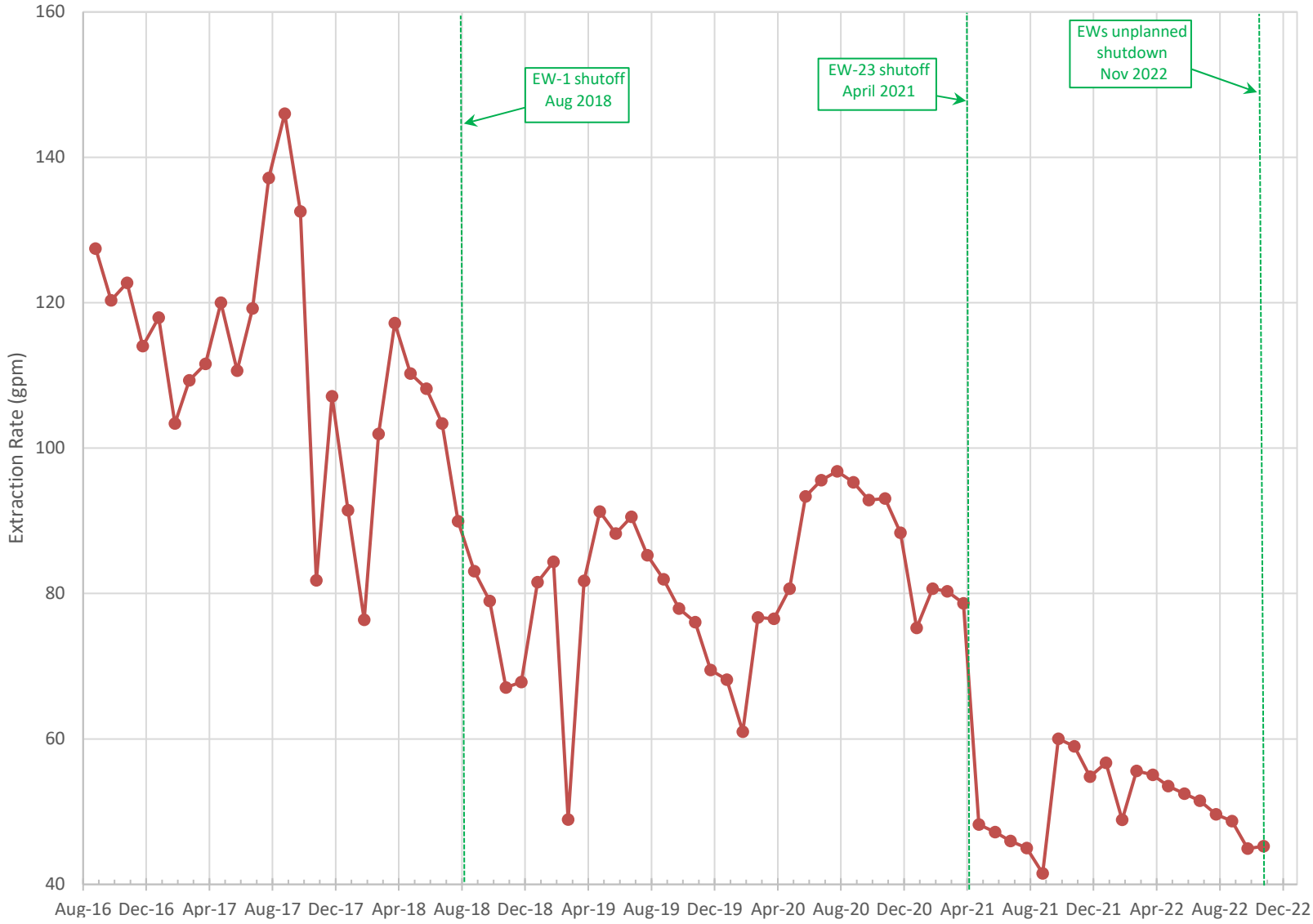
Geosyntec consultants

Cascade Corporation Gresham, Oregon	**EW-2 Monthly Average Flowrate and Water Level** ***Measuring Point Elevation (MPE) is a surveyed stand-pipe located in the well vault**	Figure A-1



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**EW-14 Monthly Average Flowrate and Water Level** *Measuring Point Elevation (MPE) is a surveyed stand-pipe located in the well vault	Figure A-2



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**Total Extraction Rate for Remedy All Wells** **TSA Remedy**	Figure A-3

APPENDIX B
Well Decommissioning

MULT 138452

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

6/24/2022

WELL I.D. LABEL# L 13929

START CARD # 1055365

(1) LAND OWNER

Owner Well I.D. EW-8

First Name 110-22-0003 Last Name

Company CASCADE CORPORATION

Address 2201 NE 201ST AVE

City FAIRVIEW State OR Zip 97024

(2) TYPE OF WORK

☐ New ☐ Deepening ☐ Conversion
☐ Alteration (repair/recondition) ☒ Abandonment

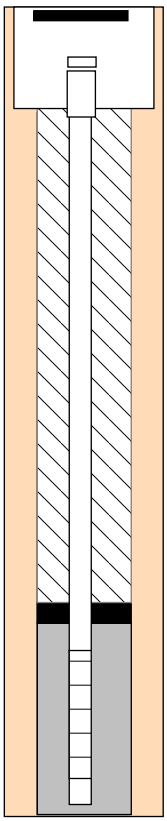
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☒ Other SONIC

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 111.00 ft. Special Standard ☐



MONUMENT/VAULT Below Ground
From 0 To 3

BORE HOLE
Diameter 12 From 0 To 111

CASING
Dia. 8 From ☐ 0 To 71
Gauge .25 Wld Thrd
Material ◉ Steel ○ Plastic ☒ ☐

LINER
Dia. From ☐ To
Gauge Wld Thrd
Material ○ Steel ○ Plastic ☐ ☐

SEAL
From 0 To 3
Material Other
Amount 10 Sacks Grout weight

SCREEN
Casing/Liner Casing Material Stainless Steel
Diameter 8 From 71 To 111
Slot Size 0.040

FILTER
From To Material Size of pack

(5) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 54 °F Lab analysis ☐ Yes By

Supervising Geologist/Engineer

Water quality concerns? ☐ Yes (describe below) TDS amount 100 ppm

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County MULTNOMAH Twp 1.00 N N/S Range 3.00 E E/W WM
Sec 29 SW 1/4 of the NE 1/4 Tax Lot 00500
Tax Map Number Lot
Lat ° ' " or 45.54322000 DMS or DD
Long ° ' " or -122.46183600 DMS or DD

○ Street address of well ◉ Nearest address

19730 NE SANDY BLVD, PORTLAND, OR 97230 (NEAR BOEING FAIRVIEW, OR)

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening	2/7/2022		☐	57
Completed Well			☐	

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES Depth water was first found

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG

Ground Elevation

Material	From	To
Abandon 8" MW by Overdrill method	0	111

Date Started 2/7/2022 Completed 2/9/2022

(unbonded) Monitor Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 10697 Date 6/24/2022
Password : (if filing electronically)
Signed AUNDRICO RODRIGUEZ (E-filed)

(bonded) Monitor Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10408 Date 6/24/2022
Password : (if filing electronically)
Signed PETER LARSEN (E-filed)
Contact Info (optional) CDLP # 110-22-1003

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version:

MONITORING WELL REPORT - continuation page

MULT 138452

6/24/2022

WELL I.D. LABEL# L 13929

START CARD # 1055365

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight
Bentonite Grout	3	111	25	S	9.9

CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd

SCREENS

Perf/ Screen	Casing/ Liner	Screen Dia	From	To	Scrn size/ slot width	Slot length	# of slots	Tele/ pipe size

(5) WELL TESTS

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Water Quality Concerns

From	To	Description	Amount	Units

(7) STATIC WATER LEVEL

Water Bearing Zones

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)

(8) WELL LOG

Material	From	To

Comments/Remarks

Overdrill and abandon 8" monitoring well. Remove well and backfill with grout.
Well Installed with Air Rotary / Install Completed 06/10/97
Construction Start: 095879. Tag: L13929 (client logs)

MONITORING WELL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

MULT 138452

6/24/2022

Map of Hole

STATE OF OREGON
WELL LOCATION MAP

This map is supplemental to the WATER SUPPLY WELL REPORT

Oregon Water Resources Department
725 Summer St NE, Salem OR 97301
(503)986-0900

LOCATION OF WELL

Latitude: 45.54322000 Datum: WGS84
Longitude: -122.46183600
Township/Range/Section/Quarter-Quarter Section:
WM1.00N3.00E29SWNE
Address of Well:
19730 NE SANDY BLVD, PORTLAND, OR 97230 (NEAR BOEING FAIRVIEW, OR)

Well Label: 13929

Printed: June 24, 2022

DISCLAIMER: This map is intended to represent the approximate location the well. It is not intended to be construed as survey accurate in any manner.

Provided by well constructor

MULT 138453

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-0395)

6/24/2022

WELL I.D. LABEL# L 20781

START CARD # 1055594

(1) LAND OWNER

Owner Well I.D. EW-15

First Name _____ Last Name _____

Company CREEKSIDE MOBILE HOME PARK #6, LP

Address PO BOX 778

City CLACKAMAS State OR Zip 97015-0778

(2) TYPE OF WORK

☐ New ☐ Deepening ☐ Conversion ☐ Alteration (repair/recondition) ☒ Abandonment

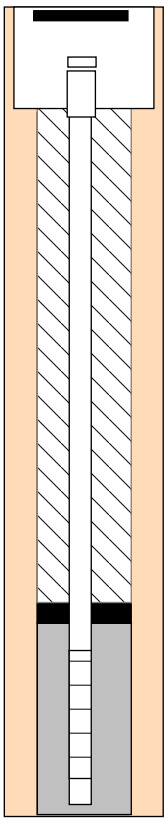
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud ☐ Reverse Rotary ☒ Other SONIC

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 175.00 ft. Special Standard ☐



MONUMENT/VAULT Below Ground
From 0 To 3

BORE HOLE
Diameter 12 From 0 To 180

CASING
Dia. 8 From ☐ 0 To 144
Gauge Sch 40 Wld Thrd
Material ◉ Steel ○ Plastic ☒ ☐

LINER
Dia. _____ From ☐ _____ To _____
Gauge _____ Wld Thrd
Material ○ Steel ○ Plastic ☐ ☐

SEAL
From 0 To 3
Material Concrete
Amount 15 Sacks Grout weight _____

SCREEN
Casing/Liner Casing Material Stainless Steel
Diameter 8 From 144 To 174
Slot Size 0.040

FILTER
From _____ To _____ Material _____ Size of pack _____

(5) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Temperature 54 °F Lab analysis ☐ Yes By _____

Supervising Geologist/Engineer _____

Water quality concerns? ☐ Yes (describe below) TDS amount 100 ppm

From	To	Description	Amount	Units

(6) LOCATION OF WELL (legal description)

County MULTNOMAH Twp 1.00 N N/S Range 3.00 E E/W WM
Sec 28 NW 1/4 of the SW 1/4 Tax Lot 00400
Tax Map Number _____ Lot _____
Lat ° ' " or 45.54051400 DMS or DD
Long ° ' " or -122.45293700 DMS or DD
◉ Street address of well ○ Nearest address
EW-15, 2519 NE 205TH AVE, FAIRVIEW, OR 97024

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening	2/9/2022		☐	112
Completed Well			☐	

Flowing Artesian? ☐ Dry Hole? ☐

WATER BEARING ZONES Depth water was first found _____

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)
					☐	
					☐	
					☐	
					☐	
					☐	

(8) WELL LOG

Ground Elevation _____

Material	From	To
Abandon 8" MW by Overdrill method	0	180

Date Started 2/9/2022 Completed 2/11/2022

(unbonded) Monitor Well Constructor Certification

I certify that the work I performed on the construction, deepening, alteration, or abandonment of this well is in compliance with Oregon monitoring well construction standards. Materials used and information reported above are true to the best of my knowledge and belief.

License Number 10697 Date 6/24/2022
Password : (if filing electronically) _____
Signed AUNDRICO RODRIGUEZ (E-filed)

(bonded) Monitor Well Constructor Certification

I accept responsibility for the construction, deepening, alteration, or abandonment work performed on this well during the construction dates reported above. All work performed during this time is in compliance with Oregon monitoring well construction standards. This report is true to the best of my knowledge and belief.

License Number 10408 Date 6/24/2022
Password : (if filing electronically) _____
Signed PETER LARSEN (E-filed)
Contact Info (optional) CDLP # 110-22-1014

ORIGINAL - WATER RESOURCES DEPARTMENT
THIS REPORT MUST BE SUBMITTED TO THE WATER RESOURCES DEPARTMENT WITHIN 30 DAYS OF COMPLETION OF WORK

Form Version:

MONITORING WELL REPORT - continuation page

MULT 138453

WELL I.D. LABEL# L 20781

START CARD # 1055594

6/24/2022

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight
Bentonite Grout	3	180	45	S	9.9

CASING/LINER

Casing	Liner	Dia	+	From	To	Gauge	Stl	Plstc	Wld	Thrd

SCREENS

Perf/ Screen	Casing/ Liner	Screen Dia	From	To	Scrn size/ slot width	Slot length	# of slots	Tele/ pipe size

(5) WELL TESTS

Yield gal/min	Drawdown	Drill stem/Pump depth	Duration (hr)

Water Quality Concerns

From	To	Description	Amount	Units

(7) STATIC WATER LEVEL

Water Bearing Zones

SWL Date	From	To	Est Flow	SWL(psi)	+	SWL(ft)

(8) WELL LOG

Material	From	To

Comments/Remarks

Overdrill and abandon 8" MW to 180 ft. Remove well and backfill boring with pressure grout.
Const Start #: 113878 / Well Tag: L20781

MONITORING WELL REPORT - Map with location identified must be attached and shall include an approximate scale and north arrow

MULT 138453

6/24/2022

Map of Hole

STATE OF OREGON
WELL LOCATION MAP

This map is supplemental to the WATER SUPPLY WELL REPORT

Oregon Water Resources Department
725 Summer St NE, Salem OR 97301
(503)986-0900

LOCATION OF WELL
Latitude: 45.54051400 Datum: WGS84
Longitude: -122.45293700
Township/Range/Section/Quarter-Quarter Section:
WM1.00N3.00E28NWSW
Address of Well:
EW-15, 2519 NE 205TH AVE, FAIRVIEW, OR 97024

Well Label: 20781

Printed: June 24, 2022

DISCLAIMER: This map is intended to represent the approximate location the well. It is not intended to be construed as survey accurate in any manner.

Provided by well constructor

APPENDIX C
SVE Data

Table C-1
Soil Vapor Extraction 1 January 2022 through 31 December 2022
East Multnomah County TSA Remedy

Well ID	Date	Time (hrs)	Temperature[1] (degrees F)	Flow Rate[2] (scfm)	PID Measurement[3] (ppm)	Calculated VOC Concentrations (µg/L)
Soil Vapor Extraction Outlet						
SVE System Outlet	**1/4/2022**	**13:00**	**85**	**380**	**0.3**	**1.8**
SVE System Outlet	1/11/2022	10:40	85	360	0.3	1.8
SVE System Outlet	1/18/2022	12:30	85	365	0.3	1.8
SVE System Outlet	1/25/2022	13:00	90	357	--	--
SVE System Outlet	2/1/2022	16:40	--	373	--	--
SVE System Outlet	2/8/2022	10:50	--	381	--	--
SVE System Outlet	**2/15/2022**	**12:35**	**95**	**361**	**--**	--
SVE System Outlet	2/22/2022	14:50	90	359	--	--
SVE System Outlet	3/1/2022	14:00	--	381	--	--
SVE System Outlet	3/8/2022	16:00	95	489	--	--
SVE System Outlet	3/15/2022	12:00	--	388	0.3	1.8
SVE System Outlet	**3/21/2022**	**13:45**	**90**	**380**	**0.3**	**1.8**
SVE System Outlet	3/29/2022	13:00	95	389	0.3	1.8
SVE System Outlet	**4/5/2022**	**10:45**	**90**	**391**	**0.3**	**1.8**
SVE System Outlet	4/11/2022	14:25	80	371	0.3	1.8
SVE System Outlet	4/20/2022	14:30	90	357	0.3	1.8
SVE System Outlet	4/26/2022	15:10	90	385	0.3	1.8
SVE System Outlet	**5/3/2022**	**9:40**	**85**	**379**	**0.3**	**1.8**
SVE System Outlet	5/10/2022	11:00	95	390	0.3	1.8
SVE System Outlet	5/17/2022	14:00	95	392	0.3	1.8
SVE System Outlet	5/24/2022	17:10	100	366	0.3	1.8
SVE System Outlet	5/31/2022	14:30	110	390	0.2	1.2
SVE System Outlet	**6/7/2022**	**13:40**	**110**	**391**	**0.3**	**1.8**
SVE System Outlet	6/14/2022	9:50	95	378	0.3	1.8
SVE System Outlet	6/21/2022	10:30	90	390	0.2	1.2
SVE System Outlet	6/28/2022	9:00	90	389	0.3	1.8
SVE System Outlet	**7/6/2022**	**13:30**	**100**	**377**	**0.2**	**1.2**
SVE System Outlet	7/11/2022	8:45	100	375	0.3	1.8
SVE System Outlet	7/19/2022	9:00	95	365	0.2	1.2
SVE System Outlet	7/26/2022	11:15	120	358	0.2	1.2
SVE System Outlet	8/2/2022	8:10	95	368	0.2	1.2
SVE System Outlet	**8/9/2022**	**10:40**	**95**	**371**	**0.2**	**1.2**
SVE System Outlet	8/16/2022	15:40	120	341	0.2	1.2
SVE System Outlet	8/22/2022	13:00	110	371	0.2	1.2
SVE System Outlet	8/30/2022	10:00	95	369	0.2	1.2
SVE System Outlet	**9/6/2022**	**13:40**	**110**	**385**	**0.2**	**1.2**

Table C-1
Soil Vapor Extraction 1 January 2022 through 31 December 2022
East Multnomah County TSA Remedy

Well ID	Date	Time (hrs)	Temperature[1] (degrees F)	Flow Rate[2] (scfm)	PID Measurement[3] (ppm)	Calculated VOC Concentrations (µg/L)
Soil Vapor Extraction Outlet						
SVE System Outlet	9/13/2022	15:40	100	361	0.2	1.2
SVE System Outlet	9/20/2022	9:00	100	375	0.2	1.2
SVE System Outlet	9/27/2022	14:30	125	366	0.2	1.2
SVE System Outlet	**10/3/2022**	**13:10**	**90**	**354**	**0.2**	**1.2**
SVE System Outlet	10/11/2022	10:10	100	369	0.2	1.2
SVE System Outlet	10/18/2022	9:10	90	396	0.2	1.2
SVE System Outlet	10/25/2022	10:00	90	385	0.2	1.2
SVE System Outlet	**11/1/2022**	**15:00**	**90**	**377**	**0.2**	**1.2**
SVE System Outlet	11/8/2022	15:00	85	371	0.2	1.2
SVE System Outlet	11/15/2022	12:00	90	386	0.2	1.2
SVE System Outlet	11/22/2022	12:00	90	384	0.3	1.8
SVE System Outlet	**12/6/2022**	**14:40**	**85**	**371**	**--**	**--**
SVE System Outlet	12/13/2022	15:30	90	385	--	--
SVE System Outlet	12/27/2022	8:30	85	352	--	--

Notes:

ID = identification
hrs = hours
F = Fahrenheit
ppm = parts per million
µg/L = micrograms per liter
VOC = volatile organic compounds
--- = Measurement not available

1. During some weeks, the outlet temperature was either not recorded or the incorrect value was recorded.

2. Flow measurements taken using a hot-wire anomometer. SVE system inlet flow measurements are presented as a result of high SVE system outlet temperatures interfering with the effluent measurement.

3. The PID was unavailable for use at the Site on 1/25/2022 through 3/8/2022, and on 12/6/2022 through 12/27/2022.

4. The SVE system was temporarily shutdown on 11/21/2022 and from 11/25/2022 through 12/5/2022 due to system damage caused from a tree falling onto the power line which supplied power to the SVE system.

5. Bold text indicates sample for lab analysis was taken on that day or within several days. Those results are shown on Table C-2.

Table C-2
Soil Vapor Extraction - Laboratory VOC Results
East Multnomah County TSA Remedy

Well ID	Date	cis-1,2-dichloroethene (µg/m^3)	Trichloro-ethene (µg/m3)	Tetrachloro-ethene (µg/m3)	Total VOCs (µg/m3)	Flow Rate (scfm)[1]
System Outlet	1/6/22	44	640	52	736	377.6
	2/14/22	42	720	55	817	388.9
	3/21/22	50	870	68	988	372.4
	4/5/22	52	750	58	860	372.7
	5/5/22	52	870	47	969	360.3
	6/7/22	46	680	46	772	372.6
	7/6/22	47	600	35	682	380.6
	8/9/22	54	700	47	801	391.4
	9/6/22	45	580	43	668	378.6
	10/3/22	43	529	40	612	389.9
	11/3/22	43	620	46	709	388.6
	12/7/22	27	330	29	386	357.6
Well VW17D-95.5	2/14/22	29	390	27	446	59.6
	6/7/22	36	320	20	376	67.9
	8/9/22	42	390	24	456	60.8
	11/3/22	33	370	27	430	60.1
Well VMW-C	2/14/22	43	1300	100	1443	60.2
	5/5/22	6.3	72	12	90.3	74.2
	8/9/22	5.1	77	10	92.1	60.8
	11/3/22	4	71	11	86	60.0
Well VMW-E	2/14/22	54	1200	92	1346	71.0
	5/5/22	61	760	63	884	74.1
	8/9/22	50	870	58	978	71.6
	11/3/22	50	930	73	1053	70.9
Well VMW-F	2/14/22	8.8	120	25	153.8	70.8
	5/5/22	11	120	23	154	74.6
	8/9/22	11	120	20	151	71.4
	11/3/22	7.5	30	23	60.5	70.1
Well VMW-G	2/14/22	35	330	38	403	71.6
	5/5/22	32	200	28	260	74.1
	8/9/22	0.87	1.2	1.5	3.57	70.3
	11/3/22	11	80	20	111	70.6
Well VMW-H	2/14/22	63	460	18	541	69.4
	5/5/22	15	52	3.1	70.1	68.8
	8/9/22	0.82	1.1	1.4	3.32	69.1
	11/3/22	11	55	3.4	69.4	68.4
Well VMW-J2	2/28/22	0.9	19	1.7	21.6	73.8
	6/7/22	71	880	61	1012	71.4
	8/9/22	46	660	50	756	71.3
	11/3/22	35	610	50	695	70.8
Well VMW-K	2/28/22	2.1	74	2.8	78.9	74.9
	6/7/22	160	2100	120	2380	73.8
	8/9/22	130	1900	100	2130	72.1
	11/3/22	140	1800	110	2050	70.6

Table C-2
Soil Vapor Extraction - Laboratory VOC Results
East Multnomah County TSA Remedy

Notes:
ID = identification
scfm = standard cubic feet per minute
µg/m^3 = micrograms per cubic meter
VOC = volatile organic compounds
Total VOCs are the calculated sum of the three VOCs shown

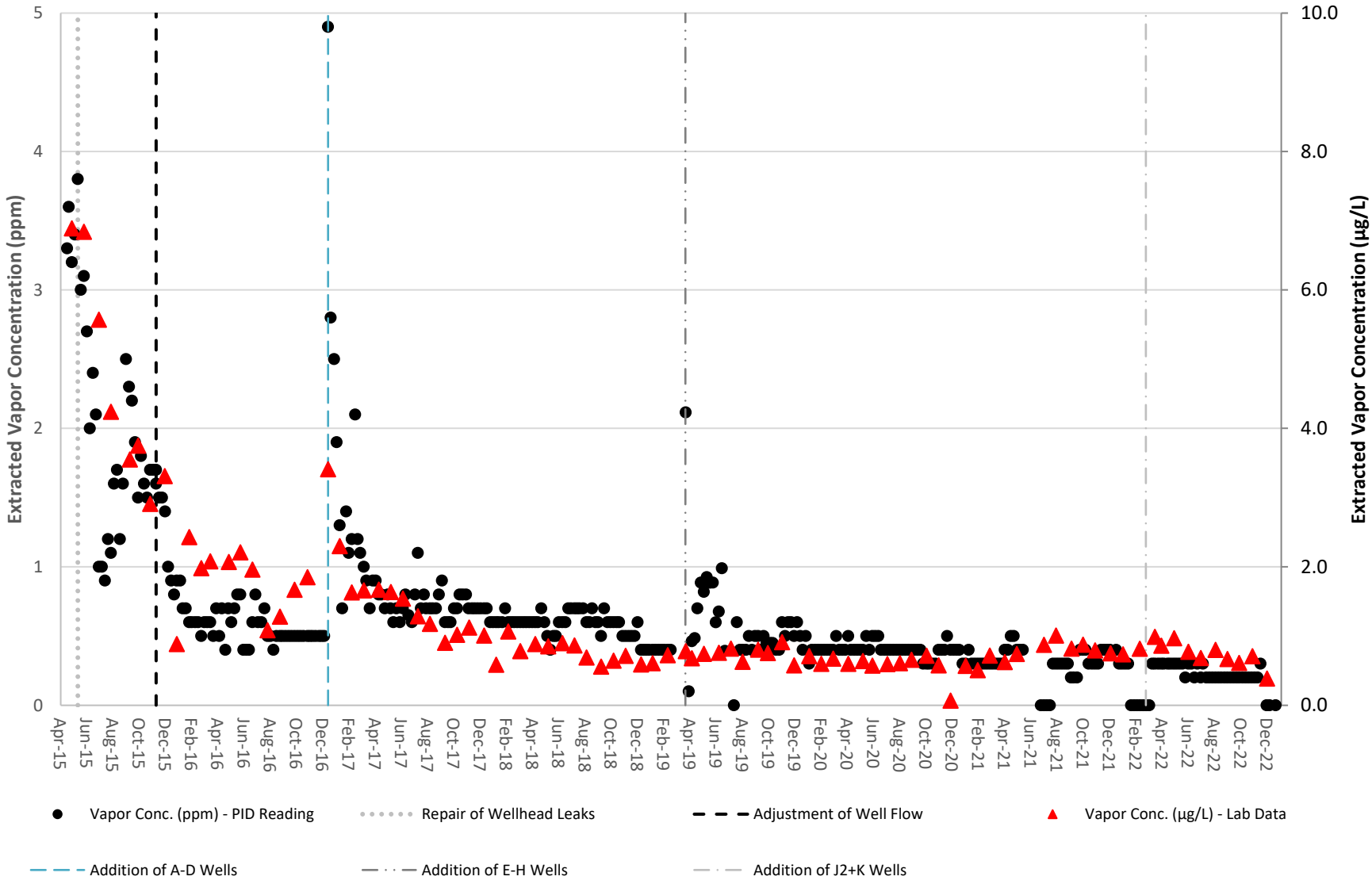
[1] Flowrates associated with the analytical data on 1/6/2022 were measured on 1/4/2022; on 2/14/2022, flows were measured 2/15/2022; on 5/5/2022, flows were measured 5/3/2022; on 11/3/2022, flows were measured 11/1/2022; on 12/7/2022, flows were measured 12/6/2022.

Table C-3
Soil Vapor Extraction VOC Mass Removal - April 2015 through December 2022
East Multnomah County TSA Remedy

Date	Pounds of TCE Removed Per Sampling Period	Cumulative Pounds of TCE Removed	Pounds of VOCs Removed Per Sampling Period	Cumulative Pounds of VOCs Removed	TCE percentage of mass removal Per Sampling Period
04/16/15	0.00	0.00	0.00	0.00	0%
04/28/15	1.13	1.13	1.30	1.30	87%
05/26/15	2.57	3.71	2.95	4.25	87%
06/30/15	2.46	6.17	2.80	7.05	88%
07/28/15	1.44	7.60	1.64	8.69	88%
09/10/15	1.68	9.29	1.93	10.62	87%
09/29/15	0.79	10.08	0.90	11.52	88%
10/27/15	0.95	11.03	1.09	12.61	87%
11/30/15	1.31	12.33	1.50	14.11	87%
12/28/15	0.84	13.17	0.96	15.07	87%
01/26/16	0.84	14.01	0.98	16.04	86%
02/23/16	1.07	15.08	1.24	17.28	86%
03/15/16	0.73	15.81	0.85	18.13	86%
04/27/16	1.51	17.32	1.74	19.88	87%
05/24/16	1.05	18.37	1.21	21.09	86%
06/21/16	0.98	19.35	1.14	22.23	86%
07/26/16	0.91	20.27	1.05	23.28	87%
08/24/16	0.59	20.86	0.69	23.97	86%
09/27/16	0.84	21.70	1.00	24.96	85%
10/27/16	0.85	22.55	1.00	25.96	85%
12/14/16	1.84	24.40	2.11	28.07	87%
01/10/17	1.51	25.91	1.73	29.80	87%
02/07/17	1.95	27.86	2.25	32.05	86%
03/07/17	1.66	29.52	1.95	34.00	85%
04/11/17	1.85	31.37	2.20	36.20	84%
05/09/17	1.48	32.85	1.75	37.95	85%
06/06/17	1.51	34.35	1.77	39.72	85%
07/11/17	1.63	35.99	1.92	41.64	85%
08/08/17	1.16	37.15	1.36	43.00	85%
09/12/17	1.24	38.39	1.46	44.46	85%
10/10/17	0.92	39.31	1.08	45.54	85%
11/07/17	0.98	40.29	1.14	46.68	86%
12/12/17	1.31	41.60	1.52	48.20	86%
01/09/18	0.74	42.34	0.87	49.07	85%
02/06/18	0.78	43.12	0.90	49.97	87%
03/06/18	0.89	44.00	1.01	50.98	88%
04/10/18	1.00	45.01	1.15	52.13	87%
05/10/18	0.79	45.80	0.91	53.04	87%
06/12/18	1.05	46.85	1.20	54.25	87%
07/10/18	0.85	47.70	0.97	55.22	87%
08/07/18	0.76	48.46	0.87	56.09	87%
09/10/18	0.75	49.21	0.86	56.95	87%
10/09/18	0.62	49.83	0.72	57.67	87%
11/06/18	0.69	50.52	0.79	58.46	87%
12/12/18	0.84	51.36	0.98	59.44	86%

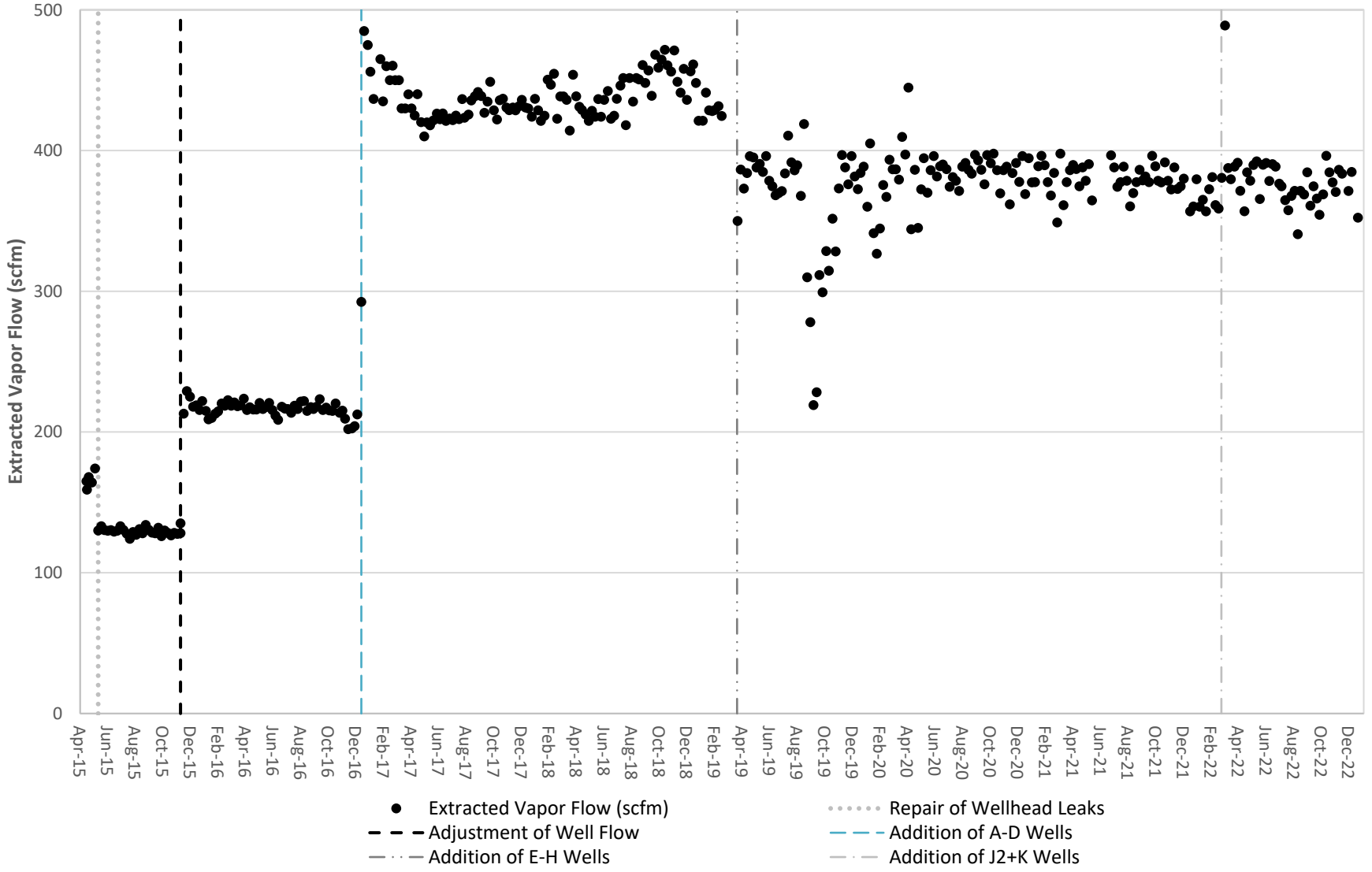
Table C-3
Soil Vapor Extraction VOC Mass Removal - April 2015 through December 2022
East Multnomah County TSA Remedy

Date	Pounds of TCE Removed Per Sampling Period	Cumulative Pounds of TCE Removed	Pounds of VOCs Removed Per Sampling Period	Cumulative Pounds of VOCs Removed	TCE percentage of mass removal Per Sampling Period
01/08/19	0.58	51.94	0.66	60.10	87%
02/12/19	0.83	52.77	0.96	61.06	86%
03/26/19	1.07	53.83	1.24	62.29	86%
04/09/19	0.31	54.14	0.36	62.66	85%
05/07/19	0.56	54.70	0.67	63.33	84%
06/11/19	0.78	55.48	0.91	64.24	85%
07/09/19	0.63	56.11	0.75	65.00	84%
08/05/19	0.56	56.67	0.67	65.67	83%
09/10/19	0.70	57.37	0.83	66.50	84%
10/03/19	0.36	57.73	0.42	66.92	84%
11/05/19	0.70	58.43	0.81	67.73	86%
12/03/19	0.56	58.99	0.66	68.39	85%
01/07/20	0.64	59.63	0.77	69.16	83%
02/04/20	0.51	60.14	0.60	69.77	85%
03/03/20	0.50	60.64	0.59	70.35	85%
04/07/20	0.64	61.28	0.77	71.13	83%
05/11/20	0.61	61.89	0.73	71.86	83%
06/02/20	0.39	62.28	0.46	72.32	84%
07/07/20	0.60	62.88	0.71	73.03	85%
08/05/20	0.49	63.37	0.57	73.61	86%
09/01/20	0.53	63.90	0.62	74.22	85%
10/06/20	0.71	64.61	0.84	75.06	84%
11/03/20	0.53	65.14	0.63	75.69	84%
12/01/20	0.25	65.39	0.31	76.00	82%
01/05/21	0.32	65.71	0.38	76.38	84%
02/02/21	0.44	66.15	0.53	76.91	84%
03/02/21	0.48	66.64	0.58	77.49	83%
04/06/21	0.66	67.29	0.79	78.28	83%
05/04/21	0.56	67.85	0.66	78.94	85%
07/06/21	0.63	68.48	0.72	79.66	87%
08/03/21	0.81	69.29	0.90	80.56	89%
09/08/21	0.98	70.27	1.09	81.66	89%
10/05/21	0.71	70.98	0.82	82.47	87%
11/02/21	0.70	71.67	0.79	83.27	88%
12/08/21	0.81	72.49	0.93	84.20	88%
01/06/22	0.61	73.09	0.70	84.90	87%
02/14/22	0.95	74.04	1.08	85.98	88%
03/21/22	0.93	74.97	1.06	87.03	88%
04/05/22	0.42	75.39	0.48	87.52	88%
05/05/22	0.78	76.17	0.88	88.39	89%
06/07/22	0.93	77.10	1.05	89.44	89%
07/06/22	0.64	77.74	0.73	90.17	88%
08/09/22	0.75	78.49	0.85	91.02	88%
09/06/22	0.60	79.08	0.68	91.70	87%
10/03/22	0.49	79.58	0.57	92.27	87%
11/03/22	0.56	80.14	0.64	92.91	87%
12/07/22	0.40	80.54	0.46	93.38	87%



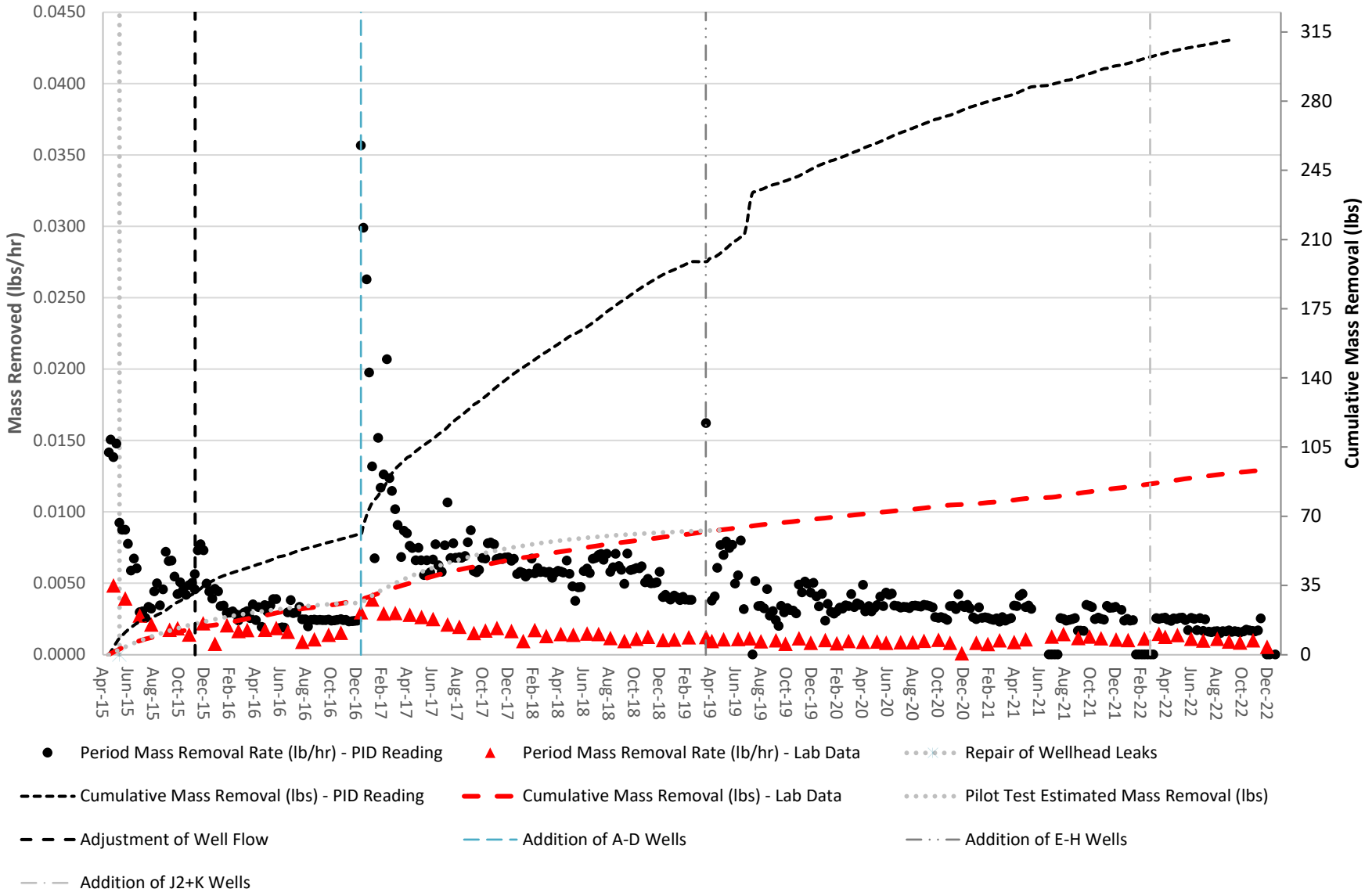
Geosyntec consultants

Cascade Corporation Gresham, Oregon	**SVE Effluent cVOC Vapor Concentration** **TSA Remedy**	Figure C-1



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**SVE Extracted Vapor Flow (Weekly Average)** **TSA Remedy**	Figure C-2



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**SVE System Mass Removal** **TSA Remedy**	Figure C-3

APPENDIX D
Groundwater Elevation Data

Table D-1
Groundwater Elevations - 1 January 2022 through 31 December 2022
East Multnomah County TSA Remedy

TSA Zone	Well ID	Date	Time	Top of Casing Elevation (ft MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft MSL)
Extraction Wells						
Lower	EW-14	1/31/2022	10:04	127.63	152.18	-24.55
Lower	EW-14	5/2/2022	11:18	127.63	153.64	-26.01
Lower	EW-14	8/1/2022	9:54	127.63	152.51	-24.88
Lower	EW-14	11/1/2022	7:46	127.63	148.91	-21.28
Lower	EW-2	1/31/2022	9:58	126.01	149.11	-23.1
Lower	EW-2	5/2/2022	11:10	126.01	146.04	-20.03
Lower	EW-2	8/1/2022	9:48	126.01	148.56	-22.55
Lower	EW-2	11/1/2022	7:40	126.01	138.14	-12.13
Monitoring Wells						
Upper	BOP-13ds	2/3/2022	14:45	128.94	116.35	12.59
Upper	BOP-13ds	2/3/2022	14:45	128.94	116.35	12.59
Upper	BOP-13ds	5/6/2022	11:45	128.94	116.72	12.22
Upper	BOP-13ds	8/2/2022	13:52	128.94	114.15	14.79
Upper	BOP-31ds	2/2/2022	14:17	99.04	84.91	14.13
Upper	BOP-31ds	2/2/2022	14:17	99.04	84.91	14.13
Upper	BOP-31ds	5/6/2022	14:00	99.04	85.22	13.82
Upper	BOP-31ds	8/2/2022	14:32	99.04	83.61	15.43
Upper	BOP-61ds	8/2/2022	15:30	94.64	81.46	13.18
Upper	BOP-66ds	8/2/2022	15:17	102.97	88.04	14.93
Upper	CMW-10ds	1/31/2022	12:02	134.54	122.89	11.65
Upper	CMW-10ds	5/2/2022	10:15	134.54	121.78	12.76
Upper	CMW-10ds	8/1/2022	15:49	134.54	120.28	14.26
Upper	CMW-10ds	11/1/2022	14:26	134.54	120.64	13.9
Upper	CMW-17ds	1/31/2022	14:00	121.89	103.02	18.87
Upper	CMW-17ds	5/2/2022	10:42	121.89	101.61	20.28
Upper	CMW-17ds	8/1/2022	17:10	121.89	100.64	21.25
Upper	CMW-17ds	11/1/2022	11:14	121.89	100.12	21.77
Upper	CMW-18ds	1/31/2022	11:54	117.66	103.68	13.98
Upper	CMW-18ds	5/2/2022	10:32	117.66	102.38	15.28
Upper	CMW-18ds	8/1/2022	12:28	117.66	101.31	16.35
Upper	CMW-18ds	11/1/2022	14:04	117.66	100.62	17.04
Upper	CMW-19ds	1/31/2022	12:08	144.08	129.56	14.52
Upper	CMW-19ds	5/2/2022	9:50	144.08	128.33	15.75
Upper	CMW-19ds	8/1/2022	15:25	144.08	127.31	16.77
Upper	CMW-19ds	11/1/2022	14:14	144.08	127.42	16.66
Upper	CMW-20ds	1/31/2022	12:31	152.72	138.98	13.74
Upper	CMW-20ds	8/1/2022	15:00	152.72	136.88	15.84
Lower	BOP-13dg	2/3/2022	14:47	128.71	116.03	12.68
Lower	BOP-13dg	2/3/2022	14:47	128.71	116.03	12.68
Lower	BOP-13dg	5/6/2022	11:50	128.71	116.03	12.68
Lower	BOP-13dg	8/2/2022	13:50	128.71	113.90	14.81
Lower	BOP-20dg	8/2/2022	9:41	77.32	62.11	15.21
Lower	BOP-31dg	2/2/2022	14:18	98.51	84.35	14.16
Lower	BOP-31dg	2/2/2022	14:18	98.51	84.35	14.16
Lower	BOP-31dg	5/6/2022	14:03	98.51	84.40	14.11
Lower	BOP-31dg	8/2/2022	14:31	98.51	83.17	15.34
Lower	BOP-61dg	8/2/2022	15:33	94.43	81.52	12.91
Lower	CMW-14Rds	1/31/2022	12:34	83.48	60.21	23.27

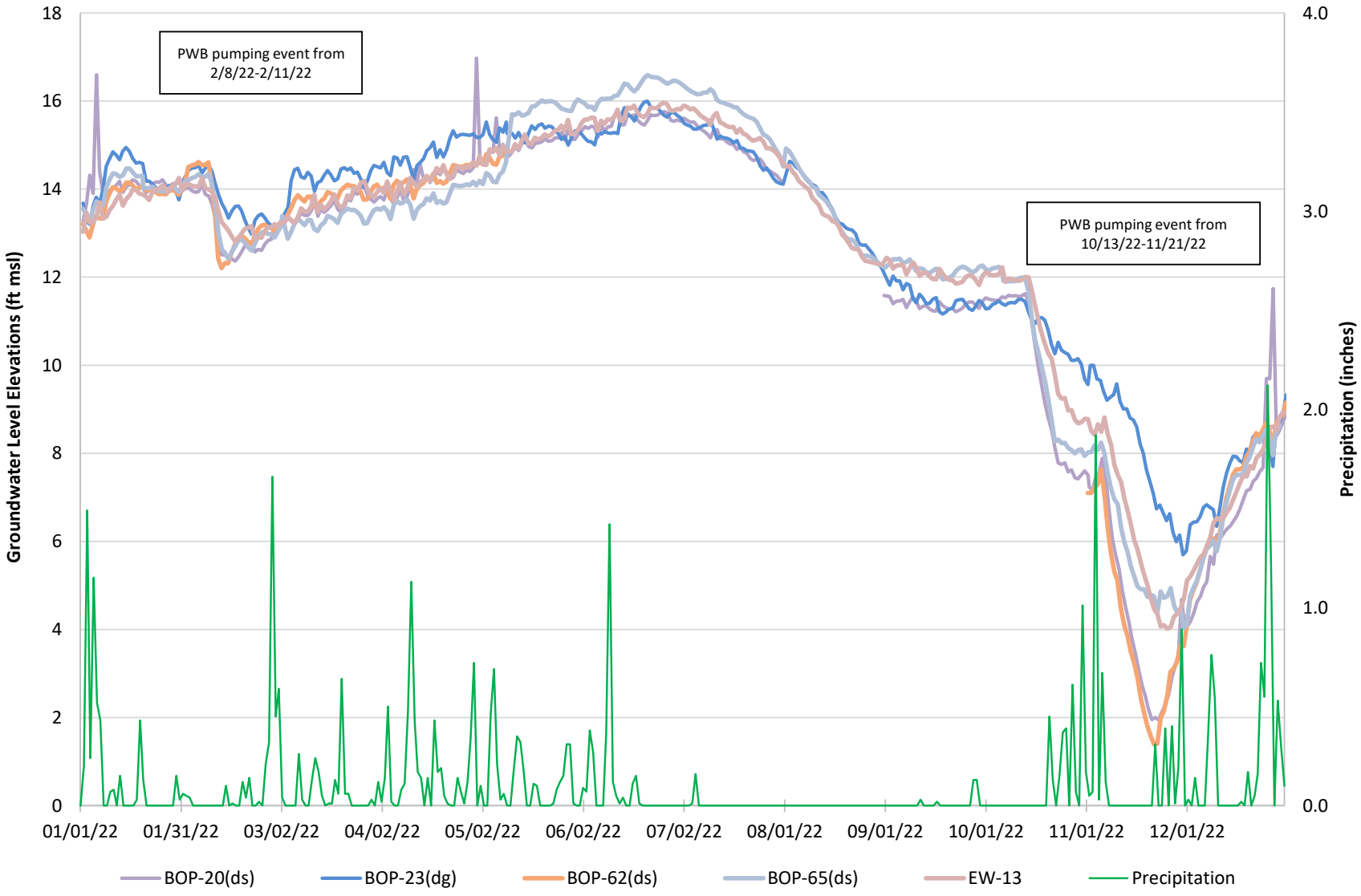
Table D-1
Groundwater Elevations - 1 January 2022 through 31 December 2022
East Multnomah County TSA Remedy

TSA Zone	Well ID	Date	Time	Top of Casing Elevation (ft MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft MSL)
Lower	CMW-14Rds	8/1/2022	12:42	83.48	59.34	24.14
Lower	CMW-22dg	1/31/2022	12:37	81.65	63.46	18.19
Lower	CMW-22dg	8/1/2022	12:52	81.65	62.16	19.49
Lower	CMW-24dg (EW-5)	1/31/2022	13:06	77.74	61.54	16.2
Lower	CMW-24dg (EW-5)	8/1/2022	16:22	77.74	59.28	18.46
Lower	CMW-25dg	1/31/2022	12:59	75.28	59.98	15.3
Lower	CMW-25dg	8/1/2022	13:53	75.28	58.57	16.71
Lower	D-17dg	1/31/2022	11:16	124.61	114.26	10.35
Lower	D-17dg	5/2/2022	11:50	124.61	111.29	13.32
Lower	D-17dg	8/1/2022	11:20	124.61	110.15	14.46
Lower	D-17dg	11/1/2022	11:26	124.61	111.64	12.97
Lower	D-17ds	1/31/2022	11:18	123.28	111.63	11.65
Lower	D-17ds	5/2/2022	11:45	123.28	109.84	13.44
Lower	D-17ds	8/1/2022	11:18	123.28	108.57	14.71
Lower	D-17ds	11/1/2022	11:22	123.28	109.73	13.55
Lower	EW-1	1/31/2022	8:50	124.04	110.34	13.7
Lower	EW-1	5/2/2022	11:29	124.04	108.88	15.16
Lower	EW-1	8/1/2022	10:22	124.04	108.22	15.82
Lower	EW-1	11/1/2022	11:31	124.04	110.75	13.29
Lower	EW-11	8/1/2022	13:36	114.73	93.92	20.81
Lower	EW-12	1/31/2022	9:04	94.14	82.71	11.43
Lower	EW-12	5/2/2022	11:37	94.14	79.15	14.99
Lower	EW-12	8/1/2022	10:26	94.14	78.48	15.66
Lower	EW-16	1/31/2022	12:53	83.71	63.73	19.98
Lower	EW-16	8/1/2022	13:00	83.71	61.52	22.19
Lower	EW-23	1/31/2022	13:24	83.93	70.02	13.91
Lower	EW-23	5/2/2022	13:44	83.93	69.35	14.58
Lower	EW-23	8/1/2022	14:30	83.93	69.71	14.22
Lower	EW-23	11/1/2022	14:30	83.93	75.41	8.52
Vapor Monitoring Wells						
Upper	VMW-A	1/31/2022	10:34	123.34	104.04	19.3
Upper	VMW-A	5/2/2022	12:19	123.34	103.61	19.73
Upper	VMW-A	8/1/2022	12:03	123.34	102.58	20.76
Upper	VMW-A	11/1/2022	13:04	123.34	102.08	21.26
Upper	VMW-B	1/31/2022	11:04	123.25	100.74	22.51
Upper	VMW-B	5/2/2022	12:39	123.25	101.65	21.6
Upper	VMW-B	8/1/2022	12:22	123.25	101.56	21.69
Upper	VMW-B	11/1/2022	11:50	123.25	101.31	21.94
Upper	VMW-C	1/31/2022	10:30	124.17	104.33	19.84
Upper	VMW-C	5/2/2022	12:09	124.17	103.44	20.73
Upper	VMW-C	8/1/2022	11:56	124.17	102.19	21.98
Upper	VMW-C	11/1/2022	12:54	124.17	101.94	22.23
Upper	VMW-D	1/31/2022	10:56	126.78	106.58	20.2
Upper	VMW-D	5/2/2022	12:32	126.78	106.33	20.45
Upper	VMW-D	8/1/2022	12:16	126.78	104.92	21.86
Upper	VMW-D	11/1/2022	11:56	126.78	104.81	21.97
Upper	VMW-E	A	A	132.39	A	A
Upper	VMW-F	A	A	127.51	A	A
Upper	VMW-G	A	A	123.14	A	A

Table D-1
Groundwater Elevations - 1 January 2022 through 31 December 2022
East Multnomah County TSA Remedy

TSA Zone	Well ID	Date	Time	Top of Casing Elevation (ft MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft MSL)
Upper	VMW-H	1/31/2022	10:12	126.88	104.09	22.79
Upper	VMW-H	5/2/2022	11:57	126.88	102.29	24.59
Upper	VMW-H	8/1/2022	11:48	126.88	100.02	26.86
Upper	VMW-H	11/1/2022	12:21	126.88	101.56	25.32
Upper	VMW-I	1/31/2022	10:42	131.98	122.97	9.01
Upper	VMW-I	5/2/2022	12:27	131.98	120.22	11.76
Upper	VMW-I	8/1/2022	12:19	131.98	118.74	13.24
Upper	VMW-I	11/1/2022	12:00	131.98	114.15	17.83
Upper	VMW-J2	1/31/2022	10:37	130.12	112.71	17.41
Upper	VMW-J2	5/2/2022	12:14	130.12	111.38	18.74
Upper	VMW-J2	8/1/2022	11:58	130.12	110.14	19.98
Upper	VMW-J2	11/1/2022	12:06	130.12	109.54	20.58
Upper	VMW-K	1/31/2022	10:25	129.80	108.02	21.78
Upper	VMW-K	5/2/2022	12:05	129.80	106.47	23.33
Upper	VMW-K	8/1/2022	11:53	129.80	105.38	24.42
Upper	VMW-K	11/1/2022	12:15	129.80	104.93	24.87
Upper	VMW-L	1/31/2022	10:20	115.23	93.08	22.15
Upper	VMW-L	5/2/2022	12:00	115.23	91.04	24.19
Upper	VMW-L	8/1/2022	11:44	115.23	89.31	25.92
Upper	VMW-L	11/1/2022	12:46	115.23	90.34	24.89
Upper	VMW-M	1/31/2022	11:10	114.72	91.99	22.73
Upper	VMW-M	5/2/2022	12:21	114.72	89.87	24.85
Upper	VMW-M	8/1/2022	12:08	114.72	88.44	26.28
Upper	VMW-M	11/1/2022	13:14	114.72	89.02	25.7
Upper	VMW-N	1/31/2022	11:07	115.77	92.67	23.1
Upper	VMW-N	5/2/2022	12:44	115.77	91.25	24.52
Upper	VMW-N	8/1/2022	12:13	115.77	89.98	25.79
Upper	VMW-N	11/1/2022	13:22	115.77	90.52	25.25

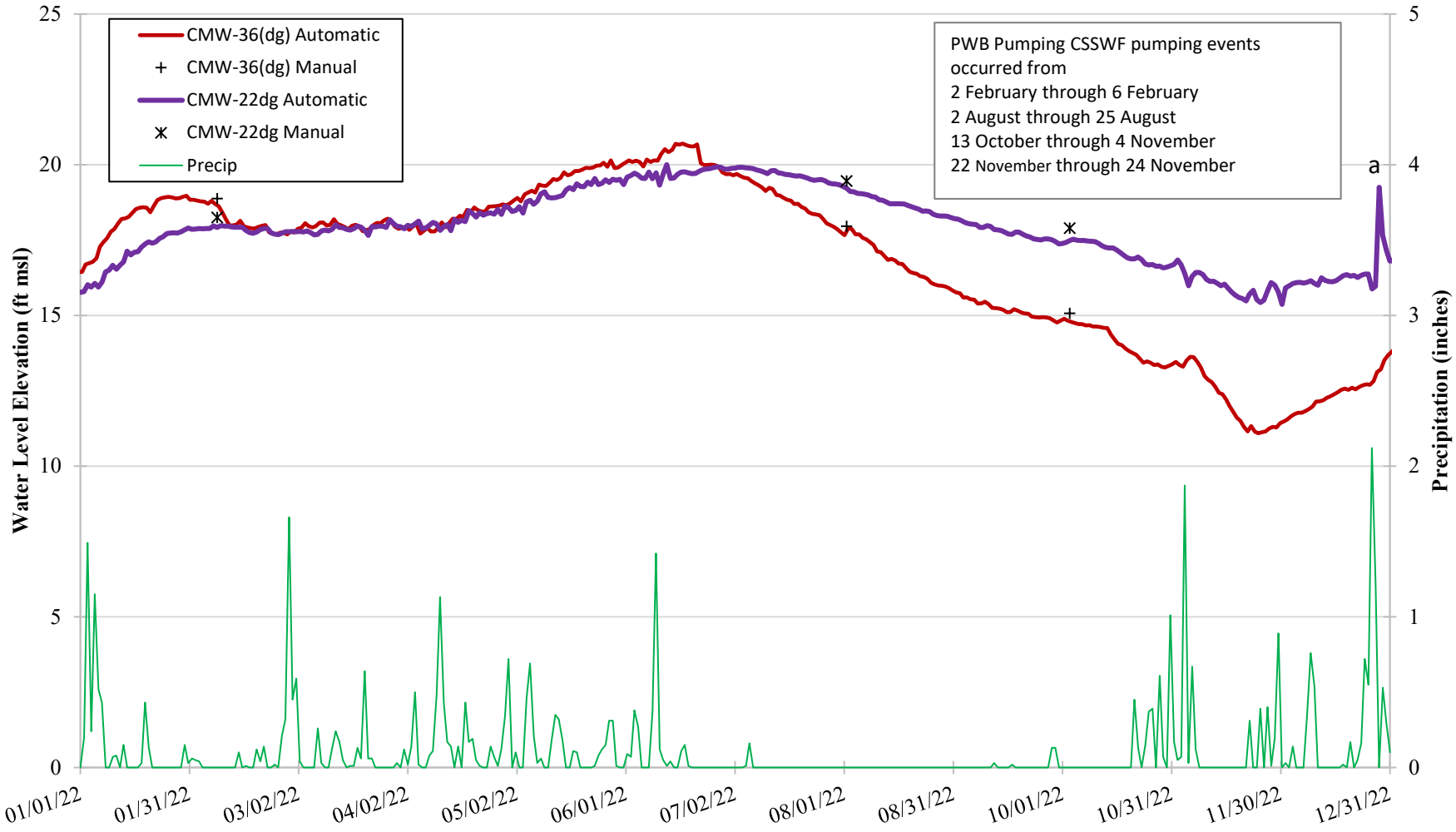
Notes:
ft MSL = feet above mean sea level
TOC = top of casing
A - Wells VMW-E, VMW-F, and VMW-G are angled wells and depth to water cannot be measured manually.



Notes:
BOP-20(ds) datalogger malfunction from 8/2-8/31. No data for this time period.
BOP-62(ds) datalogger malfunciton from 5/11-10/31. No data for this time period.

East Multnomah County Cleanup	**Hydrographs for TSA Zone B Wells 1 January 2022 through 31 December 2022**	Figure **D-1**

LANDAU ASSOCIATES



Notes:
a) The water level in CMW-22(dg) rapidly increased by 3.3 ft between 27 and 28 December 2022. This water level increase is not representative of the aquifer. The well is located in a parking lot that most likely flooded during a storm event when 3.3 inches of rain fell between 26 and 27 December 2022. It is suspected that the well cap did not seal and resulted in stormwater flow into the well. After the rainfall stopped, the water level reocovered to pre-storm levels over the course of a week. The well cap will be inspected and replaced if necessary.

Geosyntec consultants

Cascade Corporation Gresham, Oregon	**Hydrograph for Zone A TSA Wells** **1 January 2022 throgh December 2022**	Figure D-2

APPENDIX E
Groundwater Quality Data

Table E-1
Groundwater Analytical Results
1 January 2022 through 31 December 2022
East Multnomah County TSA Remedy

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride	Duplicate sample
System Influent/Effluent									
Lower	TS-C-Eff	TS-C-EFF-020122	2/1/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Eff	TS-C-EFF-020122-DUP	2/1/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	Yes
Lower	TS-C-Eff	TS-C-EFF-050322	5/3/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Eff	TS-C-EFF-050322-DUP	5/3/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	Yes
Lower	TS-C-Eff	TS-C-EFF-080222	8/2/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Eff	TS-C-EFF-080222-DUP	8/2/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	Yes
Lower	TS-C-Eff	TS-C-EFF-110322	11/3/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Eff	TS-C-EFF-110322-DUP	11/3/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	Yes
Lower	TS-C-Inf	TS-C-INF-020122	2/1/2022	**7.35**	0.475 J	**0.852**	< 0.500	< 0.500	
Lower	TS-C-Inf	TS-C-INF-050322	5/3/2022	**4.01**	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Inf	TS-C-INF-080222	8/2/2022	**4.75**	< 0.500	**0.569**	< 0.500	< 0.500	
Lower	TS-C-Inf	TS-C-INF-110322	11/3/2022	**5.48**	< 0.500	**0.629**	< 0.500	< 0.500	
Extraction Wells									
Lower	EW-14	EW14-020122	2/1/2022	**5.68**	< 0.500	**0.696**	< 0.500	< 0.500	
Lower	EW-14	EW14-050322	5/3/2022	5.26 J	< 0.500	**0.673**	< 0.500	< 0.500	
Lower	EW-14	EW14-080222	8/2/2022	**4.51**	< 0.500	**0.654**	< 0.500	< 0.500	
Lower	EW-14	EW14-110322	11/3/2022	**5.91**	< 0.500	**0.824**	< 0.500	< 0.500	
Lower	EW-2	EW2-020122	2/1/2022	**8.02**	**0.585**	**0.725**	< 0.500	< 0.500	
Lower	EW-2	EW2-050322	5/3/2022	8.70 J	**0.61**	**0.739**	< 0.500	< 0.500	
Lower	EW-2	EW2-080222	8/2/2022	**7.36**	**0.652**	**0.783**	< 0.500	< 0.500	
Lower	EW-2	EW2-110322	11/3/2022	**7.11**	**0.612**	**0.704**	< 0.500	< 0.500	
Monitoring Wells									
Upper	BOP-13ds	BOP-13DS;BOP-13DS-0222;20220203	2/3/2022	**2.9**	< 0.20	**0.5**	< 0.20	< 0.20	
Upper	BOP-13ds	BOP-13DS;BOP-Z-0222;20220203	2/3/2022	**2.9**	< 0.20	**0.52**	< 0.20	< 0.20	Yes
Upper	BOP-13ds	BOP-13DS;BOP-13DS-0522;20220506	5/6/2022	**3.2**	< 0.20	**0.41**	< 0.20	< 0.20	
Upper	BOP-13ds	BOP-13DS;BOP-13DS-0822;20220802	8/2/2022	**2.9**	< 0.20	**0.53**	< 0.20	< 0.20	
Upper	BOP-31ds	BOP-31DS;BOP-31DS-0222;20220203	2/3/2022	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	BOP-31ds	BOP-31DS;BOP-31DS-0522;20220506	5/6/2022	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	BOP-31ds	BOP-31DS;BOP-31DS-0822;20220802	8/2/2022	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	
Upper	BOP-61ds	BOP-61DS;BOP-61DS-0822;20220802	8/2/2022	**4.1**	**0.21**	**0.31**	< 0.20 J	< 0.20 J	
Upper	BOP-66ds	BOP-66DS;BOP-66DS-0822;20220802	8/2/2022	**1.1**	< 0.20	< 0.20	< 0.20 J	< 0.20 J	
Upper	CMW-10ds	CMW10DS-020122	2/1/2022	**8.93**	0.332 J	< 0.500	< 0.500	< 0.500	
Upper	CMW-10ds	CMW10DS-020122-DUP	2/1/2022	**8.5**	0.300 J	< 0.500	< 0.500	< 0.500	Yes
Upper	CMW-10ds	CMW10DS-050322	5/3/2022	8.45 J	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-10ds	CMW10DS-050322-DUP	5/3/2022	7.61 J	< 0.500	< 0.500	< 0.500	< 0.500	Yes
Upper	CMW-10ds	CMW10DS-080122	8/1/2022	**5.7**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-10ds	CMW10DS-110322	11/3/2022	**5.87**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-17ds	CMW17DS-020122	2/1/2022	**31.8**	**1.48**	**4.01**	< 0.500	< 0.500	
Upper	CMW-17ds	CMW17DS-050322	5/3/2022	33.4 J	**1.4**	**4.31**	< 0.500	< 0.500	
Upper	CMW-17ds	CMW17DS-080122	8/1/2022	**24.3**	**1.88**	**3.67**	< 0.500	< 0.500	
Upper	CMW-17ds	CMW17DS-080122-DUP	8/1/2022	**24.1**	**1.74**	**3.5**	< 0.500	< 0.500	Yes
Upper	CMW-17ds	CMW17DS-110322	11/3/2022	**4**	< 0.500	**0.57**	< 0.500	< 0.500	
Upper	CMW-17ds	CMW17DS-110322-DUP	11/3/2022	**4.31**	< 0.500	**0.604**	< 0.500	< 0.500	Yes
Upper	CMW-18ds	CMW18DS-020122	2/1/2022	**50.2**	**1.49**	**7.07**	< 0.500	< 0.500	
Upper	CMW-18ds	CMW18DS-050322	5/3/2022	78.5 J	**1.89**	**11.3**	< 0.500	< 0.500	
Upper	CMW-18ds	CMW18DS-080122	8/1/2022	**91.6**	**3.9**	**14.7**	< 0.500	< 0.500	
Upper	CMW-18ds	CMW18DS-080122-DUP	8/1/2022	**88**	**4.23**	**15**	< 0.500	< 0.500	Yes

Table E-1
Groundwater Analytical Results
1 January 2022 through 31 December 2022
East Multnomah County TSA Remedy

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride	Duplicate sample
Upper	CMW-18ds	CMW18DS-110322	11/3/2022	**98.6**	**3.58**	**14.7**	< 0.500	< 0.500	
Upper	CMW-19ds	CMW19DS-020122	2/1/2022	0.419 J	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-19ds	CMW19DS-050322	5/3/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-19ds	CMW19DS-080122	8/1/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-19ds	CMW19DS-110322	11/3/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-20ds	CMW20DS-080122	8/1/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	BOP-13dg	BOP-13DG;BOP-13DG-0222;20220203	2/3/2022	**0.35**	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-13dg	BOP-13DG;BOP-13DG-0522;20220506	5/6/2022	**0.35**	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-13dg	BOP-13DG;BOP-13DG-0822;20220802	8/2/2022	**0.3**	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-13dg	BOP-13DG;BOP-Y-0822;20220802	8/2/2022	**0.26**	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-31dg	BOP-31DG;BOP-31DG-0222;20220203	2/3/2022	**2.8**	**0.4**	**0.24**	< 0.20	< 0.20	
Lower	BOP-31dg	BOP-31DG;BOP-31DG-0522;20220506	5/6/2022	**2.8**	**0.37**	**0.25**	< 0.20	< 0.20	
Lower	BOP-31dg	BOP-31DG;BOP-31DG-0822;20220802	8/2/2022	**1.9**	< 0.20	< 0.20	< 0.20	< 0.20	
Lower	BOP-61dg	BOP-61DG;BOP-61DG-0822;20220802	8/2/2022	**0.68**	< 0.20	< 0.20	< 0.20 J	< 0.20 J	
Lower	CMW-14Rds	CMW14RDS-020122	2/1/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-14Rds	CMW14RDS-080122	8/1/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-24dg (EW-5)	CMW24DG-020122	2/1/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-24dg (EW-5)	CMW24DG-080122	8/1/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-25dg	CMW25DG-020122	2/1/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-25dg	CMW25DG-080122	8/1/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	D-17dg	D17DG-020122	2/1/2022	**4.02**	< 0.500	**0.545**	< 0.500	< 0.500	
Lower	D-17dg	D17(DG)-050322	5/3/2022	18.2 J	**0.503**	**5.32**	< 0.500	< 0.500	
Lower	D-17dg	D17DG-080122	8/1/2022	**2.83**	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	D-17dg	D17DG-110322	11/3/2022	**2.68**	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	D-17ds	D17DS-020122	2/1/2022	**31.5**	**0.728**	**8.52**	< 0.500	< 0.500	
Lower	D-17ds	D17(DS)-050322	5/3/2022	18.2 J	< 0.500	**5.66**	< 0.500	< 0.500	
Lower	D-17ds	D17DS-080122	8/1/2022	**13.7**	**0.561**	**4.48**	< 0.500	< 0.500	
Lower	D-17ds	D17DS-110322	11/3/2022	**28.8**	**0.662**	**8.72**	< 0.500	< 0.500	
Lower	EW-1	EW1-020122	2/1/2022	**1.11**	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-1	EW1-050322	5/3/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-1	EW1-080222	8/2/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-1	EW1-110322	11/3/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-11	EW11-080122	8/1/2022	**1.87**	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-12	EW12-020122	2/1/2022	**2**	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-12	EW12-050322	5/3/2022	1.78 J	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-12	EW12-080122	8/1/2022	**1.69**	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-16	EW16-080122	8/1/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-23	EW23-020122	2/1/2022	**0.586**	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-23	EW23-080122	8/1/2022	**2.16**	< 0.500	< 0.500	< 0.500	< 0.500	
Vapor Monitoring Wells									
Upper	VMW-A	VMWA-020122	2/1/2022	**2.63**	< 0.500	0.221 J	< 0.500	< 0.500	
Upper	VMW-A	VMWA-050422	5/4/2022	2.67 J	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-A	VMWA-080222	8/2/2022	**1.93**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-A	VMWA-110322	11/3/2022	**2.19**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-B	VMWB-020122	2/1/2022	**16.5**	**0.749**	**2.53**	< 0.500	< 0.500	
Upper	VMW-B	VMWB-050422	5/4/2022	14.6 J	**0.537**	**2.25**	< 0.500	< 0.500	
Upper	VMW-B	VMWB-080222	8/2/2022	**12.1**	< 0.500	**2.03**	< 0.500	< 0.500	
Upper	VMW-B	VMWB-110322	11/3/2022	**12.6**	**0.655**	**2.28**	< 0.500	< 0.500	

Table E-1
Groundwater Analytical Results
1 January 2022 through 31 December 2022
East Multnomah County TSA Remedy

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride	Duplicate sample
Upper	VMW-C	VMWC-020122	2/1/2022	**2.71**	< 0.500	0.252 J	< 0.500	< 0.500	
Upper	VMW-C	VMWC-050422	5/4/2022	2.84 J	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-C	VMWC-080222	8/2/2022	**2.06**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-C	VMWC-110322-Water	11/3/2022	**1.52**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-D	VMWD-020122	2/1/2022	**0.519**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-D	VMWD-050422	5/4/2022	0.594 J	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-D	VMWD-080222	8/2/2022	**0.65**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-D	VMWD-110322	11/3/2022	**0.624**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-E	VMWE-020122	2/1/2022	**24.4**	**1.56**	**3.35**	< 0.500	< 0.500	
Upper	VMW-E	VMWE-050422	5/4/2022	25.9 J	**1.56**	**3.31**	< 0.500	< 0.500	
Upper	VMW-E	VMWE-080222	8/2/2022	**17.5**	**1.31**	**1.83**	< 0.500	< 0.500	
Upper	VMW-E	VMWE-110322-Water	11/3/2022	**20.9**	**1.57**	**2.41**	< 0.500	< 0.500	
Upper	VMW-F	VMWF-020122	2/1/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-F	VMWF-050422	5/4/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-F	VMWF-080222	8/2/2022	**10.2**	**0.889**	**1.15**	< 0.500	< 0.500	
Upper	VMW-F	VMWF-110322-Water	11/3/2022	**0.884**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-G	VMWG-020122	2/1/2022	**1.94**	< 0.500	0.151 J	< 0.500	< 0.500	
Upper	VMW-G	VMWG-050422	5/4/2022	1.85 J	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-G	VMWG-080222	8/2/2022	**1.83**	< 0.500	**0.599**	< 0.500	< 0.500	
Upper	VMW-G	VMWG-110322-Water	11/3/2022	**1.41**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-H	VMWH-020122	2/1/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-H	VMWH-050422	5/4/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-H	VMWH-080222	8/2/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-H	VMWH-110322-Water	11/3/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-I	VMWI-020122-143.7	2/1/2022	**35.3**	**1.35**	**2.11**	< 0.500	< 0.500	
Upper	VMW-I	VMWI-050422-143.7	5/4/2022	29.7 J	**1.3**	**1.82**	< 0.500	< 0.500	
Upper	VMW-I	VMWI-080222-143.7	8/2/2022	**32.1**	**1.45**	**2.04**	< 0.500	< 0.500	
Upper	VMW-I	VMWI-110322-143.7	11/3/2022	**35.3**	**1.57**	**2.41**	< 0.500	< 0.500	
Upper	VMW-J2	VMWJ2-020122-120.25	2/1/2022	**40.3**	0.499 J	**6.41**	< 0.500	< 0.500	
Upper	VMW-J2	VMWJ2-020122-120.25-DUP	2/1/2022	**48.2**	0.613 J	**7.04**	< 0.500	< 0.500	Yes
Upper	VMW-J2	VMWJ2-050422-120.25	5/4/2022	**21.8**	**0.761**	**2.08**	< 0.500	< 0.500	
Upper	VMW-J2	VMWJ2-050422-DUP-120.25	5/4/2022	**22.8**	**0.857**	**2.23**	< 0.500	< 0.500	Yes
Upper	VMW-J2	VMWJ2-080222-120.25	8/2/2022	**18**	**0.808**	**1.03**	< 0.500	< 0.500	
Upper	VMW-J2	VMWJ2-110322-120.25	11/3/2022	**3.36**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-K	VMWK-020122-114.25	2/1/2022	**18**	< 0.500	**3.27**	< 0.500	< 0.500	
Upper	VMW-K	VMWK-050422-114.25	5/4/2022	**15.1**	< 0.500	**2.93**	< 0.500	< 0.500	
Upper	VMW-K	VMWK-080222-114.25	8/2/2022	**12.8**	0.507 J	**2.25**	< 0.500	< 0.500	
Upper	VMW-K	VMWK-080222-114.25-DUP	8/2/2022	**12.2**	< 0.500 J	**2.21**	< 0.500	< 0.500	Yes
Upper	VMW-K	VMWK-110322-114.25	11/3/2022	**9.89**	< 0.500	**1.94**	< 0.500	< 0.500	
Upper	VMW-K	VMWK-110322-114.25-DUP	11/3/2022	**9.8**	< 0.500	**1.73**	< 0.500	< 0.500	Yes
Upper	VMW-L	VMWL-020122-103.25	2/1/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-L	VMWL-050422-103.25	5/4/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-L	VMWL-080222-103.25	8/2/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-L	VMWL-110322-103.25	11/3/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-M	VMWM-020122-94	2/1/2022	**5.81**	< 0.500	**0.67**	< 0.500	< 0.500	
Upper	VMW-M	VMWM-050422-94	5/4/2022	**5.11**	< 0.500	**0.597**	< 0.500	< 0.500	
Upper	VMW-M	VMWM-080222-94	8/2/2022	**3.88**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-M	VMWM-110322-94	11/3/2022	**3.33**	< 0.500	< 0.500	< 0.500	< 0.500	

Table E-1
Groundwater Analytical Results
1 January 2022 through 31 December 2022
East Multnomah County TSA Remedy

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride	Duplicate sample
Upper	VMW-N	VMWN-020122-110.8	2/1/2022	**8.78**	**0.743**	**0.926**	< 0.500	< 0.500	
Upper	VMW-N	VMWN-050422-110.8	5/4/2022	**0.785**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-N	VMWN-080222-110.8	8/2/2022	**0.744**	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-N	VMWN-110322-110.8	11/3/2022	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	

Notes:

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

BOP = wells installed by and /or on Boeing Corporation Property

CMW = monitoring wells installed by and/or on Cascade Corporation property.

J=estimated concentration

< = compound not detected above the reporting limit shown.

Bold value indicates detection above method detection limit.

Sample ID with "DUP" indicates duplicate sample.

Sample ID with "U" indicates sample collected from the upper portion of the screened interval.

Sample ID with "L" indicates sample collected from the lower portion of the screened interval.

Samples analyzed using EPA Method 8260 and results shown above have been validated with applicable qualifiers shown.

Data validation reports are provided in Appendix F, and laboratory reports are presented on a disc in Appendix F.

N/A = not applicable

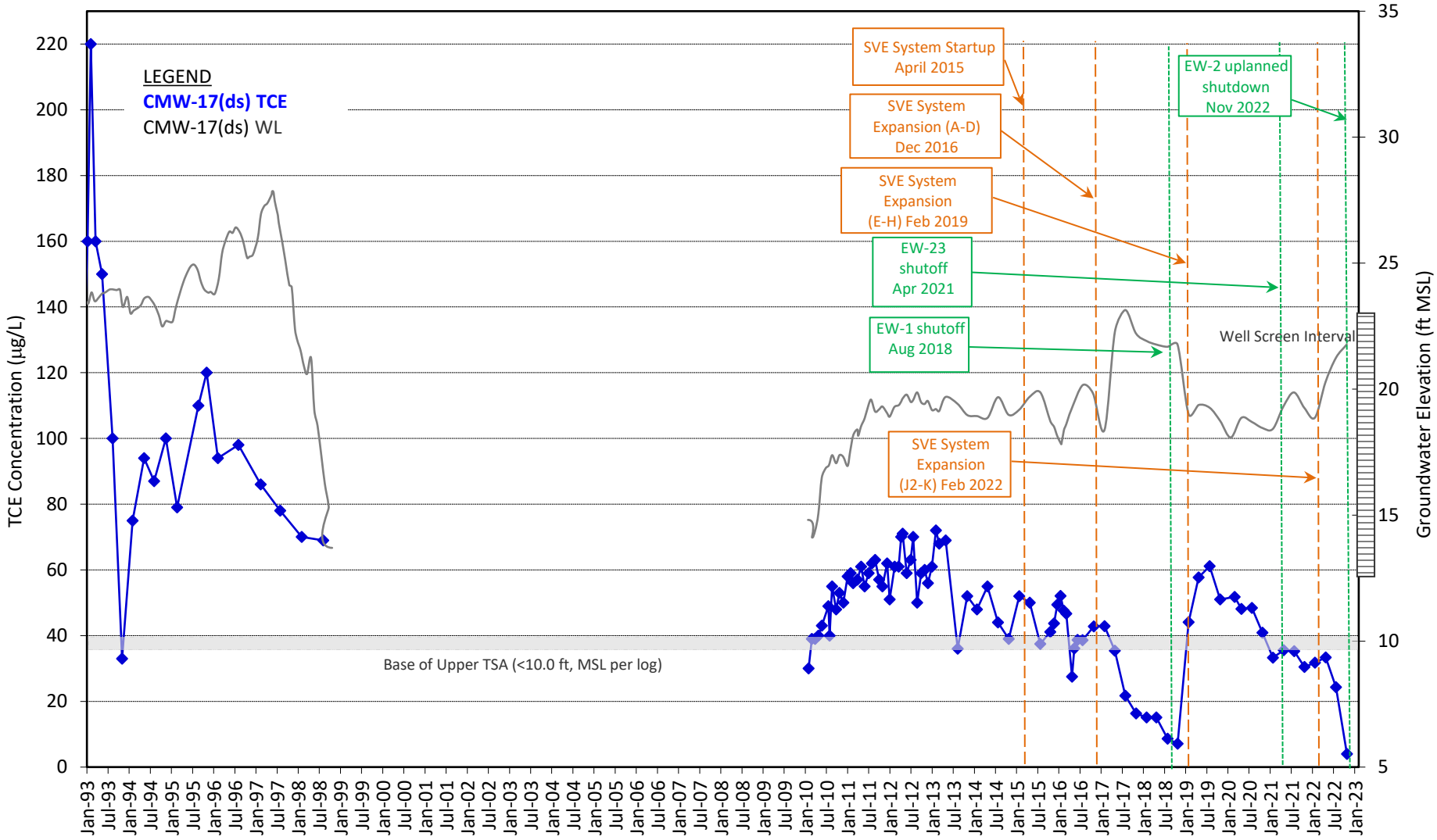
Table E-2
TCE Mass Removal - January 1998 through December 2022
TSA Remedy - East Multnomah County

Date	Pounds of TCE Removed Per Year	Cumulative Pounds of TCE Removed
Jan-98	0.00	0.00
Aug-98	116.00	116.00
Feb-00	110.00	226.00
Feb-01	55.00	281.00
Feb-02	51.20	332.20
Feb-03	32.30	364.50
Feb-08	81.00	445.50
Feb-09	8.10	453.60
Feb-10	6.11	459.71
Feb-11	4.59	464.30
Feb-12	5.48	469.79
Feb-13	7.17	476.96
Dec-13	3.39	480.35
Dec-14	3.46	483.81
Dec-15	2.98	486.80
Dec-16	3.25	490.04
Dec-17	2.53	492.58
Dec-18	2.65	495.23
Dec-19	2.43	497.66
Dec-20	2.52	500.18
Dec-21	1.70	501.88
Dec-22	1.43	503.31

Table E-3
TCE Mass Removal Per Extraction Well
TSA Remedy - East Multnomah County

Date	Pounds of TCE Removed Per Well										
	EW-1	EW-2	EW-3	EW-13	EW-14	EW-15	EW-16	EW-18	EW-22	EW-23	Total
Mar 2008-Feb 2009	1.02	2.03	1.54	0.47	1.69	0.60	0.08	0.13	0.12	0.43	8.10
Mar 2009-Feb 2010	0.68	1.93	1.07	0.20	1.52	0.21	0.04	0.08	0.00	0.38	6.11
Mar 2010-Feb 2011	0.79	1.70			1.41	0.03	0.05			0.61	4.59
Mar 2011-Feb 2012	1.86	1.60			1.58		0.00			0.46	5.48
Mar 2012-Feb 2013	1.72	3.10			1.36		0.22			0.77	7.17
Mar 2013-Dec 2013	0.80	1.34			0.83		0.05			0.37	3.39
2014	0.68	1.41			0.82		0.10			0.44	3.46
2015	0.60	1.22			0.74					0.43	2.98
2016	0.87	1.42			0.70					0.26	3.25
2017	0.67	0.98			0.60					0.28	2.53
2018	0.32	1.45			0.64					0.24	2.65
2019		1.52			0.67					0.24	2.43
2020		1.57			0.72					0.24	2.52
2021		1.15			0.51					0.04	1.70
2022		0.95			0.48						1.43
Total (5 years)	0.32	6.64	0.00	0.00	3.01	0.00	0.00	0.00	0.00	0.76	10.73
Total (10 years)	3.94	13.02	0.00	0.00	6.71	0.00	0.15	0.00	0.00	2.54	26.35

Notes
The amount of TCE removed by the extraction wells in the remedial systems was calculated using the average quarterly flow rates at each extraction well and the TCE concentration from samples collected on a quarterly basis. Note that the mass removal for 2018 was incorrectly reported as 1.28 lbs in the 2018 TSA Annual Report and has been corrected here to 2.65 lbs.



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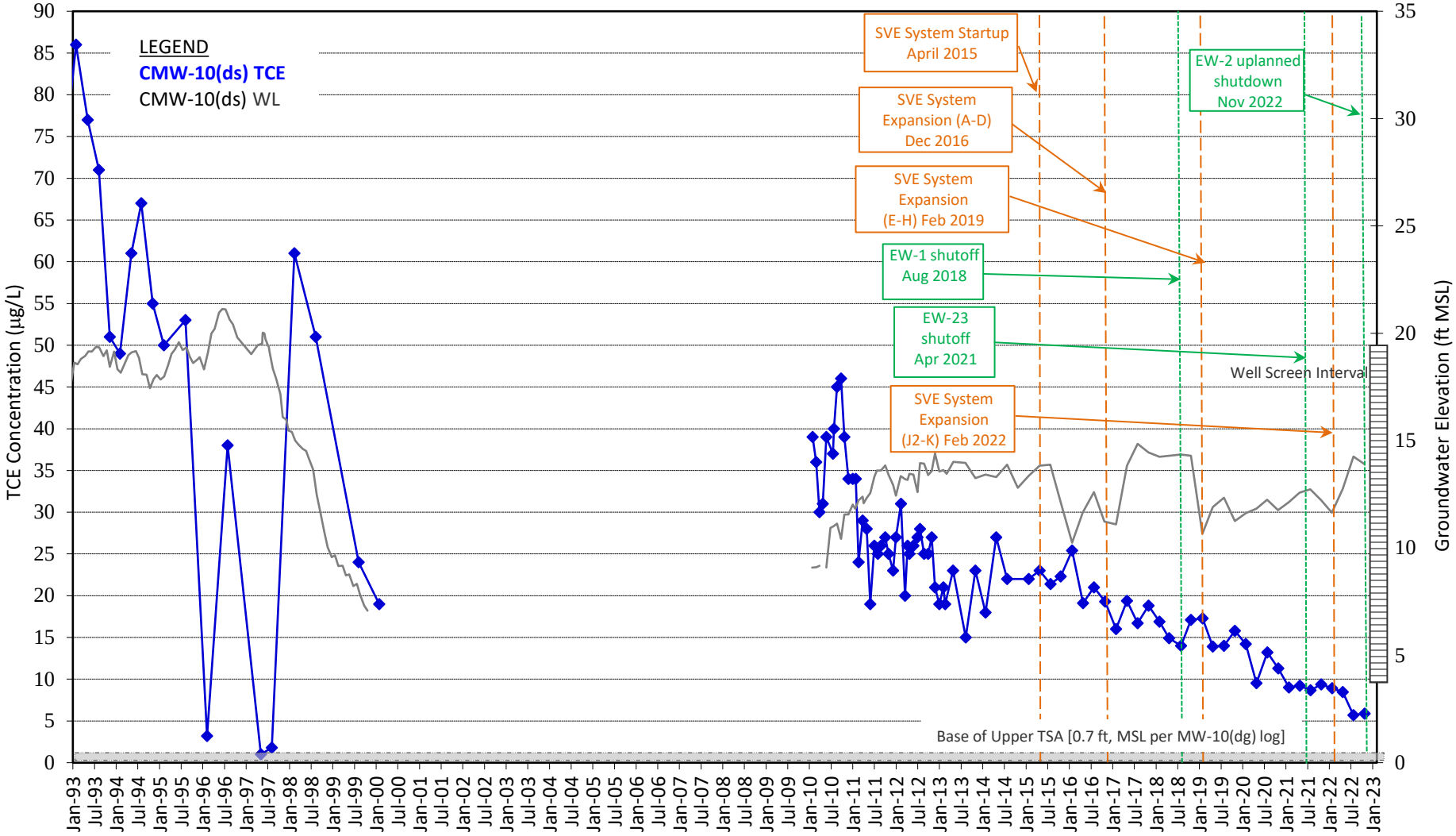
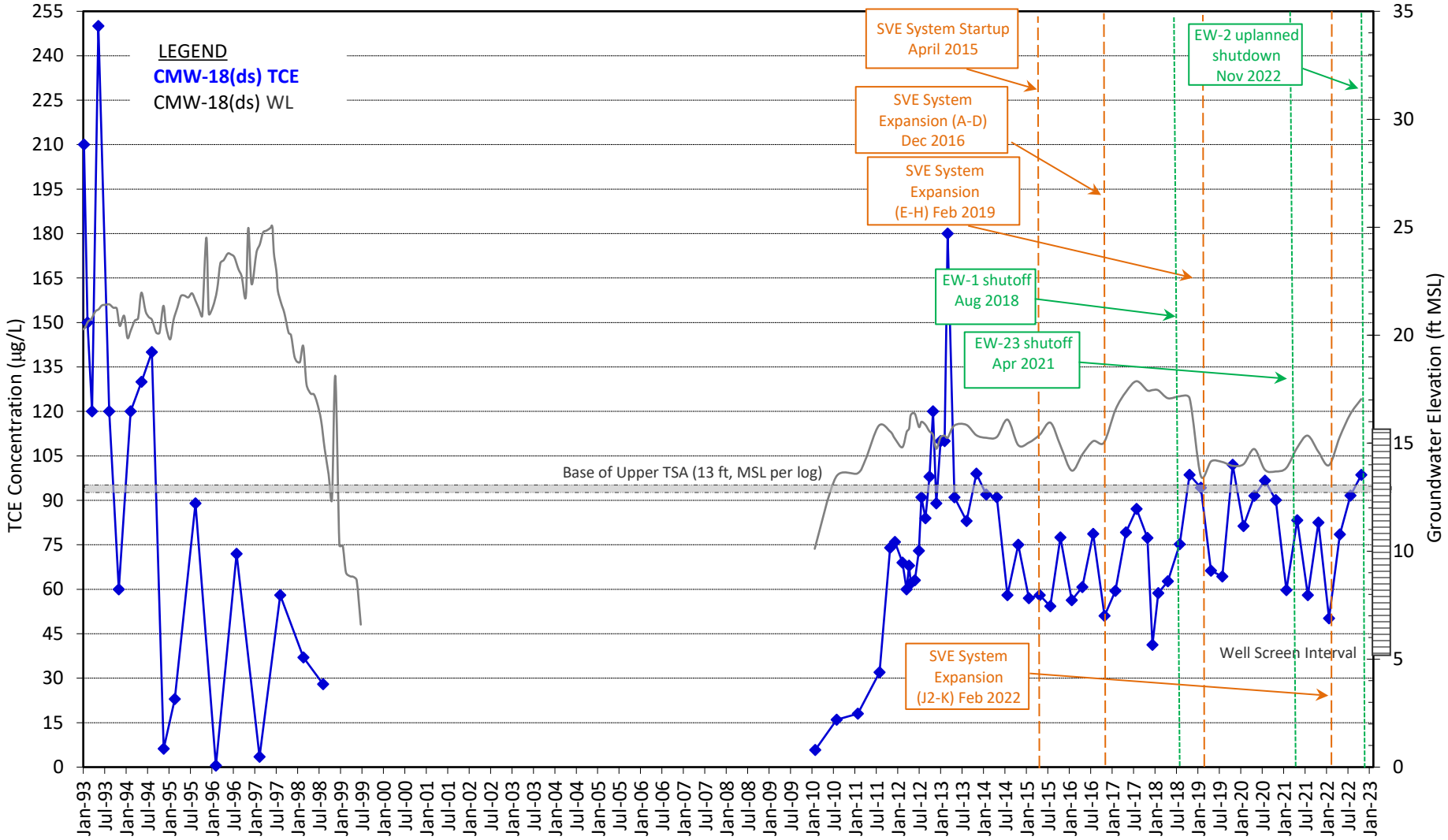
Cascade Corporation Gresham, Oregon	**TCE Concentration Profile CMW-17(ds) TSA Remedy**	Figure E-1



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**TCE Concentration Profile CMW-10(ds)** **TSA Remedy**	Figure E-2



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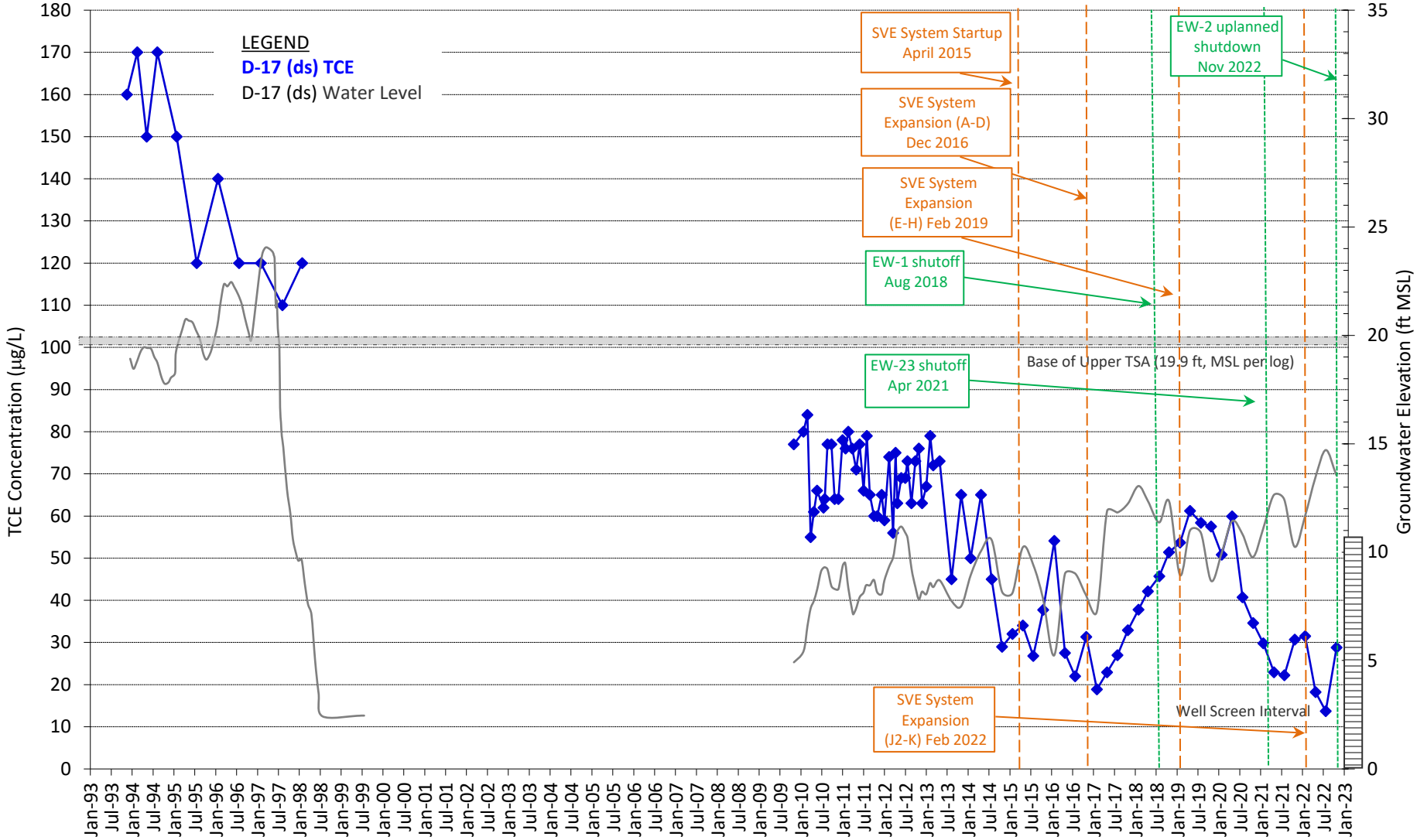
Cascade Corporation Gresham, Oregon	**TCE Concentration Profile CMW-18(ds)** **TSA Remedy**	Figure E-3



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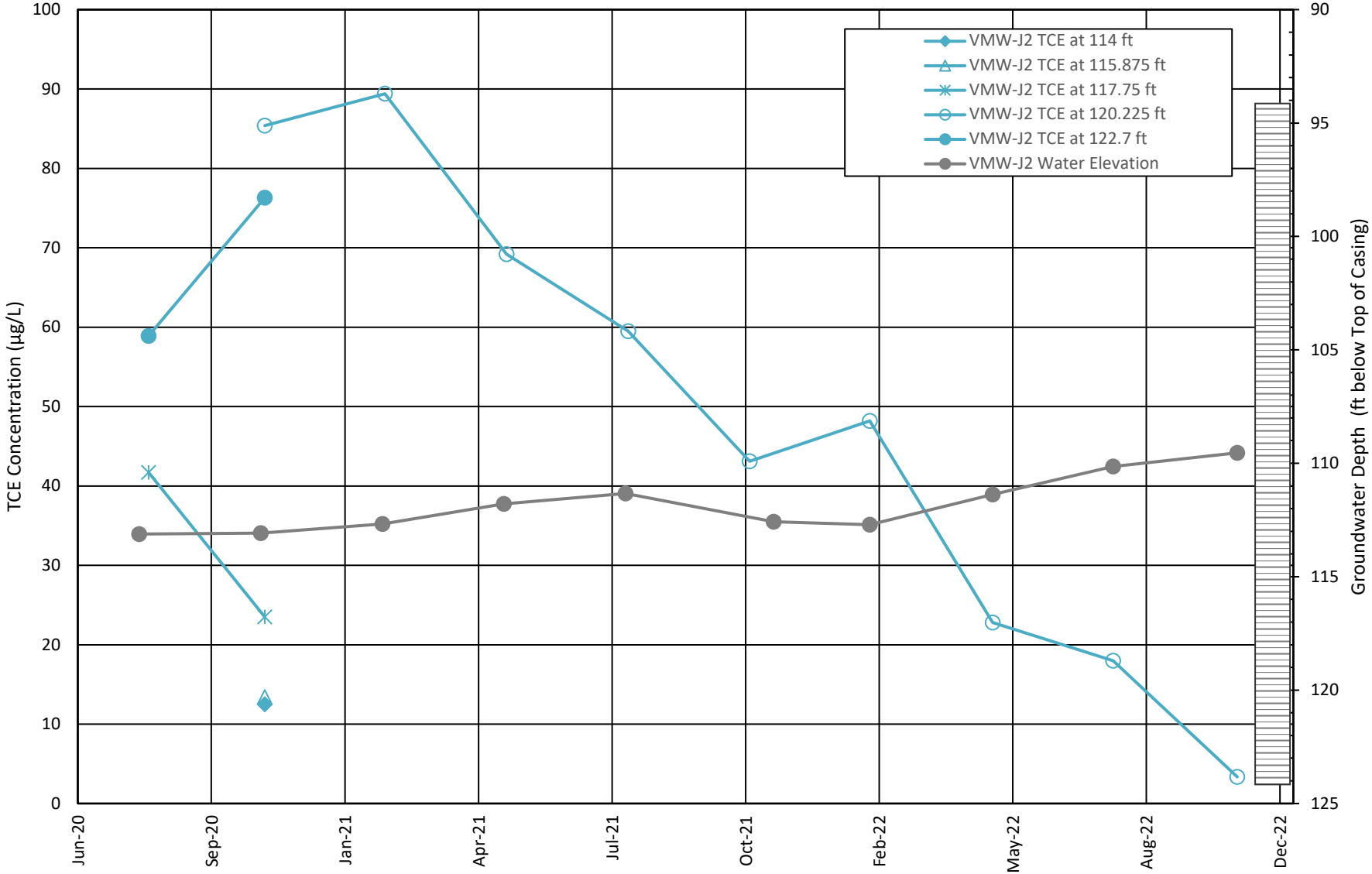
Cascade Corporation Gresham, Oregon	**TCE Concentration Profile D-17(ds)** **TSA Remedy**	Figure E-4



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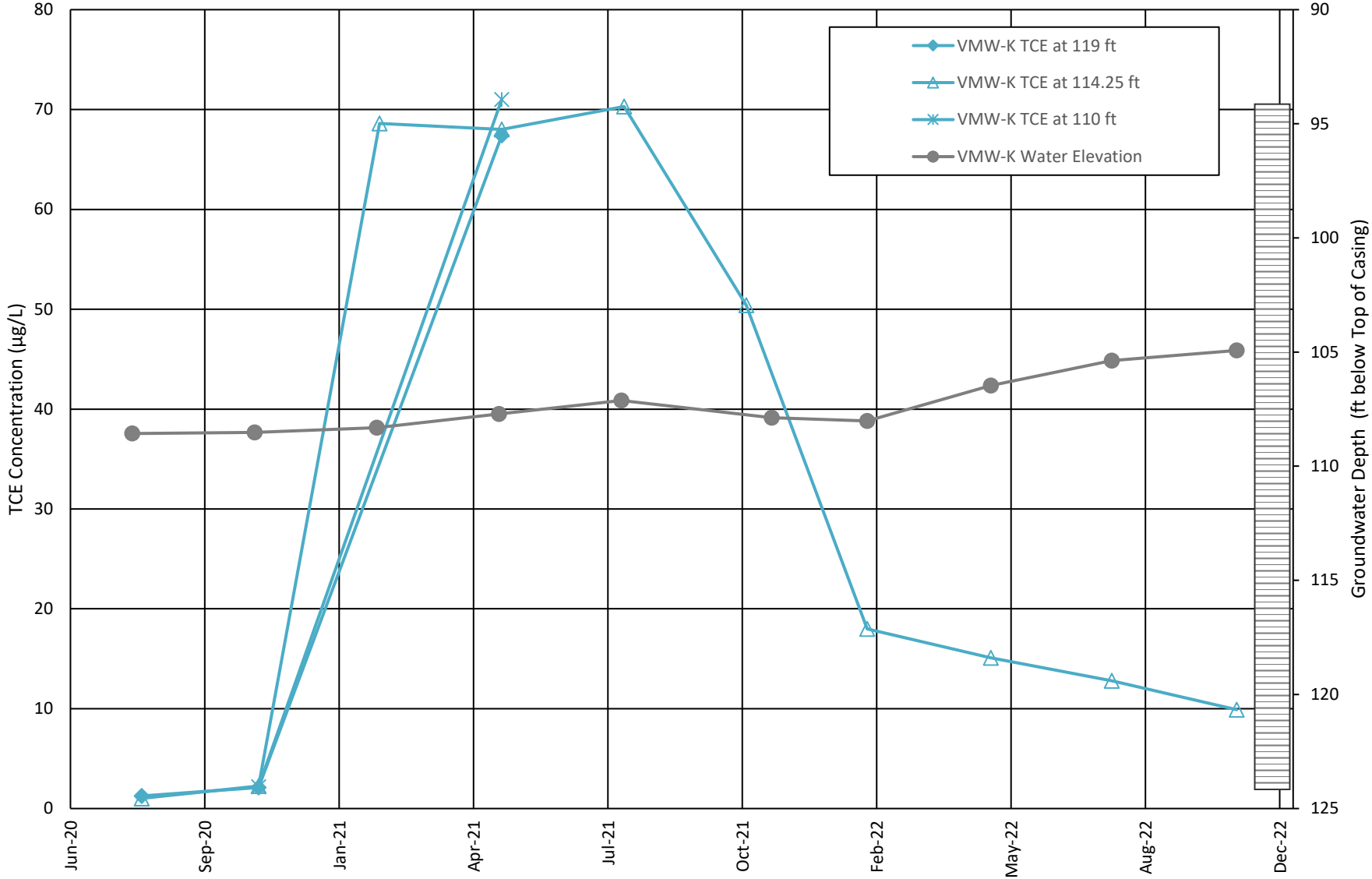
Cascade Corporation Gresham, Oregon	**TCE Concentration Profile VMW-J2** **TSA Remedy**	Figure E-5



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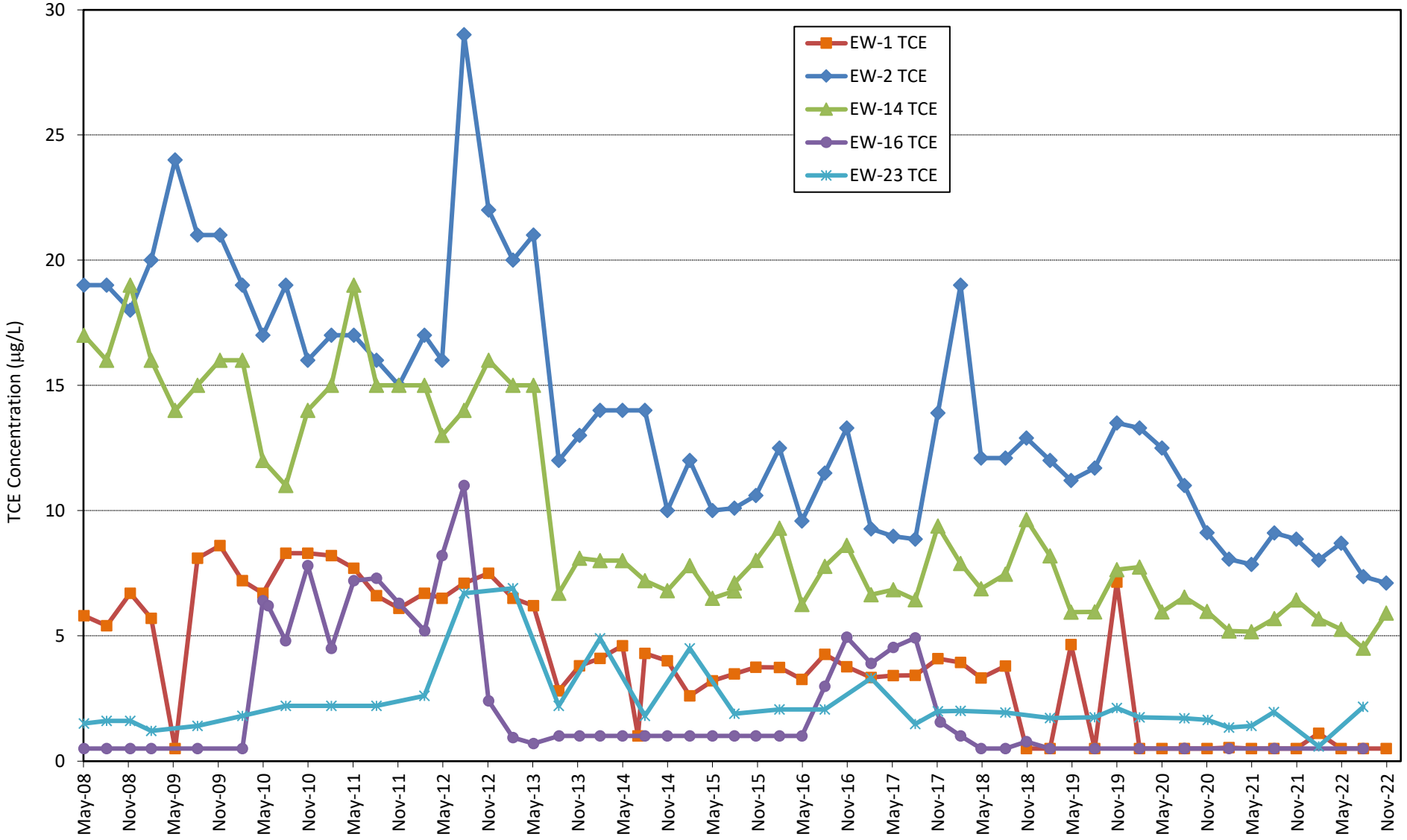
Cascade Corporation Gresham, Oregon	**TCE Concentration Profile VMW-K TSA Remedy**	Figure E-6



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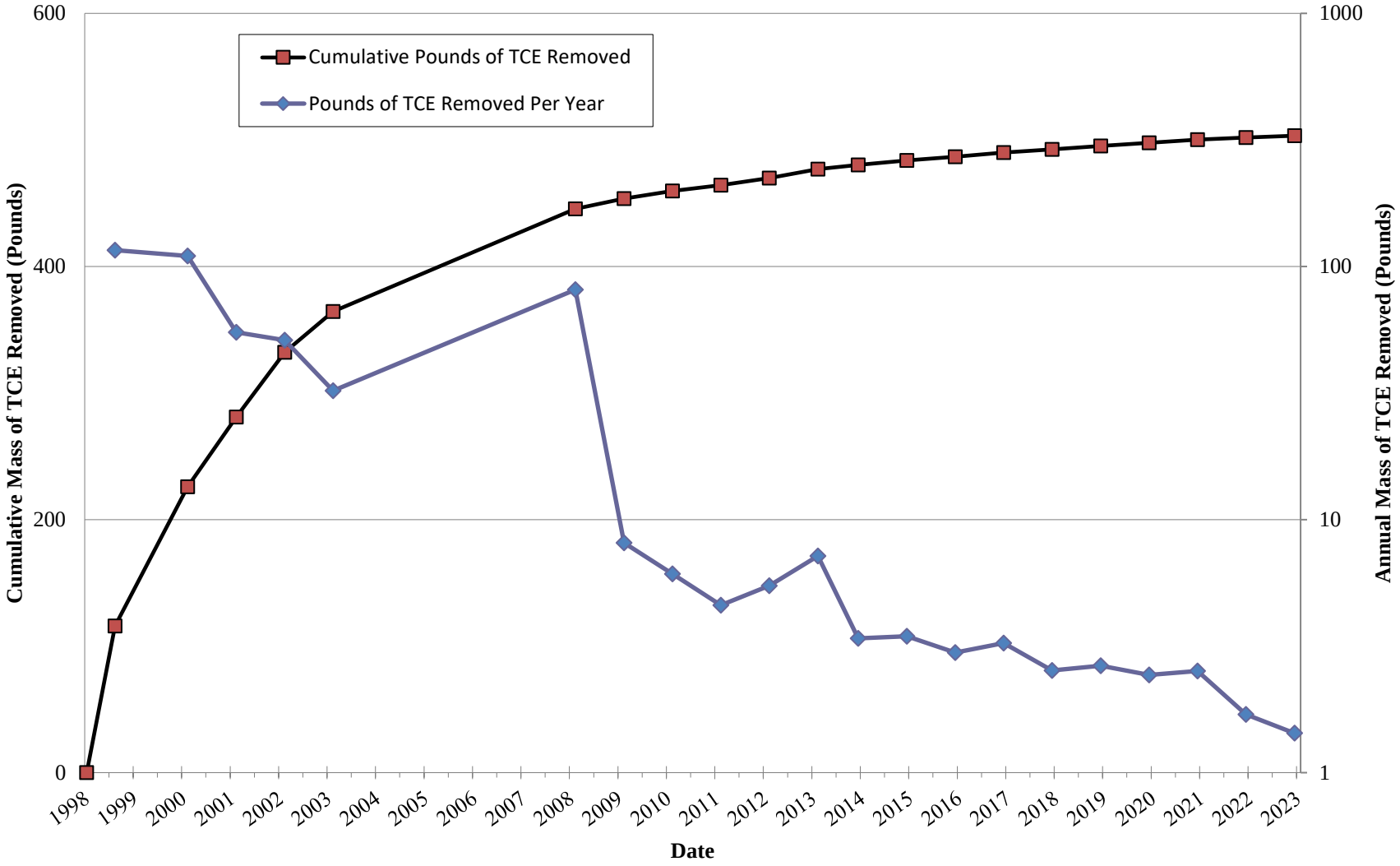
Cascade Corporation Gresham, Oregon	**Extraction Wells** **TCE Concentration Profiles** **TSA Remedy**	Figure E-7



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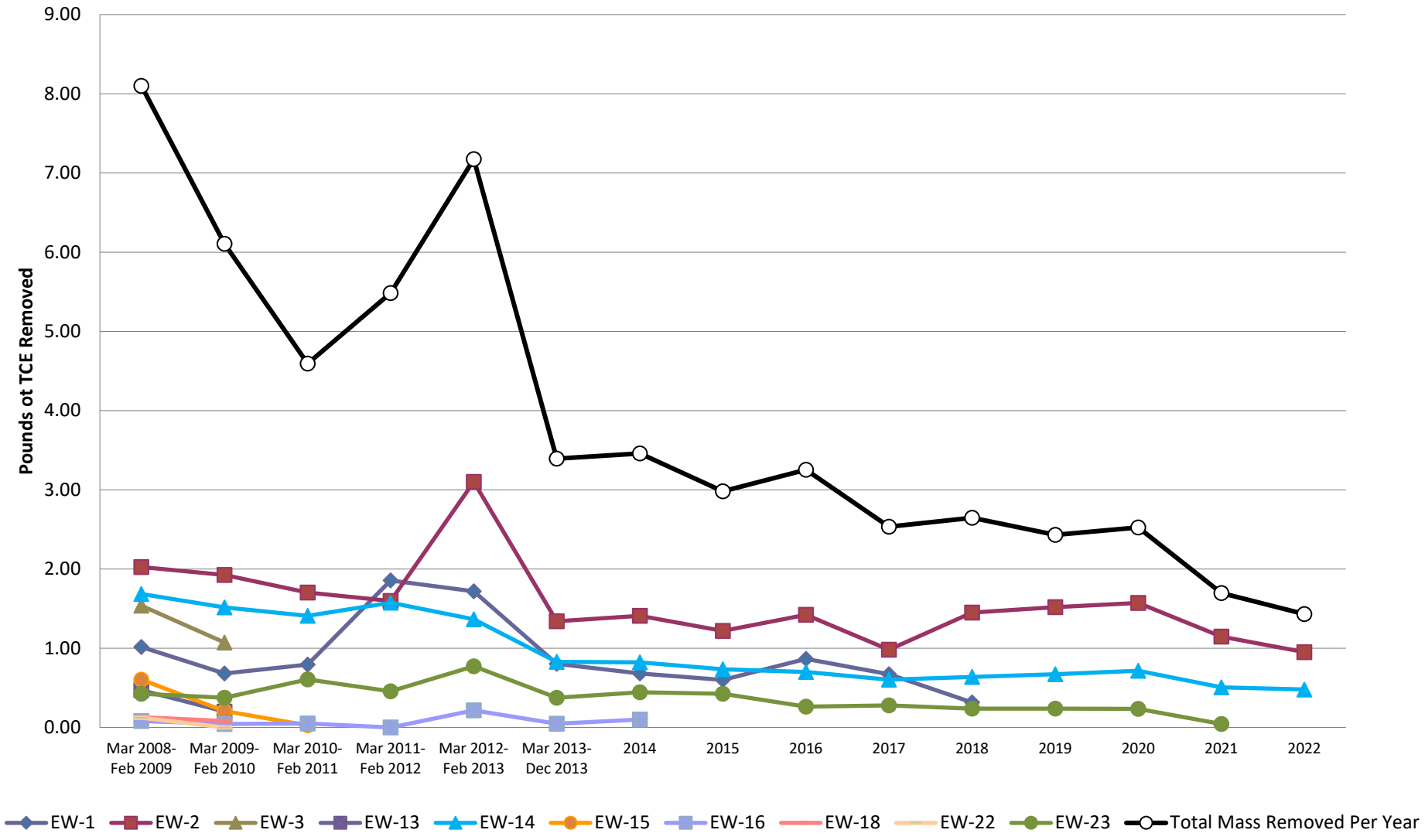
Cascade Corporation Gresham, Oregon	**TCE Mass Removal** **TSA Remedy**	Figure E-8



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Cascade Corporation Gresham, Oregon	**TCE Mass Removal per Extraction Well TSA Remedy**	Figure E-9

APPENDIX F

Data Validation Memoranda, Annual Reporting Period

Data Validation Memoranda

Laboratory Reports (CD)

Historical Data Summary Tables - VOCs and Groundwater Elevations (CD)

Technical Memorandum

TO: Christine Kimmel, Project Manager

FROM: Kristi Schultz and Danille Jorgensen

DATE: March 25, 2022

RE: **Boeing Portland (TSA)**
First Quarter 2022 Groundwater Quality Sampling
Laboratory Data Quality Evaluation

This technical memorandum provides the results of a focused data validation associated with 5 groundwater samples and 1 trip blank collected during the first quarter 2022 TSA water quality sampling event at Boeing Portland. Samples were analyzed by Eurofins Lancaster Laboratories Environmental LLC (ELLE), located in Lancaster, Pennsylvania. This data quality evaluation covers ELLE data package 410-72502-1. Samples submitted to ELLE were analyzed for volatile organic compounds ([VOCs]; US Environmental Protection Agency [EPA] Method SW8260C).

The verification and validation check was conducted with guidance from applicable portions of EPA's *National Functional Guidelines for Organic Data Review* (EPA 2020). Landau Associates performed an EPA-equivalent Level IIa verification and validation check on each laboratory data package, which included the following:

- Verification that the laboratory data package contained all necessary documentation (including chain-of-custody records; identification of samples received by the laboratory; date and time of receipt of the samples at the laboratory; sample conditions upon receipt at the laboratory; date and time of sample analysis; explanation of any significant corrective actions taken by the laboratory during the analytical process; and, if applicable, date of extraction, definition of laboratory data qualifiers, all sample-related quality control data, and quality control acceptance criteria).
- Verification that all requested analyses, special cleanups, and special handling methods were performed.
- Evaluation of sample holding times.
- Evaluation of quality control data compared to acceptance criteria, including method blanks, surrogate recoveries, matrix spike results, laboratory duplicate and/or replicate results, and laboratory control sample results.
- Evaluation of overall data quality and completeness of analytical data.

Data validation qualifiers are added to the sample results, as appropriate, based on the verification and validation check. The absence of a data qualifier indicates that the reported result is acceptable without qualification. The data quality evaluation is summarized below. All data was found to be acceptable with no qualifications.

Chain-of-Custody Records

A signed chain-of-custody (COC) record was attached to the data packages. The laboratory received all samples in good condition. All analyses were performed as requested. No special cleanups or handling methods were requested.

Upon receipt by ELLE, the sample container information was compared to the associated chain-of-custody and the cooler temperatures were recorded. The coolers were received with temperatures within the EPA-recommended limit of ≤6°C. No qualification of the data was necessary.

Holding Times

For all analyses and all samples, the time between sample collection, extraction (if applicable), and analysis was determined to be within EPA- and project-specified holding times. No qualification of the data was necessary.

Blank Results

Laboratory Method Blanks

At least one method blank was analyzed with each batch of samples for VOCs analysis. Target analytes were not detected at concentrations greater than the reporting limits in the associated method blanks. No qualification of the data was necessary.

Field Trip Blanks and Field Equipment Blanks

One trip blank was submitted to the laboratory for VOC analysis with each sample batch. Target analytes were not detected at concentrations greater than the reporting limits in the associated trip blanks. No qualification of the data was necessary.

No field equipment blanks were submitted for analysis with this sample batch.

Surrogate Recoveries

Appropriate compounds were used as surrogate spikes for the VOCs analysis. Recovery values for the surrogate spikes were within the current laboratory-specified control limits. No qualification of the data was necessary.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) and Laboratory Replicate Results

No matrix spikes were analyzed with this sample batch. No qualification of the data was determined necessary.

Laboratory Control Sample and Laboratory Control Sample Duplicate (LCS/LCSD) Results

At least one laboratory control sample and/or laboratory control sample duplicate (LCS/LCSD) was analyzed with each batch of samples for VOCs analysis. Recoveries and RPDs for the laboratory control

samples and associated duplicates were within the current laboratory-specified control limits, with the following exceptions:

- The LCS/LCSD recoveries for carbon disulfide and vinyl acetate associated with analytical batch 410-224195 were greater than the laboratory-specified control limits. The affected compounds were not detected at concentrations greater than the reporting limits in the associated samples. No qualification of the data was necessary.

Blind Field Duplicate Results

As specified in the QAPP, blind field duplicate samples were collected at a rate of one blind field duplicate sample per 20 samples, but not less than one blind field duplicate per sampling round. One pair of blind field duplicate water samples (BOP-Z-0222/BOP-13ds-0222) was submitted for analysis with data package 410-72502-1.

A project-specified control limit of 20 percent was used to evaluate the RPDs between the duplicate samples except when the sample results were within five times the reporting limit. In these cases, a project-specified control limit of plus or minus the reporting limit was used. RPDs for the duplicate sample pairs submitted for analysis were within the project-specified control limits. No qualification of the data was necessary.

Quantitation Limits

Project-specified quantitation limits were met for all samples except for instances where high concentrations required dilution of the sample extracts.

Audit/Corrective Action Records

No audits were performed or required. No corrective action records were generated for this sample batch. Based on the laboratory's case narratives, continuing calibration verification (CCV) recovery results were within laboratory-specified control limits, with the following exceptions:

- The CCV recoveries associated with batch 410-224195 were high for bromoform; trans-1,3-dichloropropene; and vinyl acetate. The affected compounds were not detected at concentrations greater than the laboratory reporting limits in the associated samples. No qualification of the data was necessary.

Completeness and Overall Data Quality

The completeness for this data set is 100 percent, which meets the project-specified goal of 90 percent minimum.

Data precision was evaluated through laboratory control sample duplicates. Data accuracy was evaluated through laboratory control samples and surrogate spikes. No data were rejected.

LANDAU ASSOCIATES, INC.

Kristi Schultz
Data Specialist

Danille Jorgensen
Environmental Data Manager

DRJ/kes
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References

EPA. 2020. National Functional Guidelines for Organic Superfund Methods Data Review. OLEM 9240.0-51; EPA-540-R-20-005. US Environmental Protection Agency. November. https://www.epa.gov/sites/default/files/2021-03/documents/nfg_for_organic_superfund_methods_data_review_november_2020.pdf.

Technical Memorandum

TO: Christine Kimmel, Project Manager

FROM: Kristi Schultz and Danille Jorgensen

DATE: June 7, 2022

RE: **Boeing Portland (TSA)**
Second Quarter 2022 Groundwater Quality Sampling
Laboratory Data Quality Evaluation

This technical memorandum provides the results of a focused data validation associated with 4 groundwater samples and 1 trip blank collected during the second quarter 2022 TSA water quality sampling event at Boeing Portland. Samples were analyzed by Eurofins Lancaster Laboratories Environmental LLC (ELLE), located in Lancaster, Pennsylvania. This data quality evaluation covers ELLE data package 410-83699-1. Samples submitted to ELLE were analyzed for volatile organic compounds ([VOCs]; US Environmental Protection Agency [EPA] Method SW8260C).

The verification and validation check was conducted with guidance from applicable portions of EPA's *National Functional Guidelines for Organic Data Review* (EPA 2020). Landau Associates performed an EPA-equivalent Level IIa verification and validation check on each laboratory data package, which included the following:

- Verification that the laboratory data package contained all necessary documentation (including chain-of-custody records; identification of samples received by the laboratory; date and time of receipt of the samples at the laboratory; sample conditions upon receipt at the laboratory; date and time of sample analysis; explanation of any significant corrective actions taken by the laboratory during the analytical process; and, if applicable, date of extraction, definition of laboratory data qualifiers, all sample-related quality control data, and quality control acceptance criteria).
- Verification that all requested analyses, special cleanups, and special handling methods were performed.
- Evaluation of sample holding times.
- Evaluation of quality control data compared to acceptance criteria, including method blanks, surrogate recoveries, matrix spike results, laboratory duplicate and/or replicate results, and laboratory control sample results.
- Evaluation of overall data quality and completeness of analytical data.

Data validation qualifiers are added to the sample results, as appropriate, based on the verification and validation check. The absence of a data qualifier indicates that the reported result is acceptable without qualification. The data quality evaluation is summarized below. All data was found to be acceptable with no qualifications.

Chain-of-Custody Records

A signed chain-of-custody (COC) record was attached to the data packages. The laboratory received all samples in good condition. All analyses were performed as requested. No special cleanups or handling methods were requested.

Upon receipt by ELLE, the sample container information was compared to the associated chain-of-custody and the cooler temperatures were recorded. The coolers were received with temperatures within the EPA-recommended limit of ≤6°C. No qualification of the data was necessary.

Holding Times

For all analyses and all samples, the time between sample collection, extraction (if applicable), and analysis was determined to be within EPA- and project-specified holding times. No qualification of the data was necessary.

Blank Results

Laboratory Method Blanks

At least one method blank was analyzed with each batch of samples for VOCs analysis. Target analytes were not detected at concentrations greater than the reporting limits in the associated method blanks. No qualification of the data was necessary.

Field Trip Blanks and Field Equipment Blanks

One trip blank was submitted to the laboratory for VOC analysis with each sample batch. Target analytes were not detected at concentrations greater than the reporting limits in the associated trip blanks. No qualification of the data was necessary.

No field equipment blanks were submitted for analysis with this sample batch.

Surrogate Recoveries

Appropriate compounds were used as surrogate spikes for the VOCs analysis. Recovery values for the surrogate spikes were within the current laboratory-specified control limits. No qualification of the data was necessary.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) and Laboratory Replicate Results

No matrix spikes were analyzed with this sample batch. No qualification of the data was determined necessary.

Laboratory Control Sample and Laboratory Control Sample Duplicate (LCS/LCSD) Results

At least one laboratory control sample and/or laboratory control sample duplicate (LCS/LCSD) was analyzed with each batch of samples for VOCs analysis. Recoveries and RPDs for the laboratory control

samples and associated duplicates were within the current laboratory-specified control limits. No qualification of the data was necessary.

Quantitation Limits

Project-specified quantitation limits were met for all samples except for instances where high concentrations required dilution of the sample extracts.

Audit/Corrective Action Records

No audits were performed or required. No corrective action records were generated for this sample batch. Based on the laboratory's case narratives, continuing calibration verification (CCV) recovery results were within laboratory-specified control limits. No qualification of the data was necessary.

Completeness and Overall Data Quality

The completeness for this data set is 100 percent, which meets the project-specified goal of 90 percent minimum.

Data precision was evaluated through laboratory control sample duplicates. Data accuracy was evaluated through laboratory control samples and surrogate spikes. No data were rejected.

LANDAU ASSOCIATES, INC.

Kristi Schultz
Data Specialist

Danille Jorgensen
Environmental Data Manager

DRJ/kes
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References

EPA. 2020. National Functional Guidelines for Organic Superfund Methods Data Review. OLEM 9240.0-51; EPA-540-R-20-005. US Environmental Protection Agency. November. https://www.epa.gov/sites/default/files/2021-03/documents/nfg_for_organic_superfund_methods_data_review_november_2020.pdf.

Technical Memorandum

TO: Christine Kimmel, Project Manager

FROM: Kristi Schultz and Danille Jorgensen

DATE: September 1, 2022

RE: **Boeing Portland (TSA)**
Third Quarter 2022 Groundwater Quality Sampling
Laboratory Data Quality Evaluation

This technical memorandum provides the results of a focused data validation associated with 8 groundwater samples and 1 trip blank collected during the third quarter 2022 TSA water quality sampling event at Boeing Portland. Samples were analyzed by Eurofins Lancaster Laboratories Environmental LLC (ELLE), located in Lancaster, Pennsylvania. This data quality evaluation covers ELLE data package 410-93427-1. Samples submitted to ELLE were analyzed for volatile organic compounds ([VOCs]; US Environmental Protection Agency [EPA] Method SW8260C).

The verification and validation check was conducted with guidance from applicable portions of EPA's *National Functional Guidelines for Organic Data Review* (EPA 2020). Landau Associates performed an EPA-equivalent Level IIa verification and validation check on each laboratory data package, which included the following:

- Verification that the laboratory data package contained all necessary documentation (including chain-of-custody records; identification of samples received by the laboratory; date and time of receipt of the samples at the laboratory; sample conditions upon receipt at the laboratory; date and time of sample analysis; explanation of any significant corrective actions taken by the laboratory during the analytical process; and, if applicable, date of extraction, definition of laboratory data qualifiers, all sample-related quality control data, and quality control acceptance criteria).
- Verification that all requested analyses, special cleanups, and special handling methods were performed.
- Evaluation of sample holding times.
- Evaluation of quality control data compared to acceptance criteria, including method blanks, surrogate recoveries, matrix spike results, laboratory duplicate and/or replicate results, and laboratory control sample results.
- Evaluation of overall data quality and completeness of analytical data.

Data validation qualifiers are added to the sample results, as appropriate, based on the verification and validation check. The absence of a data qualifier indicates that the reported result is acceptable without qualification. The data quality evaluation is summarized below. Data qualifiers are summarized in Table 1.

Chain-of-Custody Records

A signed chain-of-custody (COC) record was attached to the data packages. The laboratory received all samples in good condition. All analyses were performed as requested. No special cleanups or handling methods were requested.

Upon receipt by ELLE, the sample container information was compared to the associated chain-of-custody and the cooler temperatures were recorded. The coolers were received with temperatures within the EPA-recommended limit of ≤6°C. No qualification of the data was necessary.

Holding Times

For all analyses and all samples, the time between sample collection, extraction (if applicable), and analysis was determined to be within EPA- and project-specified holding times. No qualification of the data was necessary.

Blank Results

Laboratory Method Blanks

At least one method blank was analyzed with each batch of samples for VOCs analysis. Target analytes were not detected at concentrations greater than the reporting limits in the associated method blanks. No qualification of the data was necessary.

Field Trip Blanks and Field Equipment Blanks

One trip blank was submitted to the laboratory for VOC analysis with each sample batch. Target analytes were not detected at concentrations greater than the reporting limits in the associated trip blanks. No qualification of the data was necessary.

No field equipment blanks were submitted for analysis with this sample batch.

Surrogate Recoveries

Appropriate compounds were used as surrogate spikes for the VOCs analysis. Recovery values for the surrogate spikes were within the current laboratory-specified control limits. No qualification of the data was necessary.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) and Laboratory Replicate Results

No matrix spikes were analyzed with this sample batch. No qualification of the data was determined necessary.

Laboratory Control Sample and Laboratory Control Sample Duplicate (LCS/LCSD) Results

At least one laboratory control sample and/or laboratory control sample duplicate (LCS/LCSD) was analyzed with each batch of samples for VOCs analysis. Recoveries and RPDs for the laboratory control

samples and associated duplicates were within the current laboratory-specified control limits. No qualification of the data was necessary.

Blind Field Duplicate Results

As specified in the QAPP, blind field duplicate samples were collected at a rate of one blind field duplicate sample per 20 samples, but not less than one blind field duplicate per sampling round. One pair of blind field duplicate water samples (BOP-Y-0822 / BOP-13dg-0822) was submitted for analysis with data packages 410-93427-1.

A project-specified control limit of 20 percent was used to evaluate the RPDs between the duplicate samples except when the sample results were within five times the reporting limit. In these cases, a project-specified control limit of plus or minus the reporting limit was used. RPDs for the duplicate sample pairs submitted for analysis were within the project-specified control limits. No qualification of the data was necessary.

Quantitation Limits

Project-specified quantitation limits were met for all samples except for instances where high concentrations required dilution of the sample extracts.

Audit/Corrective Action Records

No audits were performed or required. No corrective action records were generated for this sample batch. Based on the laboratory's case narratives, continuing calibration verification (CCV) recovery results were within laboratory-specified control limits, with the following exceptions:

- The CCV recoveries were low for multiple analytes associated with batches 410-284072 and 410-284542 in laboratory data package 410-93427-1. Associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.

- The CCV recoveries for high for 2-hexanone and/or 4-methyl-2-pentanone associated with batches 410-284072 and 410-93427 in laboratory data package 410-93427-1. The affected compounds were not detected in the associated samples at concentrations greater than the laboratory reporting limit; therefore, no qualification of the data was necessary.

Completeness and Overall Data Quality

The completeness for this data set is 100 percent, which meets the project-specified goal of 90 percent minimum.

Data precision was evaluated through laboratory control sample duplicates. Data accuracy was evaluated through laboratory control samples and surrogate spikes. No data were rejected.

LANDAU ASSOCIATES, INC.

Kristi Schultz
Data Specialist

Danille Jorgensen
Environmental Data Manager

DRJ/kes
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References

EPA. 2020. National Functional Guidelines for Organic Superfund Methods Data Review. OLEM 9240.0-51; EPA-540-R-20-005. US Environmental Protection Agency. November. https://www.epa.gov/sites/default/files/2021-03/documents/nfg_for_organic_superfund_methods_data_review_november_2020.pdf.

Table 1
Summary of Data Qualifiers
Boeing Portland TSA Phase I

Data Package	Sample Number	Analyte	Result	Lab Qualifier	Data Qualifier	Reason
410-93427-1	BOP-13ds-0822	1,1,1-Trichloroethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-13ds-0822	Bromomethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-13ds-0822	Carbon Tetrachloride	0.200	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-13ds-0822	Freon 113	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-13ds-0822	Trichlorofluoromethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-y-0822	1,1,1-Trichloroethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-y-0822	Bromomethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-y-0822	Carbon Tetrachloride	0.200	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-y-0822	Freon 113	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-y-0822	Trichlorofluoromethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-13dg-0822	1,1,1-Trichloroethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-13dg-0822	Bromomethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-13dg-0822	Carbon Tetrachloride	0.200	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-13dg-0822	Freon 113	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-13dg-0822	Trichlorofluoromethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-31dg-0822	1,1,1-Trichloroethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-31dg-0822	Bromomethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-31dg-0822	Carbon Tetrachloride	0.200	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-31dg-0822	Freon 113	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-31dg-0822	Trichlorofluoromethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-31ds-0822	1,1,1-Trichloroethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-31ds-0822	Bromomethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-31ds-0822	Carbon Tetrachloride	0.200	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-31ds-0822	Freon 113	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-31ds-0822	Trichlorofluoromethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-66ds-0822	1,1-Dichloroethene	0.200	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-66ds-0822	Bromomethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-66ds-0822	Carbon Disulfide	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-66ds-0822	Chloroethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-66ds-0822	Chloromethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-66ds-0822	Freon 113	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-66ds-0822	Trichlorofluoromethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-66ds-0822	Vinyl Chloride	0.200	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-61ds-0822	1,1-Dichloroethene	0.200	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-61ds-0822	Bromomethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-61ds-0822	Carbon Disulfide	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-61ds-0822	Chloroethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-61ds-0822	Chloromethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-61ds-0822	Freon 113	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-61ds-0822	Trichlorofluoromethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-61ds-0822	Vinyl Chloride	0.200	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-61dg-0822	1,1-Dichloroethene	0.200	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-61dg-0822	Bromomethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-61dg-0822	Carbon Disulfide	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-61dg-0822	Chloroethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-61dg-0822	Chloromethane	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-61dg-0822	Freon 113	0.500	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-61dg-0822	Trichlorofluoromethane	0.50	U	UJ	Low continuing calibration recovery
410-93427-1	BOP-61dg-0822	Vinyl Chloride	0.20	U	UJ	Low continuing calibration recovery

Table 1
Summary of Data Qualifiers
Boeing Portland TSA Phase I

Data Package	Sample Number	Analyte	Result	Lab Qualifier	Data Qualifier	Reason

U = The analyte was analyzed for but was not detected above the level of the reported sample quantitation limit.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.

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Memorandum

Date:	5 May 2022
To:	Cindy Bartlett, RG, LG
	Geosyntec Consultants, Portland, Oregon
From:	Matthew Richardson
CC:	J. Caprio
Subject:	**Stage 2A Data Validation - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1458251 and L1458270 and Eurofins Air Toxics Work Order # 2201135, 2202405, 2203044, 2203614**

SITE: Cascade TSA; Job No: PNG0564S21

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of thirty groundwater samples, three field duplicates and one trip blank, collected 1 February 2022, as well as eleven air samples, collected on 6 January 2022, 14 and 28 February 2022 and 21 March 2022, as part of the site investigation activities for the Cascade Corp., Fairview Oregon sampling event.

The groundwater samples were analyzed by Pace National [formerly ESC Lab Sciences (ESC)], Mt. Juliet, Tennessee for the following analytical test:

- United States (US) Environmental Protection Agency (EPA) Method 8260D – Volatile Organic Compounds (VOCs)

The air samples were analyzed by Eurofins Air Toxics, Folsom, California for the following analytical test:

- US EPA Modified Method TO-15 - Selected VOCs (1,1-dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride)

EXECUTIVE SUMMARY

Overall, based on this Stage 2A data validation covering the quality control (QC) parameters listed below and based on the information provided, the data as qualified are usable for supporting project objectives. The qualified data should be used within the limitations of the qualifications.

The data were reviewed based on the following document, the pertinent methods referenced by the data package and professional and technical judgment:

- US EPA National Functional Guidelines for Organic Superfund Methods Data Review, November 2020 (EPA 540-R-20-005)

The following samples were analyzed in the data sets:

Laboratory IDs	Client IDs
2201135-01A	SVE-EFF-010622
2202405-01A	SVE-EFF-021422
2202405-02A	VW-17d-95.5-021422
2202405-03A	VMWC-021422
2202405-04A	VMWH-021422
2202405-05A	VMWE-021422
2202405-06A	VMWF-021422
2202405-07A	VMWG-021422
2203044-01A	VMWJ2-022822
2203044-02A	VMWK-022822
2203614-01A	SVE-EFF-032122
L1458251-01	CMW24DG-020122
L1458251-02	CMW17DS-020122
L1458251-03	D17DS-020122
L1458251-04	D17DG-020122
L1458251-05	EW2-020122
L1458251-06	EW14-020122
L1458251-07	EW1-020122
L1458251-08	EW12-020122
L1458251-09	CMW14RDS-020122
L1458251-10	CMW18DS-020122
L1458251-11	CMW25DG-020122
L1458251-12	CMW19DS-020122

Laboratory IDs	Client IDs
L1458251-13	CMW10DS-020122-DUP
L1458251-14	CMW10DS-020122
L1458251-15	EW23-020122
L1458251-16	VMWH-020122
L1458251-17	VMWA-020122
L1458251-18	VMWC-020122
L1458251-19	VMWD-020122
L1458251-20	VMWE-020122
L1458251-21	VMWF-020122
L1458251-22	VMWG-020122
L1458251-23	VMWB-020122
L1458251-24	VMWI-020122-143.7
L1458251-25	VMWJ2-020122-120.25
L1458251-26	VMWJ2-020122-120.25-DUP
L1458251-27	VMWK-020122-114.25
L1458251-28	VMWL-020122-103.25
L1458251-29	VMWM-020122-94
L1458251-30	VMWN-020122-110.8
L1458270-01	TS-C-EFF-020122
L1458270-02	TS-C-EFF-020122-DUP
L1458270-03	TS-C-INF-020122
L1458270-04	TRIP BLANK #475

The groundwater samples were received at the laboratory within the temperature criteria of 0-6 degrees Celsius (°C).

The following issues were noted on the chain of custody (COC) forms. No qualifications were applied to the data based on the issues discussed below.

- L1458251, L1458270 and 2202405: Incorrect error corrections were observed on the COC instead of the proper procedure of a single strike through, correction, and initials and date of person making the corrections.

- L1458270: A sample collection time for the trip blank was not documented on the COC. The trip blank was logged by the laboratory with a sample collection time of 00:00.

- 2203044: The laboratory narrative indicated that the canister barcodes on the COC for samples VMWJ2-022822 and VMWK-022822 did not match the information recorded on the sample tags. The canister IDs were documented on the COC as 1L1763 and 1L3486, respectively, and the canister IDs on the air canisters were 1L3486 and 1L1763, respectively. The client was notified of the discrepancy, and the canister IDs from the air canisters were used by the laboratory to log and analyze the samples.

1.0 VOLATILE ORGANIC COMPOUNDS

The water samples were analyzed for VOCs per US EPA method 8260D.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

⊗ Overall Assessment
✓ Holding Times
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
✓ Laboratory Control Sample
✓ Surrogate
✓ Trip Blank
⊗ Field Duplicate
✓ Sensitivity
✓ Electronic Data Deliverable Review

1.1 Overall Assessment

1.1.1 Completeness

The VOC data reported in these data packages are considered usable for supporting project objectives. The results are considered valid; the analytical completeness, defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for the sample set is 100%.

1.1.2 Analysis Anomaly

L1458251: The percent differences (%Ds) for 1,2-dibromo-3-chloropropane, naphthalene and styrene in the continuing calibration verification (CCV) in batch WG1813777 were outside of the

method specified acceptance criteria with low biases. Information sent from the laboratory indicated the %Ds were 1,2-dibromo-3-chloropropane (-35.2%), naphthalene (-35.9%) and styrene (-23.4%). Since the %D for 1,2-dibromo-3-chloropropane was within the validation specified acceptance criteria, no qualifications were applied to the 1,2-dibromo-3-chloropropane data. However, the non-detect results of naphthalene and styrene in the associated samples were UJ qualified as estimated less than the method detection limits (MDLs).

L1458251: The %D for acetone in the CCV in batch WG1813777 was outside of the method specified acceptance criteria with a high bias. Information sent from the laboratory indicated the %D was acetone (40%). Since the %D for acetone was within the validation specified acceptance criteria, no qualifications were applied to the data.

L1458251 and L1458270: The %D for acrolein in the CCV in batch WG1813790 was outside of the method specified acceptance criteria with a low bias. Information sent from the laboratory indicated the %D was acrolein (-32.5%). Therefore, based on professional and technical judgment, the non-detect results of acrolein in the associated samples were UJ qualified as estimated less than the MDLs.

L1458251 and L1458270: The %D for 2-butanone in the CCV in batch WG1813790 was outside of the method specified acceptance criteria with a high bias. Information sent from the laboratory indicated the %D was 2-butanone (31%). Since the %D for 2-butanone was within the validation specified acceptance criteria, no qualifications were applied to the data .

L1458251: The data were flagged to indicate that the relative response factor (RRF) for 1,2,3-trichlorobenzene in the CCV standard in batch WG1813777 was low and outside of the method specified acceptance criteria. Information sent from the laboratory indicated the RRF was 0.3476 less than the method specified minimum RRF is 0.400. Therefore, based on professional and technical judgment, the non-detect results of 1,2,3-trichlorobenzene in the associated samples were UJ qualified as estimated less than the MDLs.

See attachment 3 at the end of this report for these qualifications.

1.2 Holding Time

The holding time for the VOC analysis of a preserved groundwater sample is 14 days from collection to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two method blanks were reported (batches WG1813777 and WG1813790). VOCs were not detected in the method blanks above the MDLs.

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were not reported. Precision and accuracy were assessed using the laboratory control sample (LCS)/LCS duplicate (LCSD) pair.

1.5 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One LCS and one LCS/LCSD pair were reported. The recovery and relative percent difference (RPD) results were within the laboratory specified acceptance criteria, with the following exceptions.

L1458251: One or both of the recoveries of 1,2-dibromo-3-chloropropane and 1,2,3-trimethlybenzene in the LCS/LCSD pair in batch WG1813790 were high and outside the laboratory specified acceptance criteria. Since 1,2-dibromo-3-chloropropane and 1,2,3-trimethlybenzene were not detected in the associated samples, no qualifications were applied to the data.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Trip Blank

One trip blank, TRIP BLANK #475, was submitted with the sample sets. VOCs were not detected in the trip blank above the MDLs.

1.8 Field Duplicate

Three field duplicates, CMW10DS-020122-DUP, VMWJ2-020122-120.25-DUP and TS-C-EFF-020122-DUP were collected with the sample sets. Acceptable precision (RPD $\leq$ 30%) was demonstrated between the field duplicates and the original samples CMW10DS-020122, VMWJ2-020122-120.25 and TS-C-EFF-020122 , respectively, with the following exception.

Tetrachloroethene was detected at a concentration greater than the reported detection limit (RDL) in sample VMWJ2-020122-120.25-DUP and detected at a concentration greater than the MDL and less than the RDL in VMWJ2-020122-120.25, resulting in a noncalculable RPD. Therefore, based

on professional and technical judgment, the tetrachloroethene concentrations in VMWJ2-020122-120.25 and VMWJ2-020122-120.25-DUP were J qualified as estimated.

Sample	Analyte	Laboratory Result (µg/L)	Laboratory Flag	RPD	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
VMWJ2-020122-120.25	Tetrachloroethene	0.499	J	NC	0.499	J	7
VMWJ2-020122-120.25-DUP	Tetrachloroethene	0.613	NA		0.613	J	7

µg/L-micrograms per liter
NA-not applicable
J-estimated concentration greater than or equal to the MDL and less than the RDL
NC-noncalculable
* Validation qualifiers are defined in Attachment 1 at the end of this report
**Reason codes are defined in Attachment 2 at the end of this report

1.9 Sensitivity

The sample results were reported to the MDLs. Elevated non-detect results were not reported.

1.10 Electronic Data Deliverable (EDD) Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II report and the EDD.

2.0 VOLATILE ORGANIC COMPOUNDS

The samples were analyzed for selected VOCs per US EPA modified Method TO-15 using full scan mode.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable or not applicable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Laboratory Control Sample
- ✓ Laboratory Duplicate
- ✓ Surrogates
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

2.1 Overall Assessment

The VOC data reported in these laboratory reports are considered usable for supporting project objectives. The results are considered valid; the analytical completeness, defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for this data set is 100%.

2.2 Holding Time

The holding time for the TO-15 analysis of an air sample collected in a canister is 30 days from collection to analysis. The holding times were met for the sample analyses.

2.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four method blanks were reported (batches 2201135-02A, 2202405-08A, 2203044-03A and 2203614-02A). VOCs were not detected in the method blanks above the method reporting limits (MRLs).

2.4 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four LCS/LCSD pairs were reported. The RPDs were not reported by the laboratory; therefore, the RPDs were calculated by the validator based on the reported recovery results. The recovery and RPD results were within the laboratory specified acceptance criteria.

The laboratory also reported CCV standards. The CCV recoveries were within the method specified acceptance criteria.

2.5 Surrogates

The surrogate recoveries were within the laboratory specified acceptance criteria.

2.6 Sensitivity

The samples were reported to the MRLs. Elevated non-detect results were reported due to the sample dilutions analyzed.

2.7 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II reports and the EDDs.

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ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit. Upon application of the U qualifier to a reported result, the definition changes to "not detected at or above the reported result".

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Extraction or analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other
14	Lab flag removed or modified: no validation qualification required

LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample duplicate
RPD – Relative percent difference

ATTACHMENT 3
Analysis Anomaly Qualifications

Sample	Analyte	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier	Reason Code
CMW10DS-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
CMW10DS-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
CMW10DS-020122	Styrene	0.118	U,C3	0.118	UJ	9
CMW10DS-020122-DUP	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
CMW10DS-020122-DUP	Naphthalene	0.174	U,C3	0.174	UJ	9
CMW10DS-020122-DUP	Styrene	0.118	U,C3	0.118	UJ	9
CMW14RDS-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
CMW14RDS-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
CMW14RDS-020122	Styrene	0.118	U,C3	0.118	UJ	9
CMW17DS-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
CMW17DS-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
CMW17DS-020122	Styrene	0.118	U,C3	0.118	UJ	9
CMW18DS-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
CMW18DS-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
CMW18DS-020122	Styrene	0.118	U,C3	0.118	UJ	9
CMW19DS-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
CMW19DS-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
CMW19DS-020122	Styrene	0.118	U,C3	0.118	UJ	9
CMW24DG-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
CMW24DG-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
CMW24DG-020122	Styrene	0.118	U,C3	0.118	UJ	9
CMW25DG-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
CMW25DG-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
CMW25DG-020122	Styrene	0.118	U,C3	0.118	UJ	9
D17DG-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
D17DG-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
D17DG-020122	Styrene	0.118	U,C3	0.118	UJ	9
D17DS-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
D17DS-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
D17DS-020122	Styrene	0.118	U,C3	0.118	UJ	9
EW1-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
EW1-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
EW1-020122	Styrene	0.118	U,C3	0.118	UJ	9
EW12-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
EW12-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
EW12-020122	Styrene	0.118	U,C3	0.118	UJ	9

Sample	Analyte	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier	Reason Code
EW14-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
EW14-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
EW14-020122	Styrene	0.118	U,C3	0.118	UJ	9
EW2-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
EW2-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
EW2-020122	Styrene	0.118	U,C3	0.118	UJ	9
EW23-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
EW23-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
EW23-020122	Styrene	0.118	U,C3	0.118	UJ	9
TRIP BLANK #475	Acrolein	2.54	U,C3	2.54	UJ	9
TS-C-EFF-020122	Acrolein	2.54	U,C3	2.54	UJ	9
TS-C-EFF-020122-DUP	Acrolein	2.54	U,C3	2.54	UJ	9
TS-C-INF-020122	Acrolein	2.54	U,C3	2.54	UJ	9
VMWA-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWA-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
VMWA-020122	Styrene	0.118	U,C3	0.118	UJ	9
VMWB-020122	Acrolein	2.54	U,C3	2.54	UJ	9
VMWC-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWC-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
VMWC-020122	Styrene	0.118	U,C3	0.118	UJ	9
VMWD-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWD-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
VMWD-020122	Styrene	0.118	U,C3	0.118	UJ	9
VMWE-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWE-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
VMWE-020122	Styrene	0.118	U,C3	0.118	UJ	9
VMWF-020122	Acrolein	2.54	U,C3	2.54	UJ	9
VMWG-020122	Acrolein	2.54	U,C3	2.54	UJ	9
VMWH-020122	1,2,3-Trichlorobenzene	0.164	U,C4	0.164	UJ	9
VMWH-020122	Naphthalene	0.174	U,C3	0.174	UJ	9
VMWH-020122	Styrene	0.118	U,C3	0.118	UJ	9
VMWI-020122-143.7	Acrolein	2.54	U,C3	2.54	UJ	9
VMWJ2-020122-120.25	Acrolein	2.54	U,C3	2.54	UJ	9
VMWJ2-020122-120.25-DUP	Acrolein	2.54	U,C3	2.54	UJ	9
VMWK-020122-114.25	Acrolein	2.54	U,C3	2.54	UJ	9
VMWL-020122-103.25	Acrolein	2.54	U,C3	2.54	UJ	9
VMWM-020122-94	Acrolein	2.54	U,C3	2.54	UJ	9
VMWN-020122-110.8	Acrolein	2.54	U,C3	2.54	UJ	9

µg/L-micrograms per liter
U-not detected at a concentration greater than or equal to the MDL
C3-laboratory flag indicating CCV was low and outside the laboratory specified acceptance criteria; however, the method sensitivity check was acceptance

C4- laboratory flag indicating CCV was low and outside the laboratory specified acceptance criteria

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Memorandum

Date:	3 November 2022
To:	Cindy Bartlett, RG, LG
	Geosyntec Consultants, Portland, Oregon
From:	Colleen Small
CC:	J. Caprio
Subject:	**Stage 2A Data Validation - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1490642 and L1490651 and Eurofins Air Toxics Work Order # 2204226, 2205171 and 2206193**

SITE: Cascade

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of twenty-six groundwater samples, three field duplicates and one trip blank, collected 3-4 May 2022, as well as eleven air samples, collected on 5 April 2022, 5 May 2022 and 7 June 2022, as part of the site investigation activities for the Cascade Corp., Fairview Oregon sampling event.

The groundwater samples were analyzed by Pace Analytical National [formerly ESC Lab Sciences (ESC)], Mt. Juliet, Tennessee for the following analytical test:

- United States (US) Environmental Protection Agency (EPA) Method 8260D – Volatile Organic Compounds (VOCs)

The air samples were analyzed by Eurofins Air Toxics, Folsom, California for the following analytical test:

- US EPA Modified Method TO-15 - Selected VOCs (1,1-dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride)

EXECUTIVE SUMMARY

Overall, based on this Stage 2A data validation covering the quality control (QC) parameters listed below and based on the information provided, the data as qualified are usable for supporting project objectives. The qualified data should be used within the limitations of the qualifications.

The data were reviewed based on the following document, the pertinent methods referenced by the data package and professional and technical judgment:

- US EPA National Functional Guidelines for Organic Superfund Methods Data Review, November 2020 (EPA 540-R-20-005)

The following samples were analyzed in the data sets:

Laboratory ID	Client ID
L1490642-01	CMW19DS-050322
L1490642-02	VMWA-050422
L1490642-03	VMWB-050422
L1490642-04	VMWC-050422
L1490642-05	VMWD-050422
L1490642-06	VMWE-050422
L1490642-07	VMWF-050422
L1490642-08	VMWG-050422
L1490642-09	VMWH-050422
L1490642-10	VMWI-050422-143.7
L1490642-11	EW1-050322
L1490642-12	EW2-050322
L1490642-13	EW14-050322
L1490642-14	D17(DG)-050322
L1490642-15	D17(DS)-050322
L1490642-16	EW12-050322
L1490642-17	CMW10DS-050322
L1490642-18	CMW10DS-050322-DUP
L1490642-19	CMW17DS-050322
L1490642-20	CMW18DS-050322
L1490642-21	VMWJ2-050422-120.25

Laboratory ID	Client ID
L1490642-22	VMWJ2-050422-DUP-120.25
L1490642-23	VMWK-050422-114.25
L1490642-24	VMWL-050422-103.25
L1490642-25	VMWM-050422-94
L1490642-26	VMWN-050422-110.8
L1490642-27	TRIP TEMP #481
L1490651-01	TS-C-EFF-050322
L1490651-02	TS-C-EFF-050322-DUP
L1490651-03	TS-C-INF-050322
L1490651-04	TRIP TEMP #481
2204226-01A	SVE-EFF-040522
2205171-01A	SVE-EFF-050522
2205171-04A	VMW-C-050522
2205171-06A	VMW-E-050522
2205171-07A	VMW-F-050522
2205171-08A	VMW-G-050522
2205171-09A	VMW-H-050522
2206193-01A	SVE-EFF-060722
2206193-02A	VW-17d-95.5-060722
2206193-03A	VMW-J2-060722
2206193-04A	VMW-K-060722

The groundwater samples were received at the laboratory within the temperature criteria of 0-6 degrees Celsius (^{o}C).

The following issues were noted on the chain of custody (COC) forms. No qualifications were applied to the data based on the issues discussed below.

- L1490651: Incorrect error corrections were observed on the COC instead of the proper procedure of a single strike through, correction, and initials and date of person making the corrections.

- L1490642 and L1490651: A sample collection time for the trip blank was not documented on the COCs. The trip blank was logged by the laboratory with a sample collection time of 00:00.

- L1490642 and L1490651: Sample Trip Temp #481 was recorded on both COCs and reported in the two laboratory reports with different laboratory IDs, but there was only one container of the sample.

- L1490651: The laboratory ID of sample Trip Temp #481 was crossed out on the COC but was reported under the crossed-out laboratory ID number.

- 2204226: The laboratory narrative indicated that the information on the COC for sample SVE-EFF-040522 did not match the entry on the sample tag with regard to sample identification. The information on the COC was used to process and report the sample.

- 2205171: The laboratory narrative indicated the received samples were placed on hold per the client's request. Samples SVE-EFF-050522, VMW-C-050522, VMW-E-050522, VMW-F-050522, VMW-G-050522 and VMW-H-050522 were removed from "Hold" and placed on "Active" status and samples VMW-A-050522, VMW-B-050522 and VMW-D-050522 were cancelled per client request on 5/11/22.

1.0 VOLATILE ORGANIC COMPOUNDS

The water samples were analyzed for VOCs per US EPA method 8260D.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

⊗ Overall Assessment
✓ Holding Times
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
✓ Laboratory Control Sample
✓ Surrogate
✓ Trip Blank
✓ Field Duplicate
✓ Sensitivity
✓ Electronic Data Deliverable Review

1.1 Overall Assessment

1.1.1 Completeness

The VOC data reported in these data packages are considered usable for supporting project objectives. The results are considered valid; the analytical completeness, defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to

the total number of analytical results requested on samples submitted for this analysis, for the sample set is 100%.

1.1.2 Analysis Anomaly

L1490642: The percent differences (%Ds) for 1,1,1,2-tetrachloroethane (-23.8%), 1,2,3-trichlorobenzene (-23.2%), 1,2,4-trichloroethane (-24.3%), 1,2-dibromo-3-chloropropane (-72%), methyl bromide (-79.4%), naphthalene (-37.3%) and n-butylbenzene (-20.5%) in the continuing calibration verification (CCV) in batch WG1861069 were outside of the method specified acceptance criteria with low biases. Since the %Ds for 1,1,1,2-tetrachloroethane, 1,2,3-trichlorobenzene and 1,2,4-trichloroethane were within the validation specified acceptance criteria, no qualifications were applied to the 1,1,1,2-tetrachloroethane, 1,2,3-trichlorobenzene and 1,2,4-trichloroethane data. However, the non-detect results of 1,2-dibromo-3-chloropropane, bromomethane, naphthalene and n-butylbenzene in the associated samples were UJ qualified as estimated less than the reported detection limits (RDLs).

L1490642: The %D for trichloroethene (21.4%) in the CCV in batch WG1861069 was outside of the method specified acceptance criteria with high bias. Therefore, the trichloroethene concentrations in the associated samples were J qualified as estimated.

L1490642 and L1490651: The %Ds of 1,2,4-trichlorobenzene (-21.1%) and acrolein (-61.5%) in batch WG1861096 were outside of the method specified acceptance criteria with low biases. Since the %D for 1,2,4-trichlorobenzene was within the validation specified acceptance criteria, no qualifications were applied to the 1,2,4-trichlorobenzene data. However, the non-detect results of acrolein in the associated samples were UJ qualified as estimated less than the RDL.

L1490642 and L1490651: The %Ds of acetone (44.4%) and methyl ethyl ketone (31.8%) in batch WG1861096 were outside of the method specified acceptance criteria with high biases. Since the %D for methyl ethyl ketone was within the validation specified acceptance criteria, no qualifications were applied to the methyl ethyl ketone data. However, the acetone concentrations in the associated samples were J qualified as estimated.

See attachment 3 at the end of this report for these qualifications.

1.2 Holding Time

The holding time for the VOC analysis of a preserved groundwater sample is 14 days from collection to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two method blanks were reported (batches WG1861069

and WG1861096). VOCs were not detected in the method blanks at or above the method detection limits (MDLs).

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were not reported. Precision and accuracy were assessed using the laboratory control sample (LCS)/LCS duplicate (LCSD) pair.

1.5 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two LCS/LCSD pairs were reported. The recovery and relative percent difference (RPD) results were within the laboratory specified acceptance criteria.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Trip Blank

One trip blank, TRIP BLANK #481, was submitted with the sample sets. However, the trip blank was recorded on both COCs for SDGs L1490642 and L1490651. TRIP BLANK #481 was assigned two different laboratory identification numbers, L1490642-27 and L1490651-04. Although TRIP BLANK #481 was reported twice, it was only analyzed once. VOCs were not detected in the trip blank at or above the RDLs.

1.8 Field Duplicate

Three field duplicates, CMW10DS-050322-DUP, VMWJ2-050422-DUP-120.25 and TS-C-EFF-050322-DUP were collected with the sample sets. Acceptable precision (RPD $\leq$ 30%) was demonstrated between the field duplicates and the original samples CMW10DS-050322, VMWJ2-050422-120.25 and TS-C-EFF-050322, respectively.

1.9 Sensitivity

The sample results were reported to the RDLs. Elevated non-detect results were not reported.

1.10 Electronic Data Deliverable (EDD) Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II report and the EDD.

2.0 VOLATILE ORGANIC COMPOUNDS

The samples were analyzed for selected VOCs per US EPA modified Method TO-15 using full scan mode.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable or not applicable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Laboratory Control Sample
- ✓ Surrogates
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

2.1 Overall Assessment

The VOC data reported in these laboratory reports are considered usable for supporting project objectives. The results are considered valid; the analytical completeness, defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for this data set is 100%.

2.2 Holding Time

The holding time for the TO-15 analysis of an air sample collected in a canister is 30 days from collection to analysis. The holding times were met for the sample analyses.

2.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Six method blanks were reported (batches 2204226-02A, 2205171-10A, 2205171-10B, 2206193-05A, 2206193-05B and 2206193-05C). VOCs were not detected in the method blanks at or above the method reporting limits (MRLs).

2.4 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Six LCS/LCSD pairs were reported. The RPDs were not reported by the laboratory; therefore, the RPDs were calculated by the validator based on the reported recovery results. The recovery and RPD results were within the laboratory specified acceptance criteria.

The laboratory also reported CCV standards. The CCV recoveries were within the method specified acceptance criteria.

2.5 Surrogates

The surrogate recoveries were within the laboratory specified acceptance criteria.

2.6 Sensitivity

The samples were reported to the MRLs. Elevated non-detect results were reported due to the sample dilutions analyzed.

2.7 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II reports and the EDDs.

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ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS
AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit. Upon application of the U qualifier to a reported result, the definition changes to "not detected at or above the reported result".

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Extraction or analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other
14	Lab flag removed or modified: no validation qualification required

LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample duplicate
RPD – Relative percent difference

ATTACHMENT 3
Analysis Anomaly Qualifications

Sample	Analyte	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
CMW19DS-050322	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWA-050422	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWB-050422	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWC-050422	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWD-050422	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWE-050422	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWF-050422	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWG-050422	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWH-050422	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWI-050422-143.7	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
EW1-050322	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
EW2-050322	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
EW14-050322	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
D17(DG)-050322	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
D17(DS)-050322	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
EW12-050322	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
CMW10DS-050322	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
CMW10DS-050322-DUP	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
CMW17DS-050322	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
CMW18DS-050322	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
CMW19DS-050322	Methyl Bromide	2.5	U,C3	2.5	UJ	9
VMWA-050422	Methyl Bromide	2.5	U,C3	2.5	UJ	9
VMWB-050422	Methyl Bromide	2.5	U,C3	2.5	UJ	9
VMWC-050422	Methyl Bromide	2.5	U,C3	2.5	UJ	9

Sample	Analyte	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
VMWD-050422	Methyl Bromide	2.5	U,C3	2.5	UJ	9
VMWE-050422	Methyl Bromide	2.5	U,C3	2.5	UJ	9
VMWF-050422	Methyl Bromide	2.5	U,C3	2.5	UJ	9
VMWG-050422	Methyl Bromide	2.5	U,C3	2.5	UJ	9
VMWH-050422	Methyl Bromide	2.5	U,C3	2.5	UJ	9
VMWI-050422-143.7	Methyl Bromide	2.5	U,C3	2.5	UJ	9
EW1-050322	Methyl Bromide	2.5	U,C3	2.5	UJ	9
EW2-050322	Methyl Bromide	2.5	U,C3	2.5	UJ	9
EW14-050322	Methyl Bromide	2.5	U,C3	2.5	UJ	9
D17(DG)-050322	Methyl Bromide	2.5	U,C3	2.5	UJ	9
D17(DS)-050322	Methyl Bromide	2.5	U,C3	2.5	UJ	9
EW12-050322	Methyl Bromide	2.5	U,C3	2.5	UJ	9
CMW10DS-050322	Methyl Bromide	2.5	U,C3	2.5	UJ	9
CMW10DS-050322-DUP	Methyl Bromide	2.5	U,C3	2.5	UJ	9
CMW17DS-050322	Methyl Bromide	2.5	U,C3	2.5	UJ	9
CMW18DS-050322	Methyl Bromide	2.5	U,C3	2.5	UJ	9
CMW19DS-050322	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWA-050422	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWB-050422	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWC-050422	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWD-050422	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWE-050422	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWF-050422	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWG-050422	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWH-050422	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWI-050422-143.7	Naphthalene	2.5	U,C3	2.5	UJ	9
EW1-050322	Naphthalene	2.5	U,C3	2.5	UJ	9
EW2-050322	Naphthalene	2.5	U,C3	2.5	UJ	9
EW14-050322	Naphthalene	2.5	U,C3	2.5	UJ	9
D17(DG)-050322	Naphthalene	2.5	U,C3	2.5	UJ	9
D17(DS)-050322	Naphthalene	2.5	U,C3	2.5	UJ	9
EW12-050322	Naphthalene	2.5	U,C3	2.5	UJ	9
CMW10DS-050322	Naphthalene	2.5	U,C3	2.5	UJ	9
CMW10DS-050322-DUP	Naphthalene	2.5	U,C3	2.5	UJ	9
CMW17DS-050322	Naphthalene	2.5	U,C3	2.5	UJ	9
CMW18DS-050322	Naphthalene	2.5	U,C3	2.5	UJ	9
CMW19DS-050322	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
VMWA-050422	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
VMWB-050422	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
VMWC-050422	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
VMWD-050422	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
VMWE-050422	n-Butylbenzene	0.5	U,C3	0.5	UJ	9

Sample	Analyte	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
VMWF-050422	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
VMWG-050422	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
VMWH-050422	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
VMWI-050422-143.7	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
EW1-050322	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
EW2-050322	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
EW14-050322	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
D17(DG)-050322	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
D17(DS)-050322	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
EW12-050322	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
CMW10DS-050322	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
CMW10DS-050322-DUP	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
CMW17DS-050322	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
CMW18DS-050322	n-Butylbenzene	0.5	U,C3	0.5	UJ	9
VMWA-050422	Trichloroethene	2.67	C5	2.67	J	9
VMWB-050422	Trichloroethene	14.6	C5	14.6	J	9
VMWC-050422	Trichloroethene	2.84	C5	2.84	J	9
VMWD-050422	Trichloroethene	0.594	C5	0.594	J	9
VMWE-050422	Trichloroethene	25.9	C5	25.9	J	9
VMWG-050422	Trichloroethene	1.85	C5	1.85	J	9
VMWI-050422-143.7	Trichloroethene	29.7	C5	29.7	J	9
EW2-050322	Trichloroethene	8.7	C5	8.7	J	9
EW14-050322	Trichloroethene	5.26	C5	5.26	J	9
D17(DG)-050322	Trichloroethene	18.2	C5	18.2	J	9
D17(DS)-050322	Trichloroethene	18.2	C5	18.2	J	9
EW12-050322	Trichloroethene	1.78	C5	1.78	J	9
CMW10DS-050322	Trichloroethene	8.45	C5	8.45	J	9
CMW10DS-050322-DUP	Trichloroethene	7.61	C5	7.61	J	9
CMW17DS-050322	Trichloroethene	33.4	C5	33.4	J	9
CMW18DS-050322	Trichloroethene	78.5	C5	78.5	J	9
VMWJ2-050422-120.25	Acrolein	50	U,C3	50	UJ	9
VMWJ2-050422-DUP-120.25	Acrolein	50	U,C3	50	UJ	9
VMWK-050422-114.25	Acrolein	50	U,C3	50	UJ	9
VMWL-050422-103.25	Acrolein	50	U,C3	50	UJ	9
VMWM-050422-94	Acrolein	50	U,C3	50	UJ	9
VMWN-050422-110.8	Acrolein	50	U,C3	50	UJ	9
TRIP TEMP #481	Acrolein	50	U,C3	50	UJ	9
TS-C-EFF-050322	Acrolein	50	U,C3	50	UJ	9
TS-C-EFF-050322-DUP	Acrolein	50	U,C3	50	UJ	9
TS-C-INF-050322	Acrolein	50	U,C3	50	UJ	9
VMWJ2-050422-120.25	Acetone	662	C5	662	J	9

Sample	Analyte	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
VMWJ2-050422-DUP-120.25	Acetone	783	C5	783	J	9
VMWK-050422-114.25	Acetone	96.9	C5	96.9	J	9
VMWL-050422-103.25	Acetone	699	C5	699	J	9
VMWM-050422-94	Acetone	89.8	C5	89.8	J	9
VMWN-050422-110.8	Acetone	178	C5	178	J	9

µg/L-micrograms per liter
U-Laboratory flag indicating compound was not detected at a concentration greater than or equal to the RDL
C3-Laboratory flag indicating CCV was low and outside the laboratory specified acceptance criteria; however, the method sensitivity check was acceptance
C5-Laboratory flag indicating CCV was high and outside the laboratory specified acceptance criteria
* Validation qualifiers are defined in Attachment 1 at the end of this report
**Reason codes are defined in Attachment 2 at the end of this report

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Memorandum

Date:	3 November 2022
To:	Cindy Bartlett, RG, LG
	Geosyntec Consultants, Portland, Oregon
From:	Colleen Small
CC:	J. Caprio
Subject:	**Stage 2A Data Validation - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1521386 and L1521403 and Eurofins Air Toxics Work Order # 2207276, 2208391 and 2209150**

SITE: Cascade

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of thirty-three groundwater samples, four field duplicates and one trip blank, collected 1-2 August 2022, as well as eleven air samples, collected on 6 July 2022, 9 August 2022 and 6 September 2022, as part of the site investigation activities for the Cascade Corp., Fairview Oregon sampling event.

The groundwater samples were analyzed by Pace Analytical National [formerly ESC Lab Sciences (ESC)], Mt. Juliet, Tennessee for the following analytical test:

- United States (US) Environmental Protection Agency (EPA) Method 8260D – Volatile Organic Compounds (VOCs)

The air samples were analyzed by Eurofins Air Toxics, Folsom, California for the following analytical test:

- US EPA Modified Method TO-15 - Selected VOCs (1,1-dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride)

EXECUTIVE SUMMARY

Overall, based on this Stage 2A data validation covering the quality control (QC) parameters listed below and based on the information provided, the data as qualified are usable for supporting project objectives. The qualified data should be used within the limitations of the qualifications.

The data were reviewed based on the following document, the pertinent methods referenced by the data package and professional and technical judgment:

- US EPA National Functional Guidelines for Organic Superfund Methods Data Review, November 2020 (EPA 540-R-20-005)

The following samples were analyzed in the data sets:

Laboratory ID	Client ID
L1521386-01	EW1-080222
L1521386-02	EW2-080222
L1521386-03	EW14-080222
L1521386-04	EW23-080122
L1521386-05	D17DG-080122
L1521386-06	D17DS-080122
L1521386-07	EW11-080122
L1521386-08	EW12-080122
L1521386-09	EW16-080122
L1521386-10	CMW10DS-080122
L1521386-11	CMW14RDS-080122
L1521386-12	CMW17DS-080122
L1521386-13	CMW17DS-080122-DUP
L1521386-14	CMW18DS-080122
L1521386-15	CMW18DS-080122-DUP
L1521386-16	CMW19DS-080122
L1521386-17	CMW20DS-080122
L1521386-18	CMW24DG-080122
L1521386-19	CMW25DG-080122
L1521386-20	VMWA-080222
L1521386-21	VMWB-080222
L1521386-22	VMWC-080222
L1521386-23	VMWD-080222
L1521386-24	VMWE-080222
L1521386-25	VMWF-080222

Laboratory ID	Client ID
L1521386-26	VMWG-080222
L1521386-27	VMWH-080222
L1521386-28	VMWI-080222-143.7
L1521386-29	VMWJ2-080222-120.25
L1521386-30	VMWK-080222-114.25
L1521386-31	VMWK-080222-114.25-DUP
L1521386-32	VMWL-080222-103.25
L1521386-33	VMWM-080222-94
L1521386-34	VMWN-080222-110.8
L1521386-35	TRIP BLANK LOT# 482
L1521403-01	TS-C-EFF-080222
L1521403-02	TS-C-EFF-080222-DUP
L1521403-03	TS-C-INF-080222
L1521403-04	TRIP BLANK LOT#482
2207276-01A	SVE-EFF-070622
2208391-01A	SVE-EFF-080922
2208391-02A	VW-17d-95.5-080922
2208391-03A	VMWC-080922
2208391-04A	VMWK-080922
2208391-05A	VMWH-080922
2208391-06A	VMWJ2-080922
2208391-07A	VMWE-080922
2208391-08A	VMWF-080922
2208391-09A	VMWG-080922
2209150-01A	SVE-EFF-090622

The groundwater samples were received at the laboratory within the temperature criteria of 0-6 degrees Celsius (°C).

The following issues were noted on the chain of custody (COC) forms. No qualifications were applied to the data based on the issues discussed below.

- L1521403: Incorrect error corrections were observed on the COC instead of the proper procedure of a single strike through, correction, and initials and date of person making the corrections.

- L1521386 and L1521403: A sample collection time for the trip blank was not documented on the COC. The trip blank was logged by the laboratory with a sample collection time of 00:00.

- L1521386 and L1521403: Sample Trip Temp #482 was recorded on both COCs and reported in the two laboratory reports with different laboratory IDs, but sample was only analyzed once.

- 2207276: The laboratory narrative indicated that the sample identification for sample SVE-EFF-070622 was not provided on the sample tag. Therefore, the information on the COC was used to process and report the sample.

- 2208391: The laboratory narrative indicated that the COC information for sample VW-17d-95.5-080922 did not match the entry on the sample tag with regard to sample identification. The information on the COC was used to process and report the sample.

- 2209150: The project number, 0564S22, on the COC does not match the Project number, 564522, on the laboratory report.

1.0 VOLATILE ORGANIC COMPOUNDS

The water samples were analyzed for VOCs per US EPA method 8260D.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

⊗ Overall Assessment
✓ Holding Times
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
✓ Laboratory Control Sample
✓ Surrogate
✓ Trip Blank
⊗ Field Duplicate
✓ Sensitivity
✓ Electronic Data Deliverable Review

1.1 Overall Assessment

1.1.1 Completeness

The VOC data reported in these data packages are considered usable for supporting project objectives. The results are considered valid; the analytical completeness, defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for the sample set is 100%.

1.1.2 Analysis Anomaly

L1521386 and L1521403: The data were flagged to indicate that the relative response factor (RRF) for 1,2,3-trichlorobenzene and 1,2,4-trichlorobenzene in the continuing calibration verification (CCV) in batch WG1905682 were low and outside of the method specified acceptance criteria. Information sent from the laboratory indicated the RRFs were 0.3319 and 0.3833 for 1,2,3-trichlorobenzene and 1,2,4-trichlorobenzene, respectively. Since the RRF of 1,2,3-trichlorobenzene was within the validation specified acceptance criteria and based on professional and technical judgment, no qualifications were applied to the 1,2,3-trichlorobenzene data. However, the non-detect results of 1,2,4-trichlorobenzene in the associated samples were UJ qualified as estimated less than the reported detection limit (RDL).

L1521386 and L1521403: The percent differences (%Ds) for acetone (23.0%), chloromethane (28.5%) and ethyl chloride (21.6%) in the CCV in batch WG1905682 were outside of the method specified acceptance criteria with low biases. Since the %Ds for acetone, chloromethane and ethyl chloride were within the validation specified acceptance criteria, no qualifications were applied to the data.

L1521386: The %Ds for 1,2,3-trichlorobenzene (24.8%), 1,2,4-trichlorobenzene (24.3%), 1,2-dibromo-3-chloropropane (37.7%), methyl ethyl ketone (49.4%), acetone (68.9%), and naphthalene (29.0%) in the CCV in batch WG1906549 were outside of the method specified acceptance criteria with low biases. Since the %Ds for 1,2,3-trichlorobenzene and 1,2,4-trichlorobenzene were within the validation specified acceptance criteria, no qualifications were applied to the 1,2,3-trichlorobenzene and 1,2,4-trichlorobenzene data. However, the non-detect results of 1,2-dibromo-3-chloropropane, methyl ethyl ketone, acetone, and naphthalene in the associated samples were UJ qualified as estimated less than the RDLs and the acetone concentrations were J qualified as estimated.

See attachment 3 at the end of this report for these qualifications.

1.2 Holding Time

The holding time for the VOC analysis of a preserved groundwater sample is 14 days from collection to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four method blanks were reported (batches WG1905682, WG1905720, WG1906549 and WG1907390). VOCs were not detected in the method blanks above the method detection limits (MDLs), with the following exceptions.

Naphthalene, n-butylbenzene, 1,2,4-trichlorobenzene, and 1,3,5-trimethylbenzene were detected at estimated concentrations greater than the MDLs and less than the RDLs, and 1,2,3-trichlorobenzene (0.814 µg/L) was detected above the RDL in the method blank in batch WG1906549. Since these compounds were not detected in the associated samples, no qualifications were applied to the data.

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were not reported. Precision and accuracy were assessed using the laboratory control sample (LCS)/LCS duplicate (LCSD) pair.

1.5 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two LCS/LCSD pairs and two LCSs were reported. The recovery and relative percent difference (RPD) results were within the laboratory specified acceptance criteria, with the following exceptions.

Both the recoveries of tert-butylbenzene in the LCS/LCSD in batch WG1905682 were high and outside of the laboratory specified acceptance criteria. Since tert-butylbenzene was not detected in the associated samples, no qualifications were applied to the data.

The recoveries of 2,2-dichloropropane and acrolein in the LCS in batch WG1906549 were high and outside of the laboratory specified acceptance criteria. Since 2,2-dichloropropane and acrolein were not detected in the associated samples, no qualifications were applied to the data.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Trip Blank

One trip blank, TRIP BLANK #482, was submitted with the sample sets. However, the trip blank was recorded on both COCs for L1521386 and L1521403. TRIP BLANK #482 was assigned two different laboratory identification numbers, L1521386-35 and L1521403-04. Although TRIP BLANK #481 was reported twice, it was only analyzed once. VOCs were not detected in the trip blank above the RDLs.

1.8 Field Duplicate

Four field duplicates, CMW17DS-080122-DUP, CMW18DS-080122-DUP, VMWK-080222-114.25-DUP and TS-C-EFF-080222-DUP were collected with the sample sets. Acceptable precision (RPD ≤ 30%) was demonstrated between the field duplicates and the original samples CMW17DS-080122, CMW18DS-080122, VMWK-080222-114.25 and TS-C-EFF-080222, with the following exception.

Tetrachloroethene was detected at a concentration greater than the RDL in sample VMWK-080222-114.25 and was not detected in VMWK-080222-114.25-DUP, resulting in a noncalculable RPD. Therefore, based on professional and technical judgment, the tetrachloroethene concentrations in VMWK-080222-114.25 was J qualified as estimated and the non-detect results in VMWK-080222-114.25-DUP was UJ qualified as estimated less than the RDL.

Sample	Analyte	Laboratory Result (µg/L)	Laboratory Flag	RPD	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
VMWK-080222-114.25	Tetrachloroethene	0.507	NA	NC	0.507	J	7
VMWK-080222-114.25-DUP	Tetrachloroethene	0.5	U		0.5	UJ	7

µg/L-micrograms per liter
U- Laboratory flag indicating compound was not detected at a concentration greater than or equal to the RDL
NA-Not applicable
NC-Noncalculable
*Validation qualifiers are defined in Attachment 1 at the end of this report
**Reason codes are defined in Attachment 2 at the end of this report

1.9 Sensitivity

The sample results were reported to the RDLs. Elevated non-detect results were not reported.

1.10 Electronic Data Deliverable (EDD) Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II report and the EDD.

2.0 VOLATILE ORGANIC COMPOUNDS

The samples were analyzed for selected VOCs per US EPA modified Method TO-15 using full scan mode.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable or not applicable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Laboratory Control Sample
- ✓ Surrogates
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

2.1 Overall Assessment

The VOC data reported in these laboratory reports are considered usable for supporting project objectives. The results are considered valid; the analytical completeness, defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for this data set is 100%.

2.2 Holding Time

The holding time for the TO-15 analysis of an air sample collected in a canister is 30 days from collection to analysis. The holding times were met for the sample analyses.

2.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Three method blanks were reported (batches 2207276-02A, 2208391-10A and 2209150-02A). VOCs were not detected in the method blanks above the method reporting limits (MRLs).

2.4 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Three LCS/LCSD pairs were reported. The RPDs were not reported by the laboratory; therefore, the RPDs were calculated by the validator based on the reported recovery results. The recovery and RPD results were within the laboratory specified acceptance criteria.

The laboratory also reported CCV standards. The CCV recoveries were within the method specified acceptance criteria.

2.5 Surrogates

The surrogate recoveries were within the laboratory specified acceptance criteria.

2.6 Sensitivity

The samples were reported to the MRLs. Elevated non-detect results were reported due to the sample dilutions analyzed.

2.7 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II reports and the EDDs.

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* * * * *

ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS
AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit. Upon application of the U qualifier to a reported result, the definition changes to "not detected at or above the reported result".

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Extraction or analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other
14	Lab flag removed or modified: no validation qualification required

LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample duplicate
RPD – Relative percent difference

ATTACHMENT 3
Analysis Anomaly Qualifications

Sample	Analyte	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
TS-C-EFF-080222	1,2,4-Trichlorobenzene	1	U,C4	1	UJ	9
TS-C-EFF-080222-DUP	1,2,4-Trichlorobenzene	1	U,C4	1	UJ	9
TS-C-INF-080222	1,2,4-Trichlorobenzene	1	U,C4	1	UJ	9
TRIP BLANK LOT#482	1,2,4-Trichlorobenzene	1	U,C4	1	UJ	9
VMWB-080222	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWC-080222	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWD-080222	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWE-080222	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWF-080222	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWG-080222	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWH-080222	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWI-080222-143.7	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWJ2-080222-120.25	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWK-080222-114.25	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWK-080222-114.25-DUP	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWL-080222-103.25	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWM-080222-94	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWN-080222-110.8	1,2-Dibromo-3-Chloropropane	2.5	U,C3	2.5	UJ	9
VMWB-080222	Methyl Ethyl Ketone	5	U,C3	5	UJ	9
VMWC-080222	Methyl Ethyl Ketone	5	U,C3	5	UJ	9
VMWD-080222	Methyl Ethyl Ketone	5	U,C3	5	UJ	9
VMWE-080222	Methyl Ethyl Ketone	5	U,C3	5	UJ	9
VMWF-080222	Methyl Ethyl Ketone	5	U,C3	5	UJ	9
VMWG-080222	Methyl Ethyl Ketone	5	U,C3	5	UJ	9
VMWH-080222	Methyl Ethyl Ketone	5	U,C3	5	UJ	9
VMWI-080222-143.7	Methyl Ethyl Ketone	5	U,C3	5	UJ	9

Sample	Analyte	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
VMWJ2-080222-120.25	Methyl Ethyl Ketone	5	U,C3	5	UJ	9
VMWK-080222-114.25	Methyl Ethyl Ketone	5	U,C3	5	UJ	9
VMWK-080222-114.25-DUP	Methyl Ethyl Ketone	5	U,C3	5	UJ	9
VMWL-080222-103.25	Methyl Ethyl Ketone	5	U,C3	5	UJ	9
VMWM-080222-94	Methyl Ethyl Ketone	5	U,C3	5	UJ	9
VMWN-080222-110.8	Methyl Ethyl Ketone	5	U,C3	5	UJ	9
VMWB-080222	Acetone	51.7	C3	51.7	J	9
VMWC-080222	Acetone	67.6	C3	67.6	J	9
VMWD-080222	Acetone	25	U,C3	25	UJ	9
VMWE-080222	Acetone	25	U,C3	25	UJ	9
VMWF-080222	Acetone	101	C3	101	J	9
VMWG-080222	Acetone	25	U,C3	25	UJ	9
VMWH-080222	Acetone	25	U,C3	25	UJ	9
VMWI-080222-143.7	Acetone	25	U,C3	25	UJ	9
VMWJ2-080222-120.25	Acetone	25	U,C3	25	UJ	9
VMWK-080222-114.25	Acetone	25	U,C3	25	UJ	9
VMWK-080222-114.25-DUP	Acetone	25	U,C3	25	UJ	9
VMWL-080222-103.25	Acetone	66.5	C3	66.5	J	9
VMWM-080222-94	Acetone	25	U,C3	25	UJ	9
VMWN-080222-110.8	Acetone	50.6	C3	50.6	J	9
VMWE-080222	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWF-080222	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWG-080222	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWH-080222	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWI-080222-143.7	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWJ2-080222-120.25	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWK-080222-114.25	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWK-080222-114.25-DUP	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWL-080222-103.25	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWM-080222-94	Naphthalene	2.5	U,C3	2.5	UJ	9
VMWN-080222-110.8	Naphthalene	2.5	U,C3	2.5	UJ	9

µg/L-micrograms per liter
U-Laboratory flag indicating compound was not detected at a concentration greater than or equal to the RDL
C3-Laboratory flag indicating CCV was low and outside the laboratory specified acceptance criteria; however, the method sensitivity check was acceptance
C4-Laboratory flag indicating CCV was low and outside the laboratory specified acceptance criteria

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Memorandum

Date:	23 January 2023
To:	Cindy Bartlett, RG, LG
	Geosyntec Consultants, Portland, Oregon
From:	Colleen Small
CC:	K. Henderson
Subject:	**Stage 2A Data Validation - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1554109 and L1554125 and Eurofins Air Toxics Work Orders # 2210158R1, 2211185 and 2212209**

SITE: Cascade

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of twenty-five groundwater samples, three field duplicates and two trip blanks, collected 3 November 2022, as well as eleven soil vapor samples, collected on 3 October 2022, 3 November 2022 and 7 December 2022, as part of the site investigation activities for the Cascade Corp., Fairview Oregon sampling event.

The groundwater samples were analyzed by Pace Analytical National [formerly ESC Lab Sciences (ESC)], Mt. Juliet, Tennessee for the following analytical test:

- United States (US) Environmental Protection Agency (EPA) Method 8260D – Volatile Organic Compounds (VOCs)

The air samples were analyzed by Eurofins Air Toxics, Folsom, California for the following analytical test:

- US EPA Modified Method TO-15 - Selected VOCs (1,1-Dichloroethene, Cis-1,2-Dichloroethene, Trichloroethene, Tetrachloroethene, And Vinyl Chloride)

EXECUTIVE SUMMARY

Overall, based on this Stage 2A data validation covering the quality control (QC) parameters listed below and based on the information provided, the data are usable for supporting project objectives.

The data were reviewed based on the following document, the pertinent methods referenced by the data package and professional and technical judgment:

- US EPA National Functional Guidelines for Organic Superfund Methods Data Review, November 2020 (EPA 540-R-20-005)

The following samples were analyzed in the data sets:

Laboratory ID	Client ID
L1554109-01	EW1-110322
L1554109-02	EW2-110322
L1554109-03	EW14-110322
L1554109-04	D17DG-110322
L1554109-05	D17DS-110322
L1554109-06	CMW10DS-110322
L1554109-07	CMW17DS-110322
L1554109-08	CMW17DS-110322-DUP
L1554109-09	CMW18DS-110322
L1554109-10	CMW19DS-110322
L1554109-11	VMWA-110322
L1554109-12	VMWB-110322
L1554109-13	VMWC-110322
L1554109-14	VMWD-110322
L1554109-15	VMWE-110322
L1554109-16	VMWF-110322
L1554109-17	VMWG-110322
L1554109-18	VMWH-110322
L1554109-19	VMWI-110322-143.7
L1554109-20	VMWJ2-110322-120.25
L1554109-21	VMWK-110322-114.25

Laboratory ID	Client ID
L1554109-22	VMWK-110322-114.25-DUP
L1554109-23	VMWL-110322-103.25
L1554109-24	VMWM-110322-94
L1554109-25	VMWN-110322-110.8
L1554109-26	TRIP BLANK#482
L1554125-01	TS-C-EFF-110322
L1554125-02	TS-C-EFF-110322-DUP
L1554125-03	TS-C-INF-110322
L1554125-04	TRIP BLANK#482
2210158-01A	SVE-EFF-100322
2211185-01A	SVE-EFF-110322
2211185-02A	VW-17d-95.5-110322
2211185-03A	VMWJ2-110322
2211185-04A	VMWK-110322
2211185-05A	VMWC-110322
2211185-06A	VMWE-110322
2211185-07A	VMWF-110322
2211185-08A	VMWG-110322
2211185-09A	VMWH-110322
2212209-01A	SVE-EFF-120722

The groundwater samples were received at the laboratory within the temperature criteria of 0-6 degrees Celsius (°C).

The following issues were noted on the chain of custody (COC) forms. No qualifications were applied to the data based on the issues discussed below.

- L1554109, L1554125 and 2211185: Incorrect error corrections were observed on the COCs instead of the proper procedure of a single strike through, correction, and initials and date of person making the corrections.

- L1554109 and L1554125: Sample Trip Blank#482 was recorded on both COCs and reported in the two laboratory reports with different laboratory IDs, but sample was only analyzed once.

- L1554109 and L1554125: A sample collection time for the trip blank was not documented on the COCs. The trip blank was logged by the laboratory with a sample collection time of 00:00.

- L1554109 and L1554125: The year for laboratory receipt date was not documented on the COCs.

- 2210158: The sample duration time for sample SVE-EFF-100322 was documented incorrectly. The actual sample duration is 5 minutes.

Laboratory report 2210158 was revised on 20 January 2023 to include the following narrative: Dilution was performed on sample SVE-EFF-100322 due to the presence of high-level target species. The revised report was identified as 2210158R1.

1.0 VOLATILE ORGANIC COMPOUNDS

The water samples were analyzed for VOCs per US EPA method 8260D.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

✓ Overall Assessment
✓ Holding Times
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
✓ Laboratory Control Sample
✓ Surrogate
✓ Trip Blank
✓ Field Duplicate
✓ Sensitivity
⊗ Electronic Data Deliverable Review

1.1 Overall Assessment

1.1.1 Completeness

The VOC data reported in these data packages are considered usable for supporting project objectives. The results are considered valid; the analytical completeness, defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for the sample set is 100%.

1.1.2 Analysis Anomaly

L1554109: The percent difference (%D) for acetone (30.2%) in the continuing calibration verification (CCV) in batch WG1956067 was high and outside the method specified acceptance criteria. Since the %D for acetone was within the validation specified acceptance criteria of 40%D, no qualifications were applied to the acetone data.

L1554109: The %D for Freon 12 (-26.9%) in the CCV in batch WG1956067 was low and outside the method specified acceptance criteria. Since the %D for Freon 12 was within the validation specified acceptance criteria of 40%D, no qualifications were applied to the Freon 12 data.

L1554109 and L1554125: The %D for acetone (25.0%) in the CCV in batch WG1956461 was high and outside the method specified acceptance criteria. Since the %D for acetone was within the validation specified acceptance criteria of 40%D, no qualifications were applied to the acetone data.

L1554109 and L1554125: The %Ds for acrolein (-33.5%), Freon 12 (-29.6%), 2,2-dichloropropane (-29.0%) and vinyl chloride (-24.4%) in the CCV in batch WG1956461 were low and outside the method specified acceptance criteria. Since the %Ds for Freon 12 and vinyl chloride were within the validation specified acceptance criteria of 40%D and 25%D, respectively, and based on professional and technical judgment, no qualifications were applied to the Freon 12 and vinyl chloride data. Since validation criteria is not listed for acrolein and 2,2-dichloropropane, the %Ds were less than 40% and based on professional and technical judgment, no qualifications were applied to the data.

1.2 Holding Time

The holding time for the VOC analysis of a preserved groundwater sample is 14 days from collection to analysis. The holding times were met for the sample analyses.

1.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Two method blanks were reported (batches WG1956067 and WG1956461). VOCs were not detected in the method blanks above the reported detection limits (RDLs).

1.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD)

MS/MSD pairs were not reported. Precision and accuracy were assessed using the laboratory control sample (LCS)/LCS duplicate (LCSD) pair.

1.5 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One LCS and one LCS/LCSD pair were reported. The recovery and relative percent difference (RPD) results were within the laboratory specified acceptance criteria, with the following exceptions.

The recoveries of acrolein, carbon disulfide and 1,1-dichloroethene in the LCS in batch WG1956067 were high and outside of the laboratory specified acceptance criteria. Since acrolein, carbon disulfide and 1,1-dichloroethene were not detected in the associated samples, no qualifications were applied to the data.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Trip Blank

One trip blank, TRIP BLANK #482, was submitted with the sample sets. However, the trip blank was recorded on both COCs for L1554109 and L1554125. TRIP BLANK #482 was assigned two different laboratory identification numbers, L1554109-26 and L1554125-04. Although TRIP BLANK #481 was reported twice, it was only analyzed once. VOCs were not detected in the trip blank above the RDLs.

1.8 Field Duplicate

Three field duplicates, CMW17DS-110322-DUP, VMWK-110322-114.25-DUP and TS-C-EFF-110322-DUP were collected with the sample sets. Acceptable precision (RPD $\leq$ 30%) was demonstrated between the field duplicates and the original samples CMW17DS-110322, VMWK-110322-114.25 and TS-C-EFF-110322, respectively.

1.9 Sensitivity

The sample results were reported to the RDLs. Elevated non-detect results were not reported.

1.10 Electronic Data Deliverable (EDD) Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. It was noted that the samples were reported to the RDLs in the level II reports; both the RDLs and the method detection limits (MDLs) were listed in the EDDs. No other discrepancies were identified between the level II reports and the EDDs.

2.0 VOLATILE ORGANIC COMPOUNDS

The samples were analyzed for selected VOCs per US EPA modified Method TO-15 using full scan mode.

The areas of data review are listed below. A leading check mark (✓) indicates an area of review in which the data were acceptable or not applicable. A preceding crossed circle (⊗) signifies areas where issues were raised during the course of the validation review and should be considered to determine any impact on data quality and usability.

- ✓ Overall Assessment
- ✓ Holding Time
- ✓ Method Blank
- ✓ Laboratory Control Sample
- ✓ Surrogates
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

2.1 Overall Assessment

The VOC data reported in these laboratory reports are considered usable for supporting project objectives. The results are considered valid; the analytical completeness, defined as the ratio of the number of valid analytical results (valid analytical results include values qualified as estimated) to the total number of analytical results requested on samples submitted for this analysis, for this data set is 100%.

2.2 Holding Time

The holding time for the TO-15 analysis of an air sample collected in a canister is 30 days from collection to analysis. The holding times were met for the sample analyses.

2.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four method blanks were reported (batches 2210158R1-02A, 2211185-10A, 2211185-10B and 2212209-02A). VOCs were not detected in the method blanks above the reporting limits (RLs).

2.4 Laboratory Control Sample

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four LCS/LCSD pairs were reported. The RPDs were not reported by the laboratory; therefore, the RPDs were calculated by the validator based on the reported recovery results. The recovery and RPD results were within the laboratory specified acceptance criteria.

The laboratory also reported CCV standards. The CCV recoveries were within the method specified acceptance criteria.

2.5 Surrogates

The surrogate recoveries were within the laboratory specified acceptance criteria.

2.6 Sensitivity

The samples were reported to the RLs. Elevated non-detect results were reported due to the sample dilutions analyzed.

2.7 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II report at a minimum of 20% as part of the data validation process. No discrepancies were identified between the level II reports and the EDDs.

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ATTACHMENT 1
DATA VALIDATION QUALIFIER DEFINITIONS
AND INTERPRETATION KEY
Assigned by Geosyntec's Data Validation Team

DATA QUALIFIER DEFINITIONS

U The analyte was analyzed for, but was not detected above the reported sample quantitation limit. Upon application of the U qualifier to a reported result, the definition changes to "not detected at or above the reported result".

J The analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

J+ The analyte was positively identified; however, the associated numerical value is likely to be higher than the concentration of the analyte in the sample due to positive bias of associated QC or calibration data or attributable to matrix interference.

J- The analyte was positively identified; however, the associated numerical value is likely to be lower than the concentration of the analyte in the sample due to negative bias of associated QC or calibration data or attributable to matrix interference.

UJ The analyte was not detected above the reported sample quantitation limit. However, the reported quantitation limit is approximate and may or may not represent the actual limit of quantitation necessary to accurately and precisely measure the analyte in the sample.

R The sample results are rejected due to serious deficiencies in the ability to analyze the sample and meet quality control criteria. The presence or absence of the analyte cannot be verified.

ATTACHMENT 2
DATA VALIDATION REASON CODES
Assigned by Geosyntec's Data Validation Team

Valid Value	Description
1	Preservation requirement not met
2	Extraction or analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits
6	Surrogate recovery outside limits
7	Field Duplicate RPD exceeded
8	Serial dilution percent difference exceeded
9	Calibration criteria not met
10	Linear range exceeded
11	Internal standard criteria not met
12	Lab duplicates RPD exceeded
13	Other
14	Lab flag removed or modified: no validation qualification required

LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample duplicate
RPD – Relative percent difference