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ANNUAL PERFORMANCE REPORT
1 JANUARY 2019 – 31 DECEMBER 2019

EAST MULTNOMAH COUNTY, TROUTDALE SANDSTONE AQUIFER REMEDY
ECSI 1479

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LIST OF ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
bgs	below ground surface
Boeing	The Boeing Company
Cascade	Cascade Corporation
COPC	chemicals of potential concern
CU1	Confining Unit 1
CSSWF	Columbia South Shore Well Field
CTS	Central Treatment System
DCE	1,2-dichloroethene
DEQ	Oregon Department of Environmental Quality
ECSI	Need definition?
EMC	East Multnomah County
EW	extraction well
ft	foot, feet
GETs	groundwater extraction treatment system
gpm	gallons per minute
IDW	Investigation-derived waste
lbs	pounds
MCL	maximum contaminant level
msl	mean sea level
NFA	No Further Action
NOAA	National Oceanic and Atmospheric Administration
OWRD	Oregon Water Resources Department
PCE	tetrachloroethene
PID	photoionization detector
PLC	programmable logistics controller
PUD	People's Utility District
PVC	polyvinyl chloride
PWB	Portland Water Bureau
ROD	Record of Decision
RWPUD	Rockwood PUD system

LIST OF ACRONYMS AND ABBREVIATIONS (Continued)

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 2019 – 31 December 2019

East Multnomah County Troutdale Sandstone Aquifer Remedy

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1.0 INTRODUCTION

This report is submitted on behalf of Cascade Corporation (Cascade) and The Boeing Company (Boeing) and 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 2019 through 31 December 2019 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 EMC Site discovery and groundwater investigations of the TSA and underlying Sand and Gravel Aquifer (SGA) began in 1986, and initial groundwater extraction using pump and treat methods commenced in 1993. Results of the early investigations indicated groundwater VOC concentrations above the maximum contaminant level (MCLs) for trichloroethene (TCE), tetrachloroethene (PCE), cis-1,2-dichloroethene, 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 treatment systems (GETs) have been operational since 1997 (interim operation prior to 1997) and successful in removing VOC mass from the saturated zone and decreasing the size of the dissolved VOC plume. 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).

1.1 Purpose of Report

The reporting period for the TSA remedy Annual Performance Report presents data through calendar year 2019. 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 groundwater extraction and treatment system and the soil vapor extraction (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 Lower TSA restoration 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 3.6 square miles that is bound by the Columbia River to the north, Fairview Avenue and Campbell Road to the east, NE Halsey Street to the south, and NE 181st Avenue to the West (Figure 1). The EMC Site is located in Sections 19, 20, 28, and 29 in Township 1 North, Range 3 East. Topography at the EMC Site is highest to the south and descends in elevation in a series of river/flood cut terraces northward to the Columbia River. The EMC Site discovery and groundwater investigations of the TSA and the 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 µg/L), PCE (5 µg/L), cis-1,2-DCE (70 µg/L), 1,1-DCE (7 µg/L), and VC (2 µg/L) measuring approximately 400 acres in the TSA.

Four TSA restoration areas were described in the ROD and subsequently assigned letters as follows:

TSA Restoration Zone	Zone Location
Zone A	Area north of Sandy Boulevard
Zone B	Area south of Sandy Boulevard in the western portion of the Boeing facility
Zone C	Area south of Sandy Boulevard directly east of Zone B and west of N.E. 205th Avenue
Zone D	Area south of Sandy Boulevard, directly east of Zone C and area east of N.E. 205th Avenue

These areas are shown in Figure 1-2.

Between 1993 and 2000, six GETs were installed to provide hydraulic capture of the dissolved VOC plume and to remove VOC mass. The approximate location of the former (decommissioned) GETs is shown on Figure 3-1. Below is a brief summary of each system:

- North Treatment System: Located in Zone A and began pilot testing in 1993 with full-scale operation starting in 1997 with one Upper TSA extraction well (EW-9), five Lower TSA extraction wells (EW-6, -7, -9, -19, and RPW-2), and one SGA extraction well (EW-20). The extraction wells were shut down and decommissioned in phases, and the treatment system was shut down in 2006 with DEQ approval (DEQ 2006) based on TCE concentrations below the cleanup level.

- SGA Treatment System: Cleanup of the SGA was implemented at one groundwater extraction well (EW-20) mentioned above, located in Zone A, as part of the North

Treatment System. Except at three wells (EW-20 and two nearby monitoring wells) where TCE concentrations were between 9.9 and 59 µg/L, TCE concentrations were consistently below the respective reporting limits for SGA wells. Groundwater extraction in the Lower TSA and the SGA successfully restored SGA groundwater by the year 2000 as cleanup goals were met, and the system was shut down in 2007.

- Far North Treatment System: Located in Zone A and installed as a stand-alone system with one Lower TSA extraction well EW-17. The system operated from 1998 to 2003 and was decommissioned with DEQ approval in 2007 because TCE concentrations were consistently below the cleanup level for the prior two years.

- West Treatment System: Located in Zone B and began operation in 1989. The system remains in operation for the Boeing TGA project (ECSI #13); however, operation of the system for TSA groundwater was discontinued in 2009. Historically, the system operated two Upper TSA extraction wells (EW-3 and EW-22) and one Lower TSA extraction well (EW-13). Extraction well EW-22 was decommissioned in 2010, and operation of EW-3 and EW-13 was discontinued in 2009, with DEQ's approval, based on TCE concentrations meeting cleanup levels. Wells EW-3 and EW-13 are currently utilized as groundwater monitoring wells.

- Central Treatment System (CTS): The system is installed in the TSA mound area in Zone C and started operation in 1997. The CTS continues to operate to provide hydraulic capture of the dissolved VOC plume. A total of 11 Lower TSA extraction wells (EW-1, -2, -4, -5, -8, -11, -12, -14, -15, -16, -18, and -23) route groundwater to the system. Currently, EW-1 (temporary shutdown mode), EW-2, EW-14, and EW-23 are in active operation. Wells EW-4, EW-16, and EW-18 have been decommissioned with DEQ approval based on TCE concentrations meeting cleanup levels, while the remaining wells were converted into groundwater monitoring wells.
- East Treatment System: Installed as a stand-alone system with one Upper TSA extraction well (EW-10). The system started operation in 1998 and was discontinued in 2001 due to groundwater VOC concentrations being below the MCLs; however, the well was subsequently operated for the property owner's beneficial use until 2005.

Currently, only the CTS remains in operation with four operating extraction wells, including EW-1 (in temporary shutdown mode), EW-2, EW-14, and EW-23.

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 7.0), is summarized in Table 2-2. A summary of significant documents exchanged with DEQ during the period are presented in Table 2-3.

2.1 Monitoring Program and Schedule Modifications

Monitoring schedule modifications implemented during the reporting period were presented in the *2018 Annual Performance Report: 1 January 2018 through 31 December 2018, Troutdale Sandstone Aquifer Remedy* (Geosyntec Consultants, Inc. [Geosyntec], Landau Associates, Inc [Landau], and S.S. Papadopulos & Associates, Inc. [SSPA], 2019). DEQ approved the modifications listed below on July 3, 2019 (DEQ, 2019):

- No changes except for cessation of monitoring in wells proposed to be decommissioned.
- Decommission Upper TSA wells BOP-22R(ds) and BOP-60R(ds) and Lower TSA wells CMW-8(dg) and CMW-10(dg) as groundwater quality objectives at these locations had met the Consent Order requirements.

Additional modifications recommended previously in the 2017 Annual Report (Geosyntec, Landau, and SSPA, 2018), which DEQ approved (DEQ, 2018), that were implemented in 2019 or are still pending are:

- Decommission upgradient monitoring wells DEQ-1(dg), DEQ-5(ds), DEQ-5(dg), and CMW-3 (completed).
- Decommission well BOP-71(ds). Decommissioning was postponed pending City of Gresham right of way acquisition and permit approval to remove this well, and damage to the well from an automobile collision in summer 2019 (completed[1]).
- Decommission SGA well BOP-44(usg), and TSA wells BOP-44(dg), BOP-44(ds), and EMC-2(dg), which are all located in Remedy Zone A. Although DEQ approved decommissioning these wells, the schedule for decommissioning has been delayed pending DEQ approval for partial closure of Remedy Zone A (pending).

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 water from the

[1] Well decommissioned in March 2020.

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 2019, the CSSWF was operated for one pumping event that began on 10 July and was ended on 27 August. The CSSWF operated for a total of 49 days and pumped 1.8 billion gallons (BGal) of groundwater (PWB, 2020). Below is the estimated pumped volume per aquifer during the summer shutdown:

- Sand and Gravel Aquifer: 1.1 BGal or approximately 61% of total production;
- Blue Lake Aquifer: 0.6 BGal or approximately 33% of total production; and
- Troutdale Sandstone Aquifer: 0.1 BGal or approximately 6% of total production.

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 (Landau Associates, 2015 and 2019). Water levels were collected continuously using pressure transducers with weekly manual checks to confirm data. Initial groundwater quality samples were collected on 6 August 2020 (as part of regular quarterly monitoring event) and 17 September 2020 for post-PWB pumping contingency sampling.

In addition to the PWB pumping event from the well field located north of the remedy area, the Rockwood Water People's Utility District (Rockwood PUD) periodically operated three SGA wells located near 181st Avenue and NE Halsey Street (southwest of the remedy area). Between 1 June and 30 September 2018, approximately 0.21 BGal of groundwater was pumped from the Rockwood PUD system (RWPUD, 2020).

3.0 EXTRACTION AND TREATMENT SYSTEMS

This section summarizes the operation and performance of the GETs, as well as the SVE system implemented in 2015-2019. The groundwater CTS is the only GETs remaining in operation for the TSA remedy in 2019. Up to six former GETs were operated for the EMC site historically and were closed down with DEQ's approval and decommissioned when no longer needed for hydraulic capture for the dissolved VOC plume. The decommissioned GETs, treated water lines, and extraction and monitoring wells are shown in Figure 3-1. Currently, the CTS operates to remove VOC mass from the saturated zone and maintain ongoing hydraulic plume control for the TSA groundwater contamination from three Lower TSA extractions wells, which are shown in Figure 1-2. Current operating extraction wells are EW-2 and EW-14, located in the mound area near the CTS, and EW-23 located on the Boeing property in the western treatment area.

Historically, extraction wells have been shut down once TCE concentrations are consistently below the MCL. The shutdown extraction wells are typically utilized as groundwater monitoring locations or decommissioned based on DEQ approval. Upper TSA extraction well EW-3 and Lower TSA extraction wells EW-1, EW-5, EW-8, EW-11, EW-12, EW-13, EW-15, and EW-16 remain in use as monitoring wells.

Well construction details and location coordinates for current monitoring and extraction wells are summarized in Table 3-1.

3.1 CTS Operational Summary

The CTS treats and captures groundwater through the operation of three Lower TSA extraction wells (EW-2, EW-14, and EW-23). Daily flow data from each well are recorded by the automated programmable logistics controller (PLC) system. Data from the PLC are downloaded weekly, and manual inspections and system field checks are also conducted weekly. Routine system inspections include manual collection of total flow meter 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:

- 16-17 April: EW-14 was shut down for sonar cleaning; and
- 19 August: All wells were offline for electrical maintenance work.

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

- 21 January and 8 April: EW-23 was offline because the vault flooded during high precipitation events. The vault was pumped out, and the pump restarted.
- 14 February: All wells were offline as a result of area-wide power loss. Wells restarted the same day.

- 25 February – 13 March: PLC complete failure. All wells were offline for PLC reprogramming and installation of an uninterrupted power supply unit.
- 28 September – 1 October: All wells were offline as a result of power loss, possibly due to lightning.

Significant repair and cleaning events for the operating TSA extraction wells in 2019 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 2019), and water level controls (new transducers and a barometer in 2019/2020).

3.2 Groundwater Extraction Rates

Target flow rates for the extraction wells have been established to maintain hydraulic capture of the dissolved VOC plume. The 2019 target extraction rates were: EW-2 at 25 gallons per minute (gpm), EW-14 at 20 gpm, and EW-23 at 30 gpm.

Flows at EW-2, EW-14, and EW-23 averaged 28, 22, and 29 gpm, respectively, and were either on target or close to target flow rates. In November 2019, transducer issues resulted in the reduction of flow rate in EW-2 and EW-14 pending replacement of transducers in these wells (January 2020). Flow rates were sufficient to maintain hydraulic capture in the Mound Area of the site, as evident by groundwater elevations and gradients (discussed in Section 4.2) and TCE concentrations in nearby wells (discussed in Section 4.3).

Flow rate and water level data for extraction wells are provided in Appendix A, with average monthly extraction well flow rates over the most recent five-year period in Figures A-1 through A-3 and combined average monthly flow for all wells in Figure A-4. Average flow data for the 12-month reporting period 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. Permits to discharge treated groundwater effluent from the CTS are 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, January through December 2019, was 80 gpm (Appendix A, Table A-1);

- Effluent pH ranged from 7.7 to 7.9 standard units (SU) and remained within the effluent limits of 6 to 9 SU;
- Effluent temperature ranged from 60 to 66 degrees Fahrenheit (F); and
- VOCs were not detected at the respective laboratory reporting limits in quarterly effluent samples.

Performance data were in compliance with permit limits.

3.4 Well Decommissioning

Decommissioning of DEQ-1(dg), DEQ-5(ds), DEQ-5(dg), and CMW-3 was proposed in the *2017 TSA Annual Report* (Geosyntec et al., 2018) and approved by DEQ (DEQ, 2018). Decommissioning of wells BOP-22(R)ds, BOP-60(R)ds, CMW-8(dg), and CMW-10(dg) was proposed in the *2018 TSA Annual Report* (Geosyntec et al., 2019) and approved by DEQ (DEQ, 2019c). Decommissioning for these wells was recommended because the concentrations of VOCs met the TSA criteria for well decommissioning, as outlined in Table 2-1.

The Oregon Water Resources Department (OWRD) approved special standards to allow for the following wells to be decommissioned by backfilling in-place instead of overdrilling: DEQ-1(dg), DEQ-5(ds), DEQ-5(dg), BOP-22(R)ds, BOP-60(R)ds, CMW-8(dg), and CMW-10(dg). Work plans documenting the well decommissioning methods, procedures, and OWRD special standards authorization letters were approved by DEQ on 12 June 2019 and 15 October-2019 (Geosyntec 2019b; Geosyntec and Landau Associates, 2019; DEQ 2019b, e). A total of six groundwater monitoring wells were decommissioned in 2019 utilizing Oregon State-certified drilling companies:

- DEQ-1(dg), DEQ-5(ds), and DEQ-5(dg) in July 2019 were decommissioned by backfilling in place;
- BOP-22(R)ds and BOP-60(R)ds in November 2019 were decommissioned by backfilling in place; and
- CMW-3 in December 2019 were decommissioned by overdrilling.

Two Lower TSA wells, CMW-8(dg) and CMW-10(dg) were approved by DEQ for decommissioning and will be decommissioned once the property owner grants access.

Investigation-derived waste (IDW) generated during decommissioning activities included the following:

- IDW consisted primarily of excess grout and small pieces of cement from monuments generated during backfilling activities. Waste generated from overdrilling CMW-3 included similar material from the backfilling operation, and along with polyvinyl

chloride (PVC) well casing and screen material, were placed in separate 55-gallon drums and disposed of. The steel aboveground monuments and bollards and large pieces of concrete were recycled. The above-listed IDWs for Boeing managed wells (BOP-22R[ds] and BOP-60R[ds]) were disposed of at the Hillsboro Landfill under contract with the facility, while itemized IDW disposal receipts for the remaining wells are included in Appendix B.

- Water generated from decommissioning activities, including water displaced from the wells during backfilling and wash/decontamination water, was stored in 55-gallon drums and transported to the respective groundwater treatment systems for treatment; water generated for wells BOP-22R(ds) and BOP-60R(ds) were routed to the Boeing Site while the remaining generated water was routed to the Cascade Site.

3.5 Soil Vapor Extraction

The SVE system is an additional corrective measure that has been implemented in the TSA mound area where VOC concentrations in the groundwater have responded slowly to the pump and treat remedy. 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) and again in Spring 2019 with installation of three wells (VMW-E, VMW-F, and VMW-G) angled towards groundwater monitoring well CMW-18(ds) and one vertical well VMW-H to the west of VMW-C. DEQ approved further expansion of the SVE system to the west (near well D-17ds) onto the adjacent property, and installation of five SVE wells is being considered based on the ongoing evaluation of the success of the current SVE system, site access, and potential site development activities (DEQ, 2019a).

SVE was discontinued at specific wells once mass removal reached asymptotic levels. Vapor extraction at the two shallow wells VW-17D-42.5 and VW-17D-75 was discontinued in 2016, and these wells were subsequently decommissioned in 2018. Shutdown and rebound testing for SVE wells VMW-A, VMW-B, and VMW-D was conducted in 2019.

SVE wells VW-17D-95.5 and VMW-C operated almost continuously throughout 2019, while newly installed wells VMW-E through VMW-H operated nearly continuously since March 2019, as discussed in the following sections. The SVE system wells and underground piping are shown in Figure 3-2.

3.5.1 Vapor/Groundwater Well Installation

Four vapor/groundwater monitoring wells (VMW-E, -F, -G, and –H) were installed in 2019 to evaluate enhanced removal of VOCs in the vadose zone and capillary fringe that may contribute mass to the groundwater plume as the water table rises near TSA monitoring wells that continue to show increased TCE concentrations. DEQ approved the Work Plan (Geosyntec, 2019a) on

7 February 2019 (DEQ, 2019a). The four vapor/groundwater wells were screened through the vadose zone and the upper portion of the saturated zone to allow for wells to be utilized for SVE operation, vapor monitoring, and groundwater monitoring. The four wells were installed in February 2019 using a truck-mounted roto-sonic drilling rig operated by Yellow Jacket Drilling, as follows:

- Wells VMW-E, VMW-F, and VMW-G are angled wells intended to expedite mass removal and monitor groundwater in the vicinity of groundwater monitoring well CMW-18ds. Total angled depths of the wells range from 160 to 171 feet (ft) below ground surface (bgs).
- Well VMW-H is a vertical well and was installed in the western portion of the SVE treatment area at a depth of 106 ft bgs.

The vapor monitoring wells were constructed of 4-inch, schedule 40 PVC with 20-ft-long, 10-slot screens, and aboveground monuments. The wells were designed and installed to intersect TSA groundwater for use as both vapor and groundwater monitoring.

Telescoping drilling methods were utilized during drilling, and a bentonite seal was placed at the base of the Troutdale Gravel Aquifer (TGA) before advancing into the underlying Confining Unit 1 (CU1). Outer casing used in the TGA was 10 inches in diameter and stepped down to 8- and/or 9-inch diameter casing for drilling/advancing through CU1 and the upper TSA. Observations made during the advancement of the borings included soil and rock type descriptions and results of field screening (photoionization detector [PID] measurements). Soil types were characterized using the United Soil Classification System as a guideline. Boring and monitoring well construction logs are provided in Appendix C, and well construction details are summarized in Table 3-1.

SVE piping was installed in belowground trenches approximately 12 inches bgs to connect the four new vapor/groundwater monitoring wells to the existing SVE system. Extraction from the four new vapor/groundwater monitoring wells commenced 26 March 2019, and initial flow measurements were consistent with design parameters and ranged from 50 to 86 scfm.

3.5.2 SVE Rebound Testing

The SVE Expansion and Rebound Testing Work Plan (Geosyntec, 2019) approved by DEQ (DEQ, 2019a) included shutdown of vapor/groundwater monitoring wells VMW-A, VMW-B, and VMW-D followed by resampling to evaluate if VOC vapor concentrations would increase (or rebound) following cessation of extraction. VMW-A, VMW-B, and VMW-D were selected for rebound testing due to reduced vapor concentrations and mass removal efficiency (i.e., low to no remaining mass removal).

Rebound testing included collection of vapor samples shortly after well shutdown (February 2019) and four months later (June 2019). The entire SVE system was shut down between 19 February and 26 March 2019 for installation and connection of the new SVE wells (VMW-E, VMW-F, VMW-G, and VMW-H). The SVE system resumed operation on 26 March 2019; however, vapor wells VMW-A, VMW-B, and VMW-D remained shut down during the rebound testing period. VOC results at these three wells were below detection limits during both sampling events (Appendix C, Table C-2). These results indicate that VOC concentrations did not rebound after an extended non-operational period (referred to as "passing the rebound test") at wells VMW-A, VMW-B, and VMW-D. Operations at VMW-A, VMW-B, and VMW-D were resumed 27 August 2019 to determine whether elevated groundwater TCE concentrations at CMW-17(ds) were a possible result of shutdown of nearby SVE wells VMW-A, VMW-B, and VMW-D. Vapor samples were again collected at VMW-A, VMW-B, and VMW-D on 3 October 2019, and VOC results were below detection (Appendix C, Table C-2). Because VOCs were not detected in vapor samples at these wells, it was concluded that no mass removal was occurring from operation of these wells, so VMW-A, VMW-B, and VMW-D operations were discontinued 22 October 2019. The three shutdown wells are currently utilized as quarterly groundwater sampling locations.

VOCs were detected in vapor in the six currently operating SVE wells, and rebound testing on these wells is not recommended at this point.

3.5.3 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 PVC piping and a total of 9 vapor extraction wells via belowground PVC piping. A PVC exhaust stack directly discharges into the atmosphere at a height of approximately 8 ft. The SVE system maintained an average flow rate of around 373 standard cubic feet per minute (scfm) in 2019 (Appendix C; Table C-1; Figure C-2).

3.5.4 SVE System Monitoring

Routine SVE system monitoring was conducted in the nine SVE wells (VMW-A, VMW-B, VMW-C, VMW-D, VMW-E, VMW-F, VMW-G, VMW-H, and VW-17d-95.5) during quarters in which the wells are operating, as summarized in the table below:

Well Name	Vapor Monitoring (PID)	Vapor Sampling (Summa)
VMW-17d-95.5 (soil vapor only)	Quarterly	Quarterly
VMW-A	Periodic[2]	Periodic[2]
VMW-B	Periodic[2]	Periodic[2]
VMW-C	Quarterly	Quarterly

[2]Well rebound testing conducted between February and June 2019. Well also operated between August and October 2019. Well is currently shutdown and utilized as a groundwater monitoring well. See Section 3.5.2.

Well Name	Vapor Monitoring (PID)	Vapor Sampling (Summa)
VMW-D	Periodic[2]	Periodic[2]
VMW-E	Quarterly	Quarterly
VMW-F	Quarterly	Quarterly
VMW-G	Quarterly	Quarterly
VMW-H	Quarterly	Quarterly
Effluent	Monthly	Monthly

The monitoring consisted of the following parameters for the nine SVE wells operated in 2019, as well as the system outlet, as follows:

- 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 SVE wells.

VOC results from PID measurements and laboratory testing are summarized in Tables C-1 and C-2, and the analytical results are shown in Figure C-1. As shown in Figure 1, PID and analytical results mirror each other. Analytical laboratory reports and data validation memoranda are provided in Appendix F.

3.5.5 SVE System Monitoring Results

The 2019 analytical results indicate that the highest TCE vapor concentrations were detected at angled well VMW-F (located east of the CTS) and ranged from 77 to 2,340 micrograms per cubic meter. However, groundwater samples collected from the VMW wells indicate that the highest TCE concentrations were detected at angled well VMW-E and ranged from 7.04 to 43.4 micrograms per liter (µg/L). Vapor analytical results are summarized in Tables C-1 and C-2, and groundwater analytical results are summarized in Table E-1

In addition to the quarterly samples collected at the SVE wells, groundwater samples were also collected quarterly at nearby well CMW-17(ds), which is located adjacent to the vapor wells and screened near the top of the Upper TSA. CMW-17(ds) is screened from elevation 14 to 24 ft mean sea level (msl), at depths of 98 to 108 ft bgs. The elevation of the CMW-17(ds) screen correlates to a depth just below where the deepest vapor monitoring well (VW-17d-95.5 is screened from elevation 44.5 to 24.5 ft msl). Groundwater VOC concentrations at CMW-17(ds) significantly decreased from 42.9 to 7.13 µg/L between February 2017 and August 2018 (which correlates to the time of the active SVE operation in nearby wells). However, groundwater concentrations at CMW-17(ds) increased in 2019 from 43.7 to 61.2 µg/L, as shown on Appendix E, Figure E-1. Additional evaluation of TCE concentrations in this area of the remedy are under review.

3.5.6 SVE System Mass Removal

The SVE system removed approximately 9 pounds (lbs) of VOCs in 2019 and a total of approximately 69 lbs of VOC mass from the unsaturated zone of the TSA mound area since the startup of the SVE Pilot Study in 2014 (Table C-3). Mass removal in 2019 decreased by approximately 2 lbs from the 2018 total of 11 lbs as a result of decreased extracted vapor concentrations. This mass removal decrease is typical of SVE system operation and an expected result of continued mass removal from the subsurface. SVE system operational 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, C-2, 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, or annually 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 located in 11 wells (four Upper TSA wells, six Lower TSA wells, and one SGA well). Pressure transducers are utilized in wells selected as part of the PWB contingency monitoring plan. Water level data are downloaded monthly from the pressure transducers.

During the 2019 operation of municipal well fields PWB and Rockwood PUD, drawdown in remedy well groundwater wells of approximately 11 ft in the Upper TSA (well BOP-22R[ds]), 10 ft in the Lower TSA (well BOP-60[dg]), and over 60 ft in the SGA (BOP-44[usg]) were observed along the western and northern portions of the remedy area.

Groundwater depths and groundwater elevations are summarized in Table D-1 of Appendix D. 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 12-month reporting period was approximately 26.6 inches, which is approximately 9.3 inches below the normal 36.0 inches of annual precipitation at the Portland Airport (National Oceanic and Atmospheric Administration [NOAA], 2020).

4.2 Groundwater Flow and Hydraulic Capture

As defined in the ROD, the objectives of the TSA-dissolved VOC plume remedy are to: 1) maintain hydraulic capture; 2) prevent further vertical and horizontal spread of VOC contaminants; and 3) 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 towards the operating extraction wells continued in 2019 due to ongoing remedy pumping. Groundwater contours for the semiannual water level measurement event (February 2019) and the annual event (August 2019) are provided in Figures 4-1a,b and 4-2a,b. Groundwater flow in the Upper TSA exhibits a radial flow pattern near the TSA mound area and is generally towards the north in other areas of the remedy. Lower TSA inward hydraulic gradients toward the extraction wells are indicative of hydraulic capture and demonstrate the effectiveness of Lower TSA extraction wells EW-2, EW-14, and EW-23 in achieving and maintaining capture. Groundwater flow directions in the Lower TSA in the mound

area do not vary significantly from wet to dry season and are strongly influenced by the operating extraction wells. These extraction wells capture groundwater within areas of the site with TCE concentrations above the cleanup level. Hydraulic capture of the dissolved VOC plume is also exhibited by the VOC concentrations, as discussed below.

4.3 Groundwater Quality

Groundwater quality is evaluated against the MCL for the site chemicals of potential concern (COPCs). TCE is the predominant COPC by mass and is used to evaluate remedy progress. TCE has an MCL of 5 µg/L.

Groundwater samples are collected for analytical testing on a quarterly, semi-annually, annually, or biennial frequency, based on the DEQ-approved Performance Monitoring Schedule (Table 2-2). Sampling events occur in February (quarterly and semiannual events), May (quarterly event), August (quarterly and annual events), and November (quarterly event). The annual sampling event includes the comprehensive list of wells. Biennial analytical monitoring is conducted during odd number calendar years (e.g., 2019 and 2021). The Performance Monitoring Schedule is reviewed annually to optimize the monitoring program to maintain compliance with the ROD.

Analytical results for groundwater samples collected during the 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 three operating extraction wells are presented in Appendix E, Figures E-1 through E-7. TCE concentration contours for the semiannual event (February 2019) and the annual event (August 2019) 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 in the Upper TSA mound area (located in Remedy Zone C) during the monitoring period (January through December 2019) were as follows:

- CMW-17(ds): 43.7 to 61.2 µg/L (Figure E-1);
- BOP-13(ds): 2.3 to 2.7 µg/L (Figure E-2);
- CMW-10(ds): 13.9 to 17.3 µg/L (Figure E-3);
- CMW-18(ds): 64.0 to 102 µg/L (Figure E-4); and
- Vapor monitoring wells (VMW-A through VMW-H) ranged from 0.6 µg/L (VMW-H) to 43.4 µg/L (VMW-E).

TCE concentrations in remaining Upper TSA wells outside of the mound area were below the MCL. TCE concentrations at CMW-18(ds) ranged from 64 to 102 µg/L in 2019, and at adjacent vapor/groundwater monitoring wells VMW-E, VMW-F, and VMW-G, range from 1.37 to

43.4 µg/L and appear to be localized to the Mound Area. Historically, TCE concentrations at well CMW-26(ds), located to the east, were below the MCL from 2002 to 2005. CMW-26(ds) was decommissioned in 2005 because TCE concentrations met remedy performance criteria. TCE concentration contours for February and August 2019 are shown in Figures 5-1a and 5-2a. The approximate area of the Upper TSA TCE plume is approximately 14 acres.

4.3.2 Lower TSA

In the western portion of the remedy area, Remedy Zone B, TCE concentrations in the Lower TSA were below the MCL at in all wells sampled. At well BOP-31(dg), located along the western portion of the TSA mound area, TCE concentrations ranged from 0.20 to 1.30 µg/L (Figure E-5). TCE concentrations were also below the MCL at EW-23 (Figure E-7).

In the central portion of the remedy area, Remedy Zone C, the highest TCE concentration in the Lower TSA continued to occur in the mound area well D-17(ds), where concentrations ranged from 53.7 to 61.2 µg/L (Appendix E, Figure E-6). TCE concentrations at D-17(ds) generally decreased after resaturation in 2009 through 2016. However, since 2016 TCE concentrations steadily increased to 61.2 µg/L before the last two sampling events in 2019, when concentrations slightly decreased to 57.5 µg/L. Monitoring well D-17(ds) is screened at the top of the Lower TSA across the water table, while well D-17(dg) is screened in the lower portion of the Lower TSA. TCE concentrations at D-17(dg) ranged from 0.796 to 1.23 µg/L in 2019 (Table E-1), indicating that groundwater impacts in this area of the Site are localized to the upper portion of the Lower TSA.

TCE concentrations were below the MCL at non-pumping extraction wells used for monitoring (EW-1, EW-8, and EW-12), with the exception of the November 2019 sampling event at EW-1 (7.14 µg/L). It should be noted that the February 2020 results for EW-1 were non-detect at the laboratory reporting limit. TCE concentrations at extraction wells EW-2 (11.2 to 13.5 µg/L) and EW-14 (5.94 to 8.19 µg/L) exceeded the TCE MCL (Figure E-7).

In the eastern portion of the Site, TCE concentrations remained at the Lower TSA extraction wells (now used for monitoring) have been below the MCL since 2009 at EW-11, below method detection limits (0.5-1.0 µg/L) since 2010 at well EW-15, and below the MCL since 2013 at EW-16. One exception in Zone D is well CMW-26(dg), where TCE concentrations were above the MCL during the February and August events (6.51 and 6.27 µg/L). Prior to this, TCE concentrations at CMW-26(dg) were below the MCL from August 2013 through May 2018. This well was damaged during property redevelopment sometime during winter 2019/2020, and the well may no longer be viable. The status of this well will be documented in a separate pending letter to DEQ.

TCE concentrations for the Lower TSA wells sampled in 2019 are shown in Figures 5-1b and 5-2b. The approximate area of the Lower TSA TCE plume is approximately 16 acres.

4.4 Remedy Zone A

Based on DEQ's approval of recommendations in the 2017 and 2018 Annual Reports (DEQ, 2018, 2019c), groundwater quality sampling was not conducted in 2019 at Remedy Zone A monitoring wells. The City of Portland PWB reported isolated low-level (below the MCL) TCE detection at well PWB-1(lts) and posed questions to DEQ about EMC TSA hydraulic capture as part of the interagency agreement. Groundwater samples were collected during the EMC TSA monitoring events (February 2019) and as part of PWB Contingency Monitoring (August 2019) from Lower TSA well PWB-1(lts) and Upper TSA well PWB-1(uts).

PWB sampling results are summarized in the table below.

Location	Sample Date	TCE (µg/L)
PWB-1(uts)	8/6/2019	<0.50
PWB-1(lts)	2/6/2019	1.39
PWB-1(lts)	8/6/2019	1.42

The low-level TCE concentrations detected in PWB-1(lts) are less than half of the MCL, and TCE is not detected above the laboratory limits in TSA remedy wells located between well PWB-1(lts) and the TSA mound area where elevated TCE concentrations remain. TCE concentrations since 2005 at PWB-1(lts) have fluctuated in the range of 0.86 ug/L and 1.7 ug/L, and the concentrations reported in 2019 were within this range. TCE results from PWB-1(lts) appear to indicate an isolated area with low-level TCE concentrations. TSA Remedy groundwater extraction ceased in the mid-2000s in Zone A, and the Far North and North Treatment systems were decommissioned in 2007 and 2008 (decommissioned treatment systems are shown in Figure 3-1).

4.5 TCE Mass Removal in Saturated TSA

TCE mass removal estimates are based on groundwater VOC concentrations and average quarterly groundwater flow for the operating extraction. In 2019, approximately 2.4 lbs of TCE mass were removed through the GETs, a decrease from the 2.6[3] lbs removed in 2018. The decreased mass removal is the result of pilot-shutdown of EW-1; however, increased extraction primarily from EW-2 and secondarily from EW-14 occurred (combined flow rate of 50 gpm from EW-2 and EW-14 compared to 42 gpm from these wells in 2018). Since startup of the GETs in 1996, an estimated total of 497 lbs of VOC mass have been removed from the TSA and SGA. Decreased and declining mass reduction through time is expected, as areas have cleanup and extraction wells taken offline. 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).

[3] A calculation error was noted in the 2018 Annual Report and is corrected herein such that the TCE mass removed in 2018 was 2.6 lbs, not 1.3 lbs as reported.

5.0 PERFORMANCE SUMMARY

In summary, the EMC TSA GETs has been effective at reducing TCE concentrations over the last 27 years. The TCE plume in the TSA has contracted from an original approximate 400 acres in the mid-1990s to approximately 14 acres in the Upper TSA and 16 acres in the Lower TSA (respectively) in 2019. EMC TSA Remedy groundwater extraction and soil vapor extraction systems were operational in 2019 and resulted in over 2.4 lbs and 9 lbs of TCE mass removed, respectively (Remedy total of 497 lbs and 69 lbs). The overall TCE plume footprint has contracted in the western portion of the Site (Zone B), although it persists in the mound area (Zone C).

TCE concentrations were above the MCL at 8 of 43 groundwater monitoring wells and 8 of the 9 vapor/groundwater monitoring wells sampled (16 total wells). 15 of these wells (not including CMW-26dg, located in Zone D) with TCE above the MCL, are located in TSA Remedy Zone C (mound area). TCE concentrations at these mound area wells have varied over the last three years but are below historic high concentrations. Further evaluation to determine if additional remedy optimization is needed is described in the following subsections below.

Significant remedy performance findings are summarized below.

- ROD remedy objectives for hydraulic capture continued to be achieved in 2019. Groundwater flow directions in the Upper and Lower TSA indicate ongoing inward and downward flow towards the operating extraction wells, and towards the north-northeast for Upper TSA wells located outside of the influence of the remedy pumping (Figures 4-1a,b and 4-2a,b).
- The 12-month average flow rate from the operating extraction wells was 80 gpm, which was less than the rate during the previous reporting period (91 gpm). The average rate is less due to temporary shutdown of EW-1. The combined flow rates from EW-2 and EW-14 were 50 gpm, which is greater than combined rate of 42 gpm from these wells in 2018. Average flow rates at extraction wells EW-2 (28 gpm), EW-14 (22 gpm), and EW-23 (29 gpm) are near the design target flow rates. Upgrades to the CTS and PLC in recent years have strengthened the GETs against power surges and aging infrastructure.
- In the Upper TSA, TCE concentrations were above the MCL in the TSA mound area (located in Remedy Zone C) at groundwater wells CMW-17(ds), CMW-10(ds), and CMW-18(ds) and in groundwater samples collected from VMW-A, -B, -C, -D, -F, and -G in 2019. TCE concentrations in wells located outside of the mound area are either below the laboratory reporting limit or the MCL. TCE concentrations for the Upper TSA wells are shown in Figures 5-1a and 5-2a.

- In the Lower TSA, the highest TCE concentrations remain in the mound area at well D-17(ds), as shown in Figures 5-1b and 5-2b. Outside the mound area, TCE concentrations at monitoring wells were either below the laboratory reporting limit or the MCL, with the exception of well CMW-26(ds), located in Remedy Zone D.
- TCE concentrations for Lower TSA extraction wells EW-2, EW-14, and EW-23 remained generally stable and consistent with previous years. The highest TCE concentrations measured in the extraction wells during this reporting period were at EW-2; TCE concentrations were below the MCL at extraction well EW-23.
- The GETs in 2019 removed approximately 2.4 lbs of TCE mass compared to 2.6 lbs in 2018. The slight decrease in mass removal is primarily the result of no longer pumping EW-1 in 2019.
- The SVE system was expanded in 2019 to include four new wells and removed approximately 9 lbs of VOC vapor mass compared to 11 lbs removed in 2018. The SVE system has removed a total of approximately 69 lbs of VOC mass from the unsaturated zone near the mound area since startup in 2014. Decreased mass removal in 2019 versus 2018 is typical of SVE systems and the result of declining extracted vapor concentrations.

6.0 RECOMMENDATIONS AND FUTURE PLANNED ACTIVITIES

As reported in 2018 and 2019 (Geosyntec, et al, 2018 and 2019), water-quality restoration was achieved in the SGA and in the Upper and Lower TSA north of Sandy Boulevard (Remedy Zone A). DEQ approved proceeding with a Partial Closure for these Remedy Zones (DEQ, 2018), including decommissioning of four remaining wells (BOP-44(ds), BOP-44(dg), BOP-44(usg), and EMC-2(dg)).

Water quality restoration has also been achieved in the western portion of the remedy (Remedy Zone B) and the vast majority of the eastern portion of the remedy (Remedy Zone D). In 2019, all Zone B wells were consistently below the MCL for the first time since the start of the EMC Remedy. Groundwater monitoring is anticipated to extend for two years to verify that concentrations remain below the MCL, at which time a request for a Zone B partial (or conditional) No Further Action (NFA) will be submitted for DEQs consideration.

Residual TCE was detected just above the MCL during three sampling events at monitoring well CMW-26dg, located in the eastern portion of the remedy area (Remedy Zone D). CMW-26dg was recently damaged during property redevelopment activities, and future use of the well is being evaluated. TCE concentrations at the remaining two Zone D wells are below the MCL in Remedy Zone D wells and meet remedy performance criteria for decommissioning. Depending on the outcome for well CMW-26dg, a partial NFA may be discussed with DEQ.

Residual TCE was detected above or near the MCL in two areas, the mound area in the Upper and Lower TSA (Remedy Zone C) and occasionally at monitoring well (CMW-26ds), located in the eastern portion of the remedy area (Remedy Zone D).

We request DEQ concurrence for the following proposed changes to support potential accelerated closure by optimizing the monitoring programs and the remedy performance.

6.1 Recommended Changes for Treatment Systems

The CTS continues to operate and maintain hydraulic control of the dissolved VOC plume. It is recommended to continue operation of wells EW-2 and EW-14 and temporary shutdown of EW-23. TCE concentrations in EW-23 have been below the MCL since August 2013 and thus meet criteria for a temporary shutdown. TCE concentrations at the groundwater monitoring wells within the treatment radius of EW-23 declined to below the MCL over the last year. Continued groundwater monitoring will be conducted to evaluate if resumed pumping at EW-23 is needed, per the Remedy Well Network Criteria (2-1).

We further recommend the continued temporary shutdown of EW-1 to allow for increased flushing in the TSA mound area at EW-2 and EW-14.

The SVE system has been effective at removing VOC mass from the unsaturated zone. DEQ approved a work plan to further expand the SVE system to the west towards D-17(ds); however, this activity is being evaluated and discussed with the current property owners as they propose site development. No changes are recommended for the currently operating SVE system at this time. SVE will continue at 6 wells (WV-75-95.5, VMW-C, VMW-E, VMW-F, VMW-G, and VMW-H) in 2020.

6.2 Recommend Changes to Monitoring Program and Schedule Modifications

The following monitoring program and schedule modifications are recommended for DEQ approval:

- Decommission Upper TSA wells BOP-21(ds) and BOP-42(ds) along with Lower TSA wells BOP-42(dg) and BOP-60(dg). The four wells are located in the most western portion of the remedy area in Remedy Zone B, and there are several other wells located between these locations and the leading edge of the dissolved VOC plume. The four wells meet the criteria for decommissioning outlined in Table 2-1. Below is a summary of the historical TCE concentrations for each well.
    - Well BOP-21(ds) was installed in March 1989 with a 20-ft screen extending from 165 to 185 ft bgs to characterize the Upper TSA. TCE concentrations have consistently been below the MCL since July 1993 and below the laboratory reporting limit since 2015. The maximum TCE concentration was 30 µg/L in April and August 1989.
    - Well BOP-42(ds) was installed in February 1993 with a 20-ft screen extending from 137 to 157 ft bgs in the Upper TSA. TCE concentrations have consistently been below the MCL since sampling began in 1992 and below the laboratory reporting limit since February 1992. Well BOP-42(ds) historically provided good areal distribution of the dissolved VOC plume along the southwestern portion of the Site; however, as the dissolved VOC plume continues to decrease in size, wells located closer to the plume provide the same information so BOP-42(ds) is redundant.
    - Well BOP-42(dg) was installed in February 1992 with a 20-ft screen extending from 221 to 241 ft bgs in the Lower TSA. Wells BOP-42(ds, dg) were installed to provide vertical hydraulic gradient information between the Upper and Lower TSA. TCE concentrations in BOP-42(dg) have been consistently below the MCL since February 2004. The maximum TCE concentration was 17 µg/L in February 1992.
    - Well BOP-60(dg) was installed in April 1994 with a 20-ft screen extending from 259 to 279 ft bgs in the Lower TSA. The well was installed in close vicinity to well BOP-60(ds) to provide vertical hydraulic gradient information between the Upper and Lower TSA units. It should be noted that BOP-60(ds) was identified as a well

with potential leakage along the annual seal, and the well was decommissioned and a replacement well BOP-60R(ds) was installed. BOP-60R(ds) was decommissioned in 2019. Because the Upper TSA well (BOP-60R(ds) was decommissioned, the Lower TSA well (BOP-60(dg) is no longer needed for monitoring vertical gradients. In addition, the well is located too far from the dissolved VOC plume and is a redundant location. TCE concentrations in BOP-60(dg) have consistently been below the MCL since March 2009, and the historical maximum concentration was 28 µg/L in August 1996.

- Discontinue water quality monitoring at two other wells owned by the Portland Water Bureau: PWB-1(uts) and PWB-1(lts). This change was requested in the 2017 annual report, but DEQ did not approve, given the TCE detections at PWB-1(lts) (Geosyntec et al. 2018, DEQ 2018). Since then, water levels and TCE at PWB wells have been monitored by the PWB, and TCE concentration trends at PWB-1(lts) have been stable (between 1.0 and 2.0 µg/L) over the last several years of increased monitoring. Samples were collected by EMC to assist PWB in evaluating localized low-level TCE concentrations. However, the TCE concentrations appear to be isolated because: 1) TCE concentrations are stable at very low levels (half the MCL); and 2) wells located between the PWB wells and the dissolved VOC plume are below the MCL. Based on the EMC TSA network criteria for monitoring (Table 2-1), which indicates that if TCE is less than the MCL for two years, monitoring can cease, we recommend removal of PWB-1(lts) and PWB-1(uts) from EMC TSA monitoring. We understand monitoring will be continued by PWB as part of CSSWF monitoring.

7.0 REFERENCES

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Rockwood Water People's Utility District (Rockwood PUD), 2020. Rockwood Water People's Utility District, www.rwpud.org, website accessed March 2020.

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 2019 through 31 December 2019
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 (on)	Lower TSA	Monthly	Semiannually	Cascade
TSA Monitoring Wells				
BOP-13(ds)	Upper TSA	Quarterly	Quarterly	Boeing
BOP-13(dg)	Lower TSA	Quarterly	Quarterly	Boeing
BOP-20(ds)	Upper TSA	Semiannually PWB Monitoring	Annually PWB Monitoring	Boeing
BOP-20(dg)	Lower TSA	Annually PWB Monitoring	Annually PWB Monitoring	Boeing
BOP-21(ds)	Upper TSA	Annually to Decommission	Biennial to Decommission	Boeing
BOP-23(dg)	Lower TSA	Annually PWB Monitoring	Biennial PWB Monitoring	Boeing
BOP-31(ds)	Upper TSA	Quarterly	Quarterly	Boeing
BOP-31(dg)	Lower TSA	Quarterly	Quarterly	Boeing
BOP-42(ds)	Upper TSA	Annually to Decommission	Biennial to Decommission	Boeing
BOP-42(dg)	Lower TSA	Annually to Decommission	Biennial to Decommission	Boeing
BOP-60(dg)	Lower TSA	Annually to Decommission	Biennial to Decommission	Boeing
BOP-61(ds)	Upper TSA	Semiannually	Semiannually	Boeing
BOP-61(dg)	Lower TSA	Semiannually	Semiannually	Boeing
BOP-62(ds)	Upper TSA	Annually PWB Monitoring	Biennial PWB Monitoring	Boeing
BOP-65(ds)	Upper TSA	Semiannually PWB Monitoring	Annually PWB Monitoring	Boeing
BOP-66(ds)	Upper TSA	Semiannually	Semiannually	Boeing
D-17(ds)	Lower TSA	Quarterly	Quarterly	Cascade
D-17(dg)	Lower TSA	Quarterly	Quarterly	Cascade
EW-3 (monitoring only)	Upper TSA	Annually	Biennially	Boeing
EW-8 (monitoring only)	Lower TSA	Semiannually	Annually	Cascade
EW-11 (monitoring only)	Lower TSA	Annually	Biennial	Cascade
EW-12 (monitoring only)	Lower TSA	Semiannually	Quarterly	Cascade
EW-13 (monitoring only)	Lower TSA	Semiannually PWB Monitoring	Annually PWB Monitoring	Boeing
EW-15 (monitoring only)	Lower TSA	Annually	Biennial	Cascade
EW-16 (monitoring only)	Lower TSA	Semiannually	Semiannually	Cascade
CMW-10(ds)	Upper TSA	Quarterly	Quarterly	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-26(dg)	Lower TSA	Semiannually	Semiannually	Cascade

Table 2-2
Performance Monitoring Schedule - 1 January 2019 through 31 December 2019
TSA Remedy - East Multnomah County

Well	Aquifer	Water Level Measurements	Water Quality Sampling	Responsibility
CMW-36(dg)	Lower TSA	PWB Monitoring	PWB Monitoring	Cascade
PWB-1(uts)	Upper TSA	Discontinue	Discontinue	Cascade
PWB-1(lts)	Lower TSA	Discontinue	Discontinue	Cascade
Soil Vapor and Groundwater Monitoring Wells				
VMW-17d-95.5 (soil vapor onl	Upper TSA	Quarterly	Quarterly	Cascade
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

NOTES:

[a]Annual monitoring performed in August; semiannual in February and August; quarterly in February, May, August, and November. Next biennial sampling event planned for August 2021.

Recommendations for modifications to the Monitoring Schedules are indicated in red text, and wells recommended for decommissioning are also in red text and shaded green.

Table 2-3
Significant Remedy Documents – 1 January 2019 through 31 December 2019
TSA Remedy – East Multnomah County Oregon

Date	Document Type	Author	Title	Comments
1/29/19	Memorandum	Geosyntec	East Multnomah County Groundwater TSA Remedy ECSI 1479, SVE Expansion and Rebound Testing Work Plan	Work Plan for rebound testing of three wells, VMW-A, VMW-B, and VMW-D, and installation of six new wells, VMW-H through VMW-M, to the west near monitoring wells D-17ds/dg.
2/7/19	Letter	DEQ	SVE Expansion and Rebound Testing, East Multnomah County Troutdale Sandstone Aquifer Remedy, Fairview, Oregon, ECSI No. 1479	DEQ approves the scope of work proposed for the installation of six new vapor extraction wells (VMW-H through VMW-M), SVE plumbing system, and the shut down and vapor rebound testing of existing vapor monitoring wells VMW-A, VMW-B and VMW-D. Geosyntec shall provide DEQ with the schedule for performance of this scope of work as well as the drilling schedule for previously approved angle borings VMW-E, VMW-F and VMW-G.
5/29/19	Work Plan	Geosyntec	Well Decommissioning Work Plan, East Multnomah County Troutdale Sandstone Aquifer Remedy, Fairview, Oregon, ECSI No. 1479	Work plan to decommission three wells, DEQ-1ds, DEQ-5ds, DEQ-5dg, by backfilling, and one well, CMW-3ds, by overdrilling.
05/31/19	Report	Geosyntec, Landau Associates, and SSPA	Annual Performance Report for 2018 and Five-Year Remedy Performance Evaluation. East Multnomah County Troutdale Sandstone Aquifer Remedy. ECSI #1479	Annual report recommends no operations changes to the groundwater extraction and SVE systems, no changes to monitoring schedule, decommissioning of monitoring wells BOP 22R(ds), BOP 60R(ds), CMW 8(dg), and CMW 10(dg); and requests a partial closure/conditional No Further Action of Zone A and the SGA.
6/12/19	Email	DEQ	Approval of Geosyntec Well Decommissioning Work Plan dated May 29, 2019	DEQ approves work plan for decommissioning four wells (DEQ-1ds, DEQ-5ds, DEQ-5dg, and CMW-3ds) located south of Interstate 84.

Table 2-3
Significant Remedy Documents – 1 January 2019 through 31 December 2019
TSA Remedy – East Multnomah County Oregon

Date	Document Type	Author	Title	Comments
7/3/19	Letter	DEQ	RE: Annual Performance Report for 2018 and Five-Year Remedy Performance Evaluation. East Multnomah County Troutdale Sandstone Aquifer Remedy. ECSI #1479	DEQ approval of 2018 Annual Report recommendations Sections 7.1 and 7.2: no operational changes to either the groundwater central treatment system or the soil vapor extraction system, and the decommissioning of monitoring wells BOP 22R(ds), BOP 60R(ds), CMW 8(dg), and CMW 10(dg). Section 7.3 was not approved (Partial Zone Closure).
7/7/19	Memorandum	Landau Associates	2019 Monitoring and Contingency Plan for PWB Pumping Events, East Multnomah County Troutdale Sandstone Aquifer Remedy, Gresham, Oregon, ECSI # 1479	Update contingency monitoring plan for PWB South Shore well field monitoring, proposed changes include shifting groundwater monitoring to wells south of Sandy Blvd.
8/8/19	Letter	Geosyntec	TSA SVE Well Drilling Soil IDW– No-Longer Contains Determination Request, East Multnomah County Troutdale Sandstone Aquifer Remedy (ECSI No. 1479), Fairview, Oregon	Request for No Longer Contains Determination for investigation derived waste (IDW) soil cuttings from installation of four new SVE wells (VMW-E, -F, -G, -H).
9/4/19	Memorandum	DEQ	Non-Hazardous Waste Determination for Investigation Derived Waste. East Multnomah County Troutdale Sandstone Aquifer Remedy 2201 and 2525 NE 201st Ave. Fairview, Oregon. (ECSI #1479)	DEQ approval for No Longer Contains Determination for soil investigation derived waste (IDW) from four new SVE wells (VMW-E, -F, -G, -H).
10/9/19	Letter	Geosyntec and Landau Associates, Inc.	Well Decommissioning Work Plan, East Multnomah County Troutdale Sandstone Aquifer Remedy, Fairview, Oregon, ECSI No. 1479	Work Plan provides the procedures and schedule to decommission four groundwater monitoring wells BOP-22R(ds), BOP-60R(ds), CMW-8(dg), and CMW-10(dg) by backfilling in place.

Table 2-3
Significant Remedy Documents – 1 January 2019 through 31 December 2019
TSA Remedy – East Multnomah County Oregon

Date	Document Type	Author	Title	Comments
10/15/19	Email	DEQ	DEQ approval of Well Decommissioning Workplan dated 9 Oct. 2019	DEQ approval of the well decommissioning work plan for four wells: BOP-22R(ds), BOP-60R(ds), CMW-8(dg), and CMW-10(dg).
10/15/19	Memorandum	Geosyntec and Landau Associates, Inc.	East Multnomah County TSA Groundwater Remedy (ECSI 1479), Response to DEQ and PWB Comments on 2018 Annual Report and Five-Year Evaluation, EMC TSA Remedy	Provides requested clarification to DEQ in response to their comments, as well as comments and questions received from GSI Water Solutions (GSI) on behalf of the Portland Water Bureau (PWB), regarding the 2018 Annual Performance Report.

Table 3-1
Well Construction Data - 1 January 2019 through 31 December 2019
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-1 (pilot shutdown)	Lower TSA	7699560.1	689504.6	124.1	124.04	-27.8	-57.8	183
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
EW-23	Lower TSA	7698806.9	690524.7	83.8	83.93	-26.2	-66.2	157
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-20(dg)	Lower TSA	7698381.4	691042.6	78.1	77.32	-105.0	-125.0	209
BOP-21(ds)	Upper TSA	7697591.5	691105.0	77.1	78.02	-88.0	-108.0	192
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)[3]	Upper TSA	7698995.4	691938.6	32.5	35.24	-23.0	-43.0	76
BOP-44(dg)[3]	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)[3]	Lower TSA	7701014.5	692008.0	44.8	43.51	-75.0	-85.0	140
EW-3	Upper TSA	7697737.4	690313.3	97.1	94.26	-77.9	-102.9	205
EW-8	Lower TSA	7699521.9	690435.9	77.3	77.16	6.8	-33.2	163
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-15	Lower TSA	7701759.5	689205.3	116.7	116.21	-27.3	-57.3	186
EW-16	Lower TSA	7702424.1	689665.5	84.2	83.71	-40.3	-80.3	198
CMW-8(dg)[3]	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)[3]	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
PWB-1(lts)	Lower TSA	7700352.3	692604.8	14.0	16.48	-98.0	-118.0	134
PWB-1(uts)	Upper TSA	7700344.1	692612.1	13.9	15.98	-51.0	-71.0	86
BOP-44(usg)[3]	SGA	7698996.3	691888.8	24.6	34.25	-181.0	-191.0	219

Table 3-1
Well Construction Data - 1 January 2019 through 31 December 2019
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

NOTES:

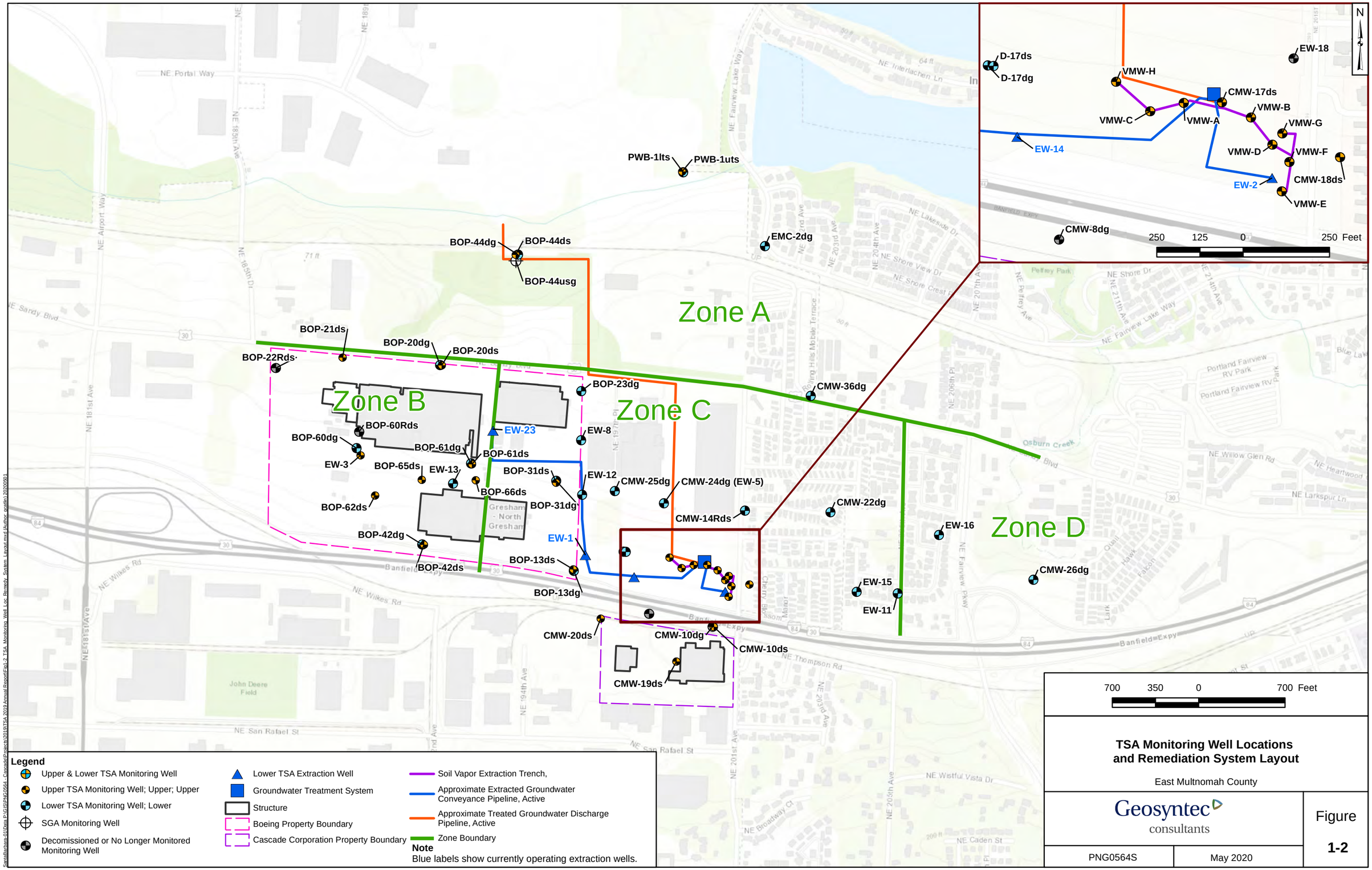
1. Monitoring wells indicated in red text were recommended for sampling frequency modifications (Table 2-2). Wells indicated in red text and green shading are recommended for decommissioning. Wells indicated in black text and green shading were previously approved for decommissioning but have not yet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

2. EW-16 was converted to monitoring in October 2017; approved by DEQ 10.04.17.

3. DEQ-approved monitoring wells pending decommissioning.

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

FIGURES



TSA Monitoring Well Locations and Remediation System Layout

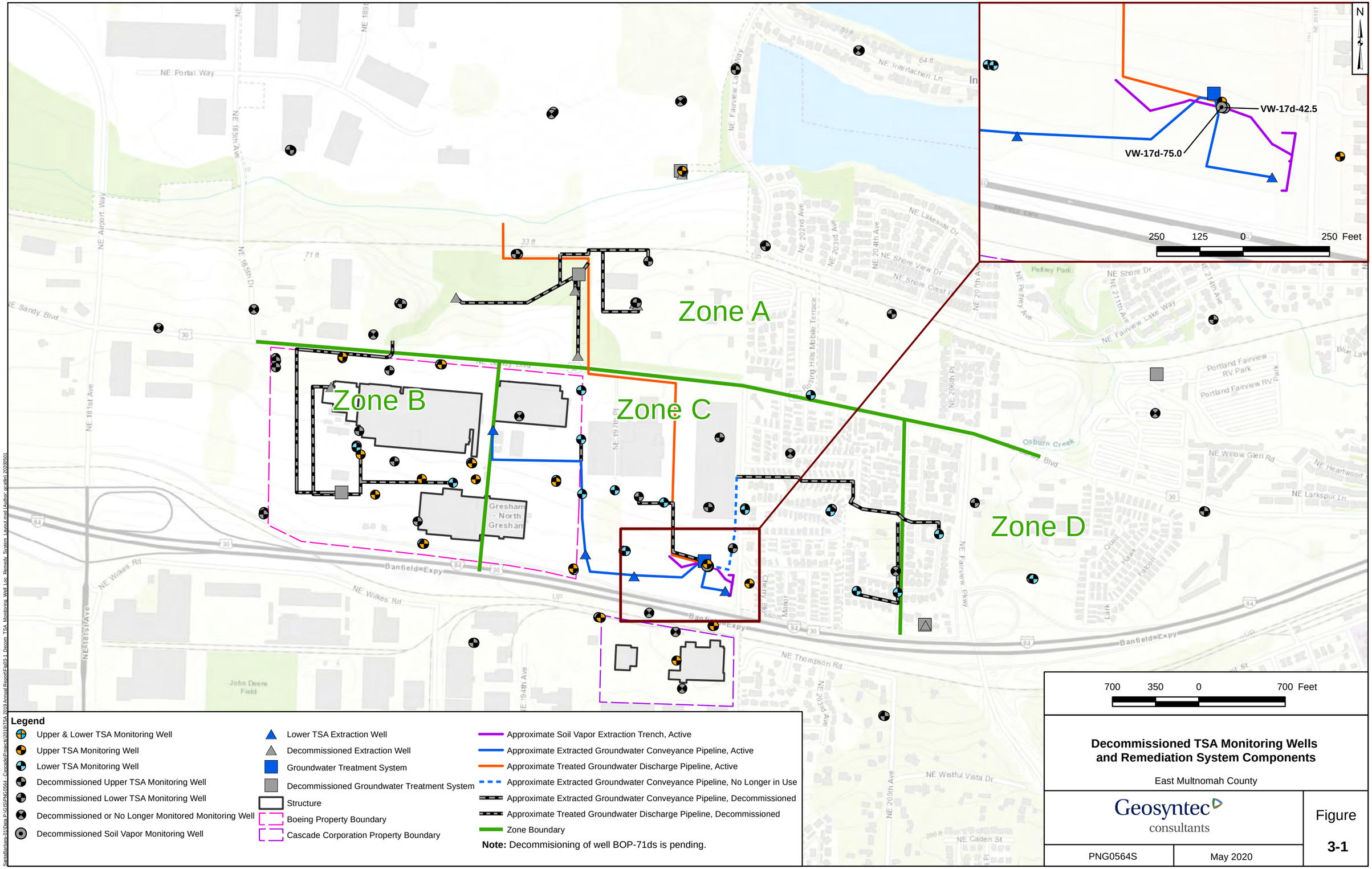
East Multnomah County

Geosyntec consultants

PNG0564S | May 2020

Figure **1-2**

SantaBarbara-010\data P:\GIS\PNG\0564 - Cascade\Projects\2019\TSA 2019 Annual Report\Fig1-2_TSA_Monitoring_Well_Loc_Remedy_System_Layout.mxd (Author: agallin) 20200501



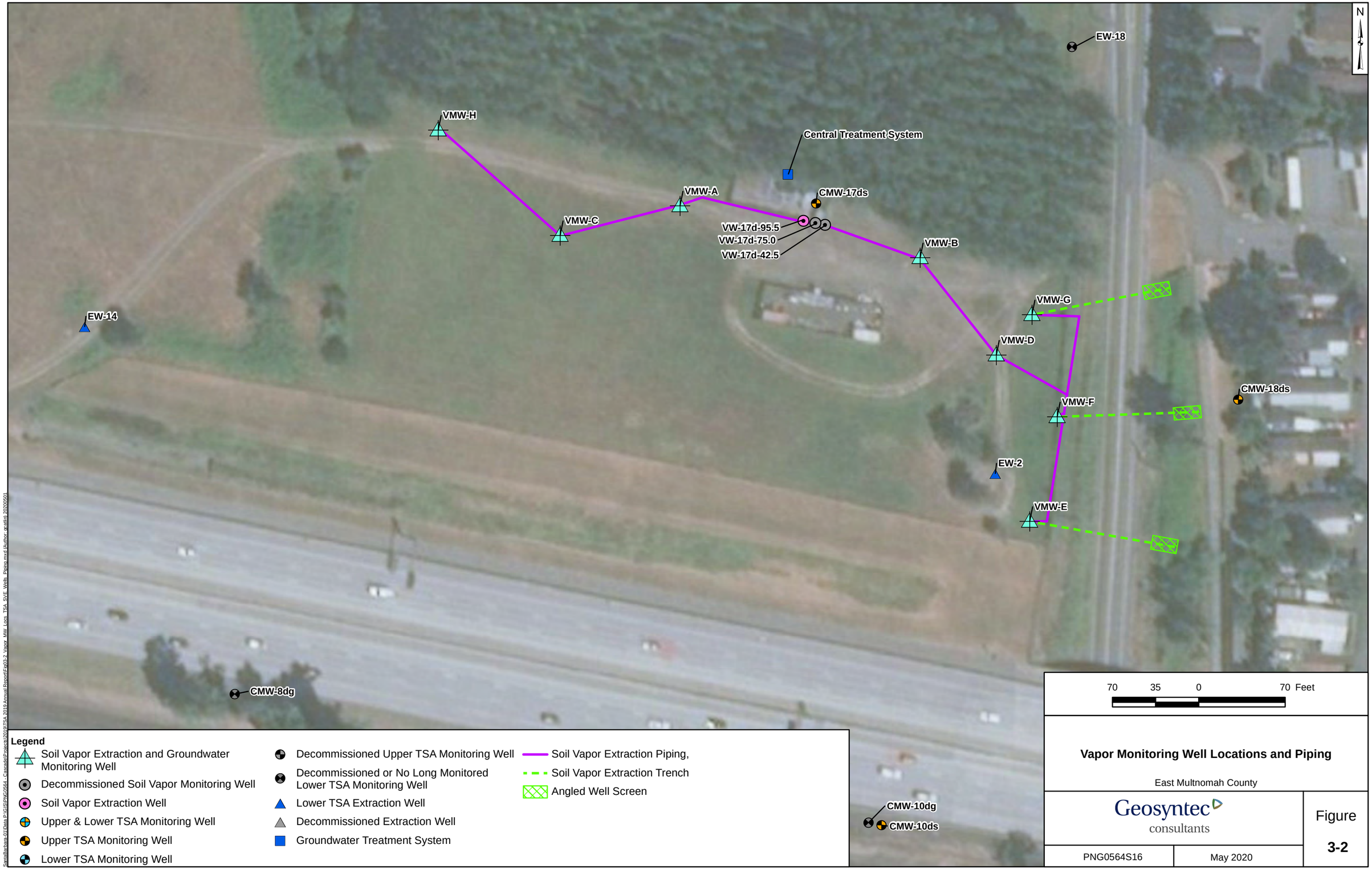
Decommissioned TSA Monitoring Wells and Remediation System Components

East Multnomah County

Geosyntec consultants

Figure 3-1

PNG0564S | May 2020



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,
- Soil Vapor Extraction Trench
- Angled Well Screen

Vapor Monitoring Well Locations and Piping

East Multnomah County

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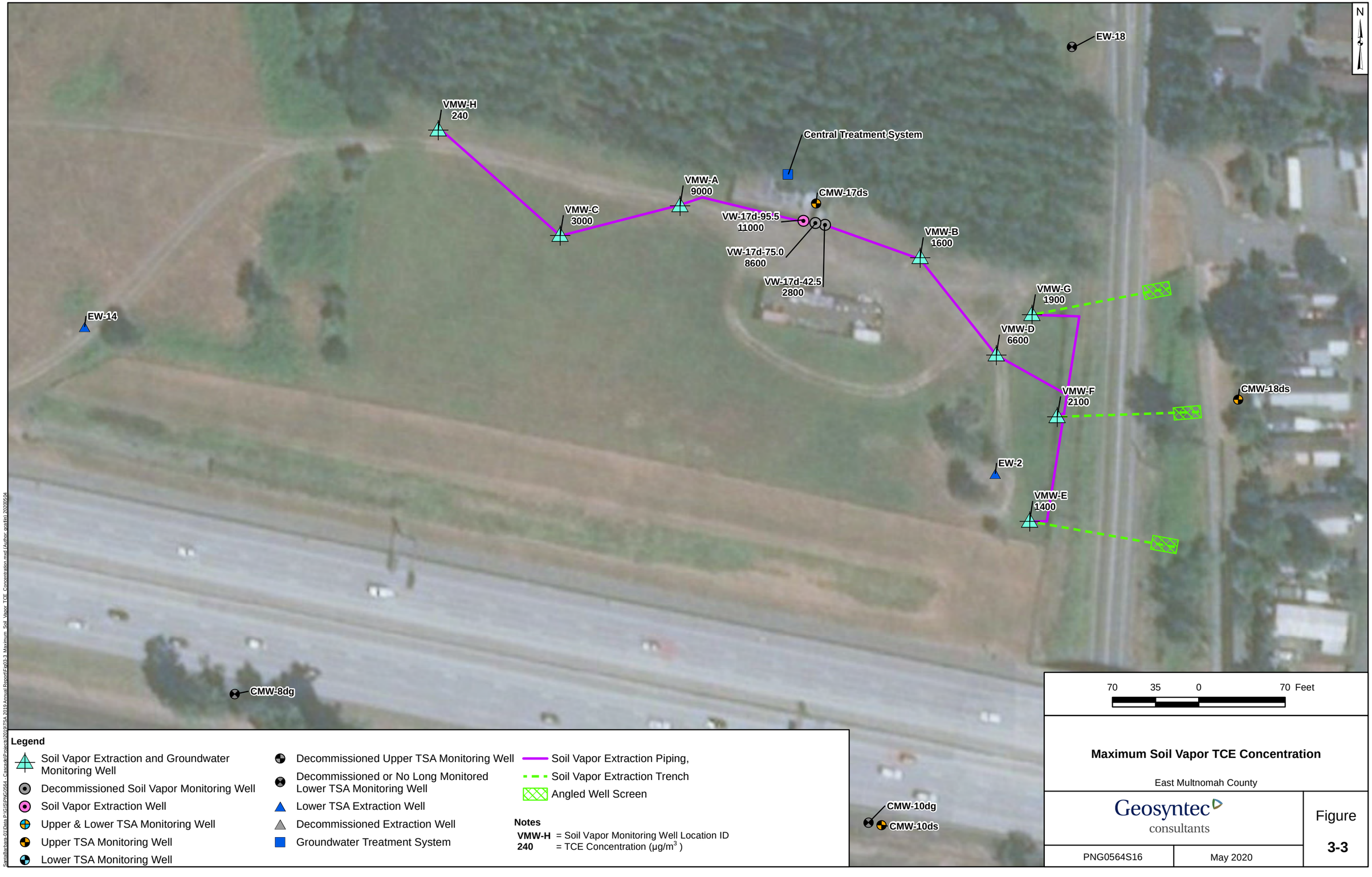
Figure 3-2

S:\antaBarbara-01\Data P:\GIS\PNG0564 - Cascade\Projects\2019\TSA 2019 Annual Report\Fig03-2 Vapor MW Locs TSA SVE Wells Piping.mxd (Author: pcatlin) 20200501



S:\anta Barbara-01\Data P:\GIS\PNG0564 - Cascade\Projects\2019\TSA 2019 Annual Report\Fig\3-3 Maximum_Soil_Vapor_TCE_Concentration.mxd (Author: pca file) 20200504

BOP-20ds
11.15

BOP-61ds
8.84

BOP-31ds
10.00

BOP-66ds
10.48

BOP-13ds
9.14

CMW-20ds
11.85

DEQ-5ds
12.49

VMW-A
20.01

CMW-17ds
19.00

VMW-B
24.51

VMW-C
21.64

VMW-D
22.97

CMW-18ds
13.48

CMW-10ds
10.66

CMW-19ds
13.16

Legend

- Upper TSA Monitoring Well
- Upper TSA Groundwater Elevation (ft. AMSL)
- Inferred Upper TSA Groundwater Elevation (ft. AMSL)
- Upper TSA Groundwater Elevation Depression (ft. AMSL)
- Unsaturated Area
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary

Notes

CMW-17ds= Monitoring Well Location ID
19.00 = Groundwater Elevation (ft. AMSL)

600 300 0 600 Feet

Upper TSA Aquifer Groundwater Levels February 2019

East Multnomah County

Geosyntec consultants

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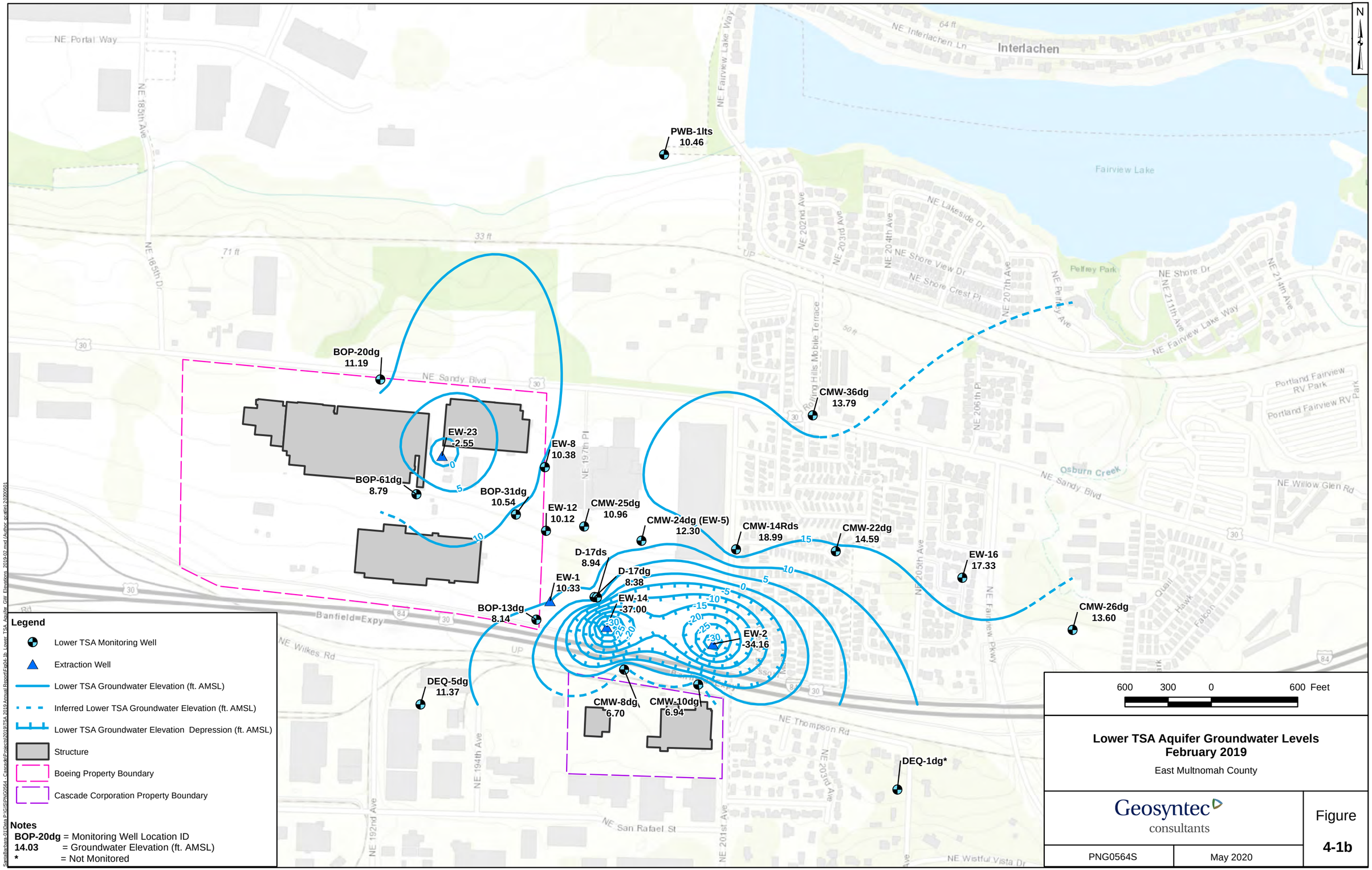
Figure **4-1a**



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

BOP-20dg = Monitoring Well Location ID
14.03 = Groundwater Elevation (ft. AMSL)
***** = Not Monitored

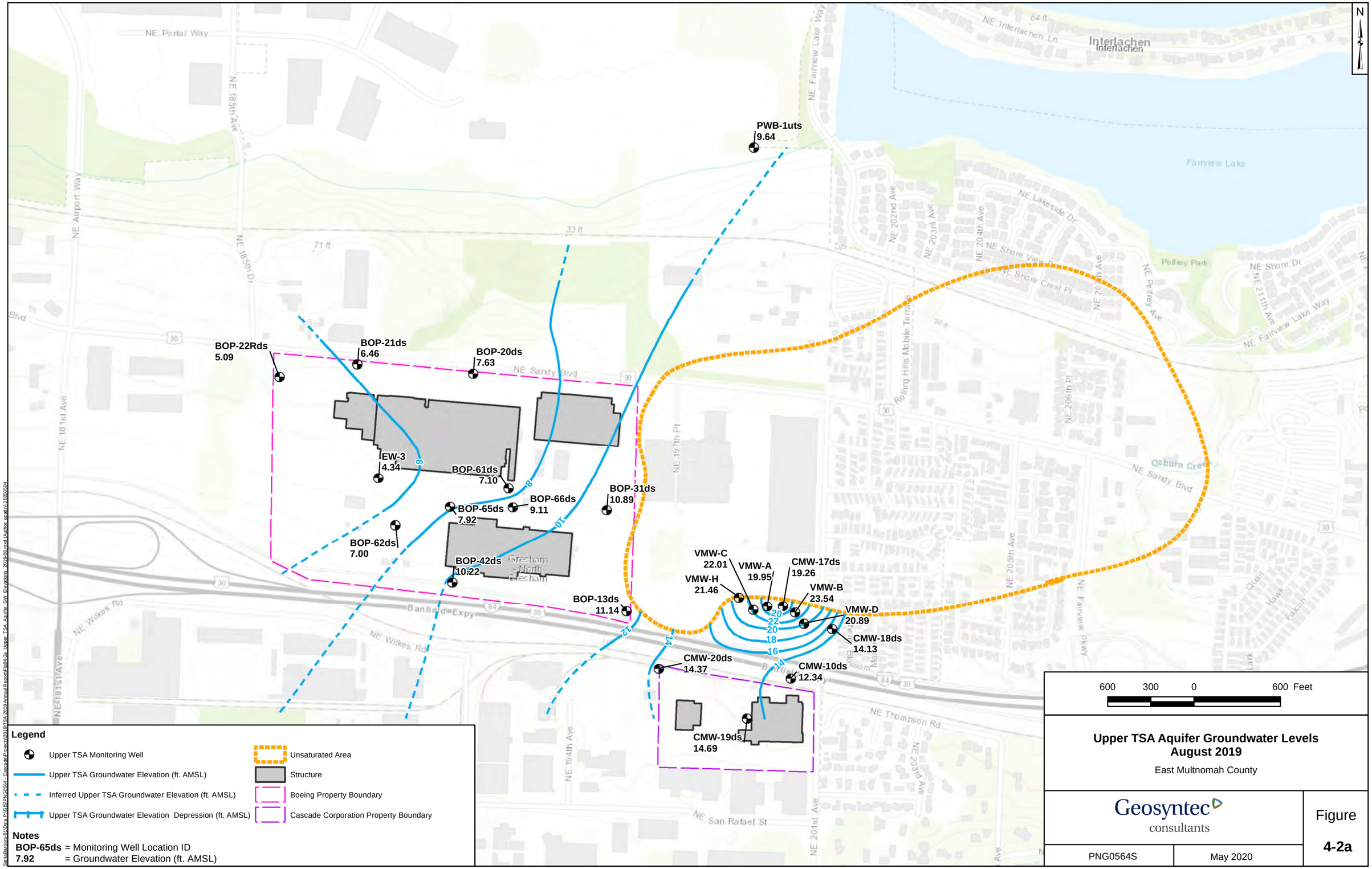
Lower TSA Aquifer Groundwater Levels February 2019

East Multnomah County

Geosyntec consultants

PNG0564S | May 2020

Figure **4-1b**



Legend

- Upper TSA Monitoring Well
- Upper TSA Groundwater Elevation (ft. AMSL)
- Inferred Upper TSA Groundwater Elevation (ft. AMSL)
- Upper TSA Groundwater Elevation Depression (ft. AMSL)
- Unsaturated Area
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary

Notes

BOP-65ds = Monitoring Well Location ID
7.92 = Groundwater Elevation (ft. AMSL)

Upper TSA Aquifer Groundwater Levels August 2019

East Multnomah County

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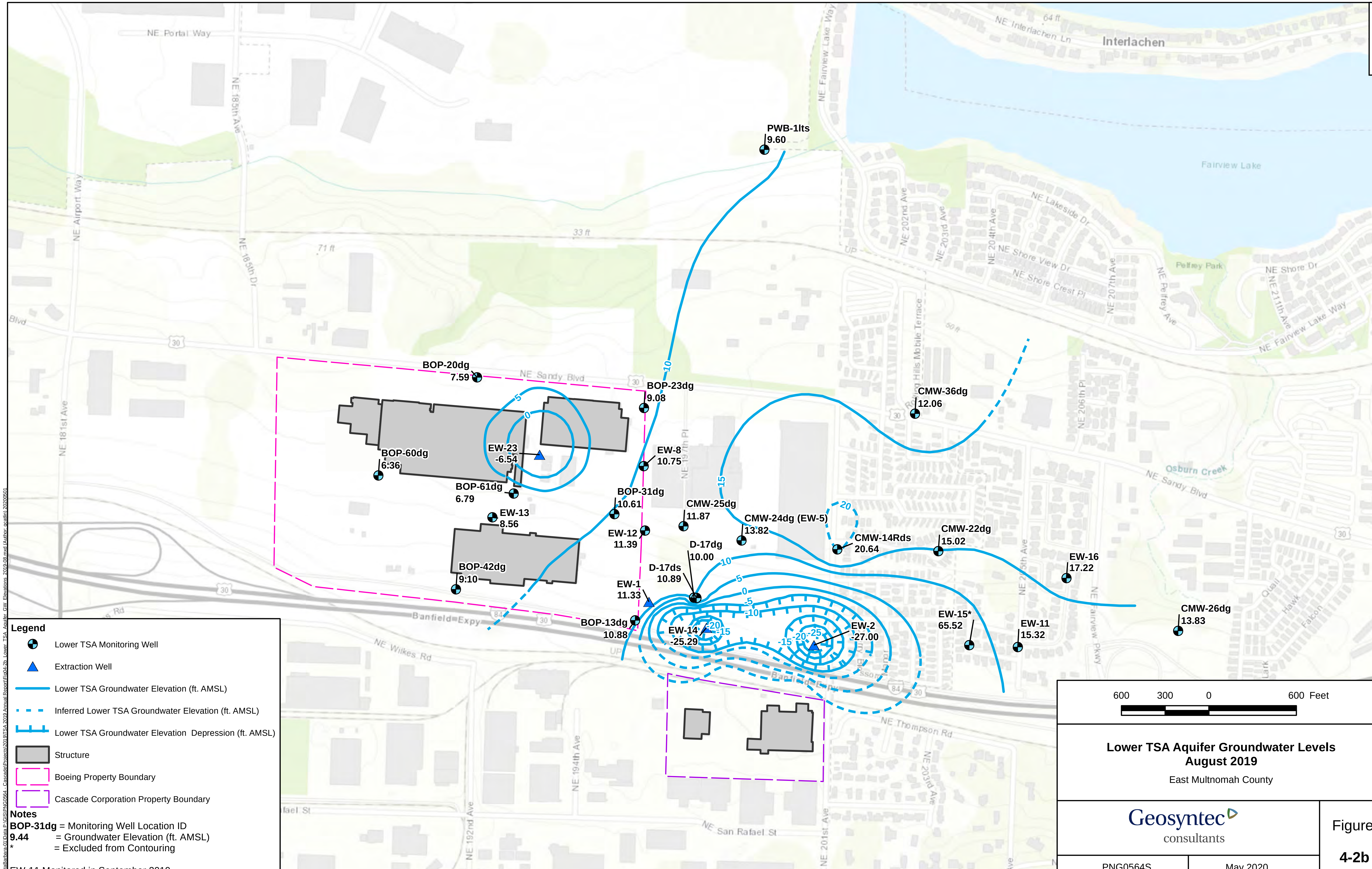
Figure **4-2a**



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

BOP-31dg = Monitoring Well Location ID
9.44 = Groundwater Elevation (ft. AMSL)
* = Excluded from Contouring

EW-11 Monitored in September 2019

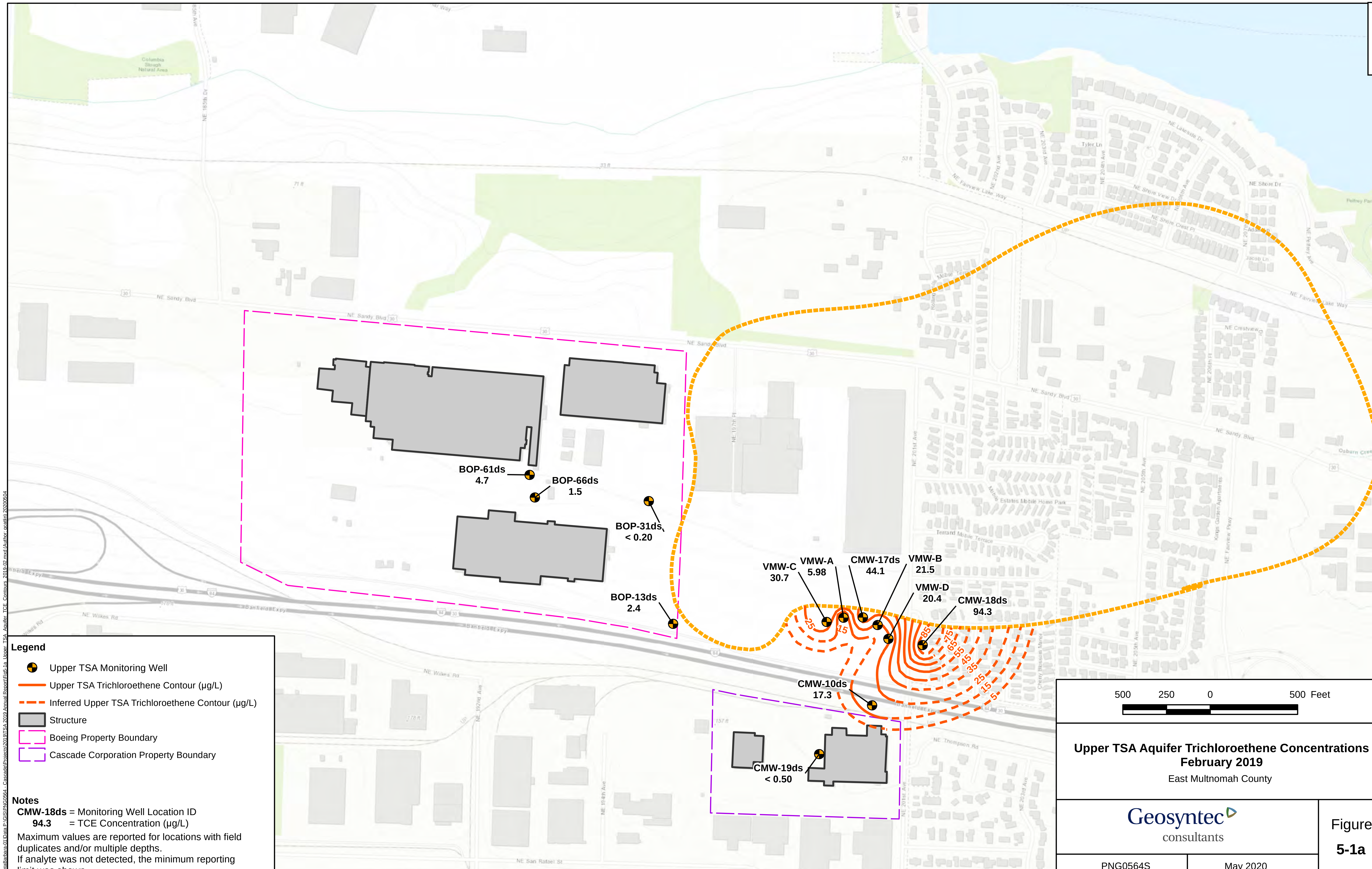
Lower TSA Aquifer Groundwater Levels
August 2019

East Multnomah County

Geosyntec consultants

Figure **4-2b**

PNG0564S | May 2020



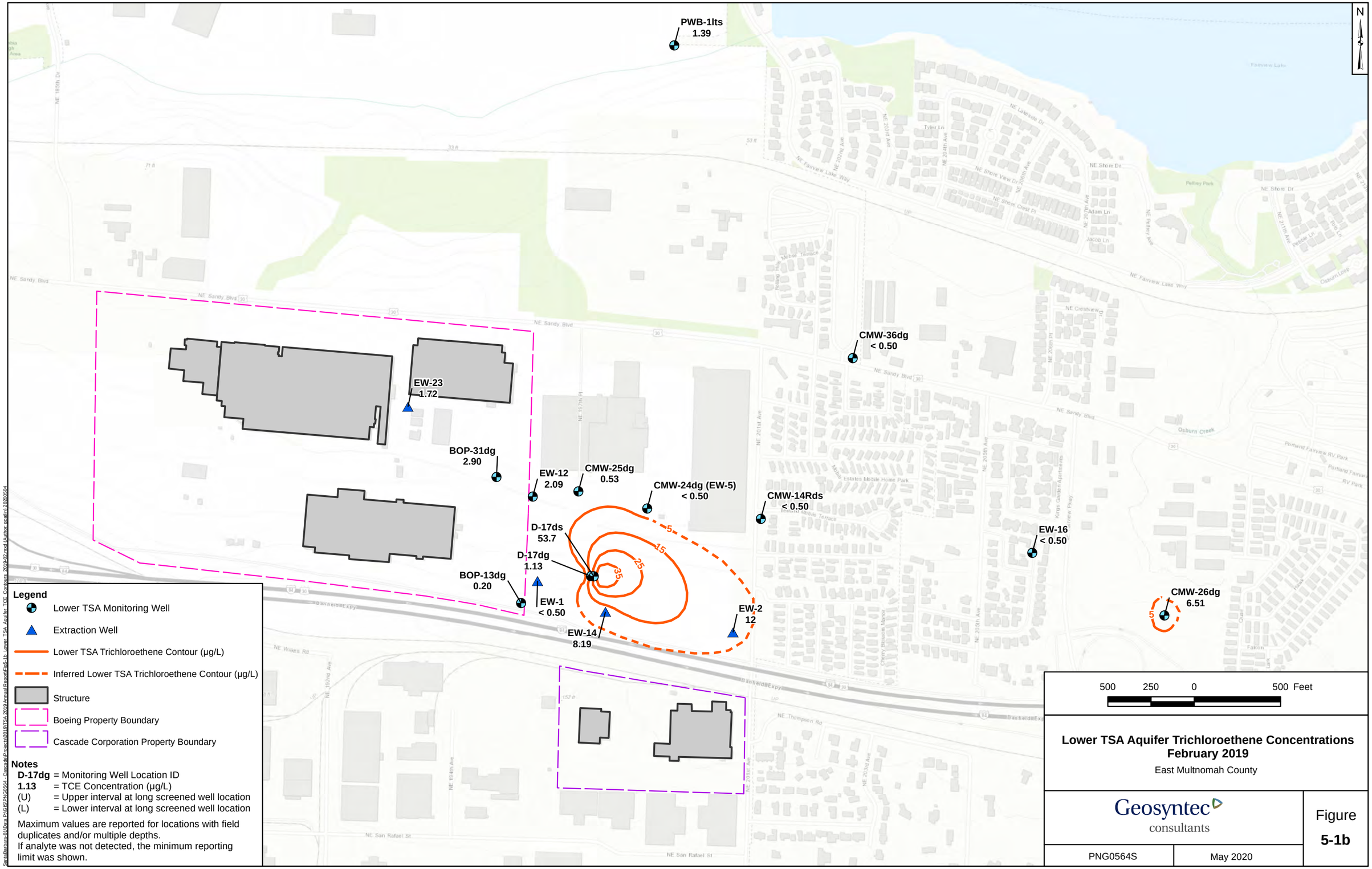
Upper TSA Aquifer Trichloroethene Concentrations February 2019

East Multnomah County

Geosyntec consultants

PNG0564S | May 2020

Figure 5-1a



Legend

- ● Lower TSA Monitoring Well
- ▲ Extraction 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
1.13 = TCE Concentration (µg/L)
(U) = Upper interval at long screened well location
(L) = Lower interval at long screened well location

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 2019

East Multnomah County

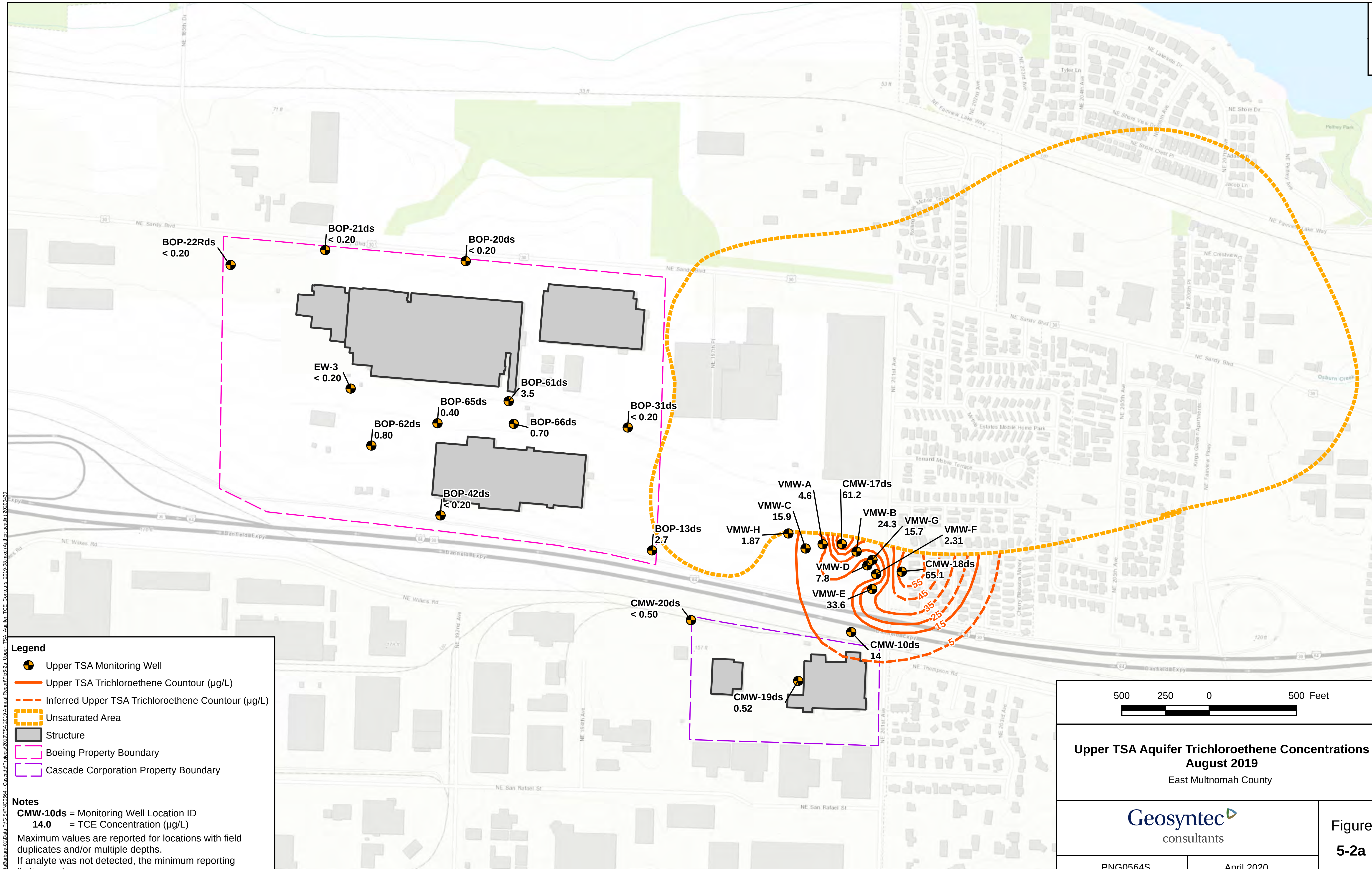
Geosyntec consultants

Figure **5-1b**

PNG0564S

May 2020

SantaBarbara-01\Data P:\GIS\PNG0564 - Cascade\Projects\2019\TSA 2019 Annual Report\Fig5-1b_Lower_TSA_Aquifer_TCE_Contours_2019-02.mxd (Author: gcatlin) 20200504



BOP-22Rds
< 0.20
BOP-21ds
< 0.20
BOP-20ds
< 0.20
EW-3
< 0.20
BOP-61ds
3.5
BOP-65ds
0.40
BOP-62ds
0.80
BOP-66ds
0.70
BOP-31ds
< 0.20
BOP-42ds
< 0.20
BOP-13ds
2.7
VMW-A
4.6
CMW-17ds
61.2
VMW-C
15.9
VMW-B
24.3
VMW-G
15.7
VMW-F
2.31
VMW-H
1.87
VMW-D
7.8
CMW-18ds
65.1
VMW-E
33.6
CMW-20ds
< 0.50
CMW-10ds
14
CMW-19ds
0.52
55
45
35
25
15
5
N
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
14.0 = 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 August 2019

East Multnomah County

Geosyntec consultants

PNG0564S | April 2020

Figure **5-2a**

PWB-1lts
1.42

BOP-20dg
< 0.20

BOP-23dg
0.70

EW-23
1.74

EW-8
1.67

BOP-60dg
2.9

EW-13
0.20

BOP-61dg
4.3

BOP-31dg
3.0

EW-12
2.12

CMW-25dg
< 0.50

CMW-24dg
(EW-5)
< 0.50

CMW-36dg
< 0.50

CMW-14Rds
< 0.50

CMW-22dg
< 0.50

EW-16
< 0.50

BOP-42dg
2.3

D-17ds
58.4

EW-1
< 0.50

BOP-13dg
1.3

D-17dg
0.796

EW-14
5.95

EW-2
11.7

EW-15
< 0.50

EW-11
1.11

CMW-26dg
6.27

5
15
25
35

N

Legend

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

Notes

D-17dg = Monitoring Well Location ID
0.796 = TCE Concentration (µg/L)
(U) = Upper interval at long screened well location
(L) = Lower interval at long screened well location
EW-11 Monitored in September 2019.
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 August 2019

East Multnomah County

Geosyntec consultants

Figure **5-2b**

PNG0564S | April 2020

APPENDIX A
Extraction Rates

Table A-1
TSA Extraction Rates 1 January 2019 through 31 December 2019 and
12-Month Averages through 31 December 2019
East Multnomah County TSA Remedy

Zone	12-Mo. Avg.	01/2019	02/2019	03/2019	04/2019	05/2019	06/2019	07/2019	08/2019	09/2019	10/2019	11/2019	12/2019
Zone B	**29**	**30**	**30**	**19**	**29**	**29**	**32**	**33**	**32**	**30**	**30**	**30**	**30**
EW-23	*29*	*30*	*30*	*19*	*29*	*29*	*32*	*33*	*32*	*30*	*30*	*30*	*30*
Zone C	**50**	**52**	**54**	**30**	**50**	**62**	**56**	**58**	**54**	**52**	**48**	**46**	**39**
EW-2	*28*	*35*	*36*	*18*	*29*	*32*	*29*	*31*	*30*	*29*	*27*	*24*	*20*
EW-14	*22*	*17*	*18*	*12*	*21*	*30*	*28*	*27*	*24*	*23*	*21*	*22*	*19*
Total Avg Flow TSA	**80**	**82**	**84**	**49**	**79**	**91**	**88**	**91**	**85**	**82**	**78**	**76**	**69**

NOTES:

Monthly average flow rates are shown in gallons per minute for each well.

Wells that have not operated during the last 12 months are not shown.

Table A-2
Discharge Monitoring Summary - Cental Treatment System
1 January 2019 through 31 December 2019
East Multnomah County TSA Remedy

Parameter	Discharge Limitations[a]	Unit	Sample Date	System Discharge			Number of Exceedances	Sample Frequency
				Min	Avg	Max		
January 2019								
pH	6.0 – 9.0	su	—	7.70	7.80	7.90	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	35	--	—	Daily
February 2019								
Trichloroethene	5.0	µg/L	2/5/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	2/5/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	2/5/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
Tetrachloroethene	5.0	µg/L	2/5/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
Vinyl Chloride	2.0	µg/L	2/5/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
pH	6.0 – 9.0	su	—	7.70	7.80	7.90	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	36	--	—	Daily
March 2019								
pH	6.0 – 9.0	su	—	7.80	7.80	7.80	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	19	--	—	Daily
April 2019								
pH	6.0 – 9.0	su	—	7.80	7.81	7.85	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	31	--	—	Daily
May 2019								
Trichloroethene	5.0	µg/L	5/3/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	5/3/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	5/3/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
Tetrachloroethene	5.0	µg/L	5/3/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
Vinyl Chloride	2.0	µg/L	5/3/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
pH	6.0 – 9.0	su	—	7.84	7.87	7.88	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	32	--	—	Daily
June 2019								
pH	6.0 – 9.0	su	—	7.80	7.86	7.88	0	Weekly
Temperature	—	ºF	—	60	60	60	—	Weekly
Flow[#]	—	gpm	—	--	32	--	—	Daily
July 2019								
pH	6.0 – 9.0	su	—	7.78	7.87	7.91	0	Weekly
Temperature	—	ºF	—	60	62	65	—	Weekly
Flow[#]	—	gpm	—	--	33	--	—	Daily
August 2019								
Trichloroethene	5.0	µg/L	8/6/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	8/6/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	8/6/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
Tetrachloroethene	5.0	µg/L	8/6/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
Vinyl Chloride	2.0	µg/L	8/6/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
pH	6.0 – 9.0	su	—	7.68	7.82	7.89	0	Weekly
Temperature	—	ºF	—	61	62	66	—	Weekly
Flow[#]	—	gpm	—	--	32	--	—	Daily

Table A-2
Discharge Monitoring Summary - Cental Treatment System
1 January 2019 through 31 December 2019
East Multnomah County TSA Remedy

Parameter	Discharge Limitations[a]	Unit	Sample Date	System Discharge			Number of Exceedances	Sample Frequency
				Min	Avg	Max		
September 2019								
pH	6.0 – 9.0	su	—	7.74	7.82	7.88	0	Weekly
Temperature	—	ºF	—	61	61	61	—	Weekly
Flow	—	gpm	—	--	30	--	—	Daily
October 2019								
pH	6.0 – 9.0	su	—	7.81	7.87	7.90	0	Weekly
Temperature	—	ºF	—	61	61	61	—	Weekly
Flow[#]	—	gpm	—	--	30	--	—	Daily
November 2019								
Trichloroethene	5.0	µg/L	11/4/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	11/4/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	11/4/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
Tetrachloroethene	5.0	µg/L	11/4/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
Vinyl Chloride	2.0	µg/L	11/4/2019	< 0.500	< 0.500	< 0.500	0	Quarterly
pH	6.0 – 9.0	su	—	7.86	7.88	7.89	0	Weekly
Temperature	—	ºF	—	60	61	61	—	Weekly
Flow[#]	—	gpm	—	--	30	--	—	Daily
December 2019								
pH	6.0 – 9.0	su	—	7.86	7.87	7.89	0	Weekly
Temperature	—	ºF	—	60	60	61	—	Weekly
Flow[#]	—	gpm	—	--	30	--	—	Daily

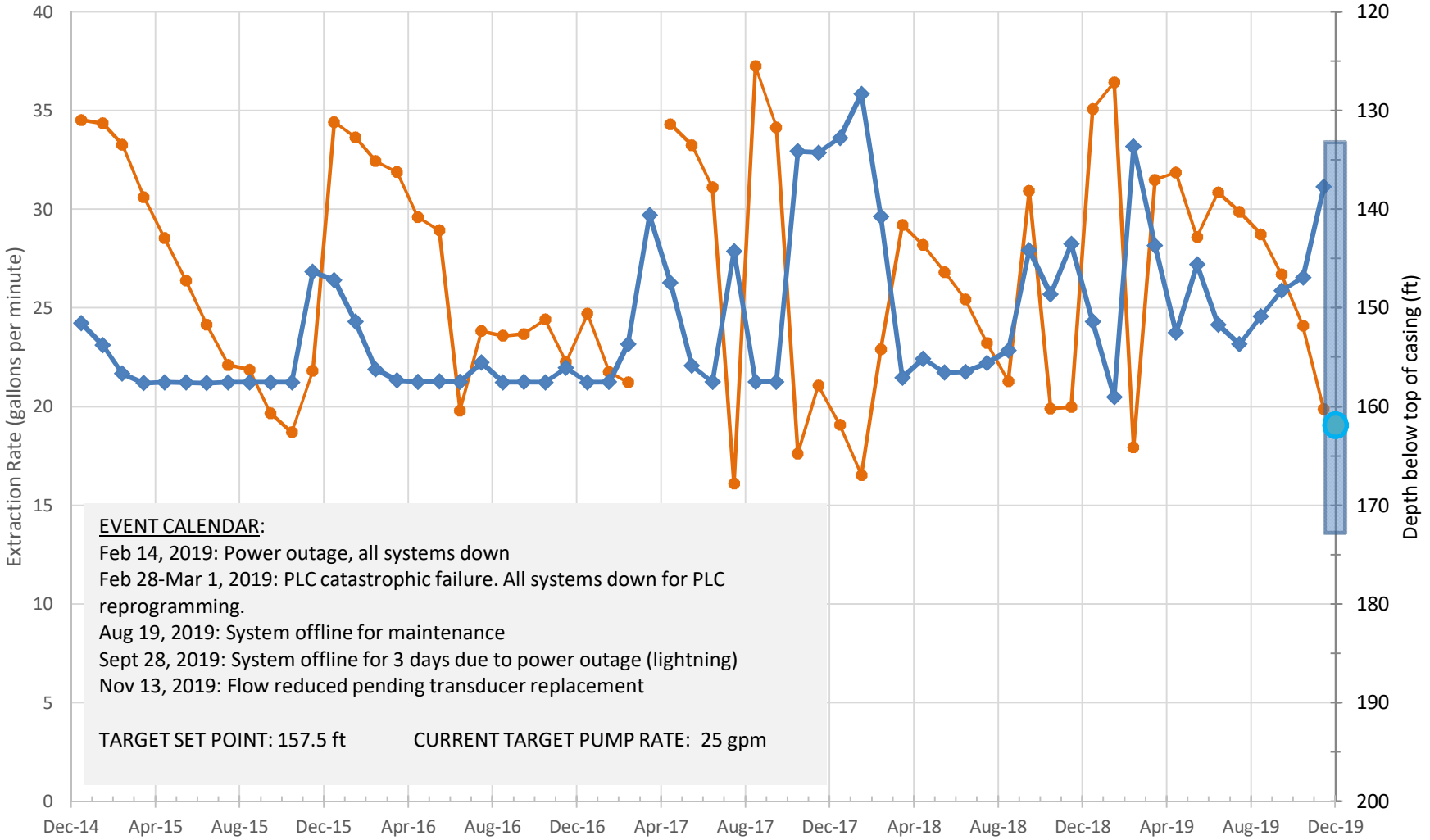
NOTES:

[a]Discharge limitations for the CTS are per Attachment C to DEQ Consent Order No. WMCSR-NWR-96-08 dated 2/14/97.

Analysis for VOCs for effluent sample TS-C-Eff.

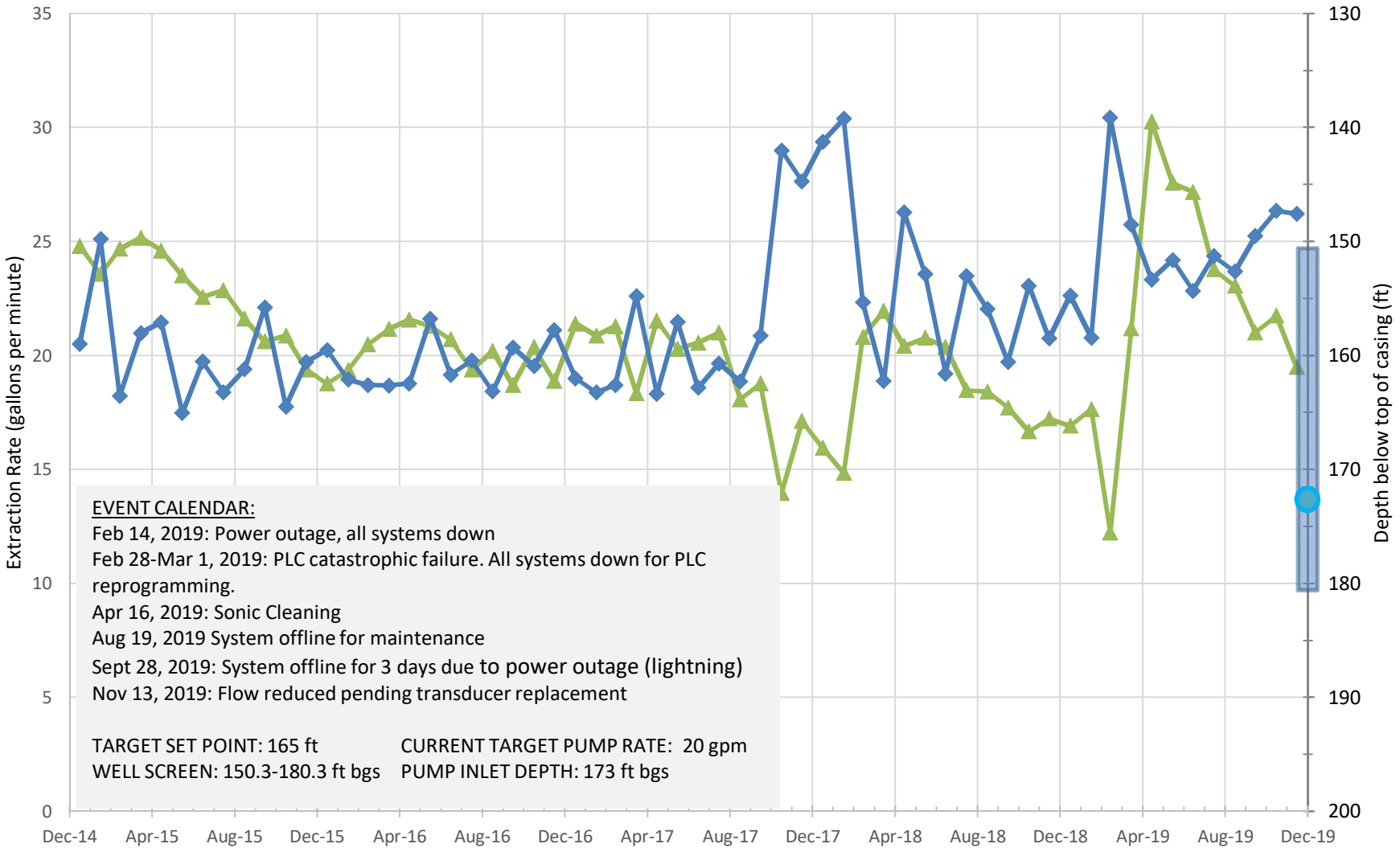
[#]Flow includes EW-2, EW-14, and EW-23.

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



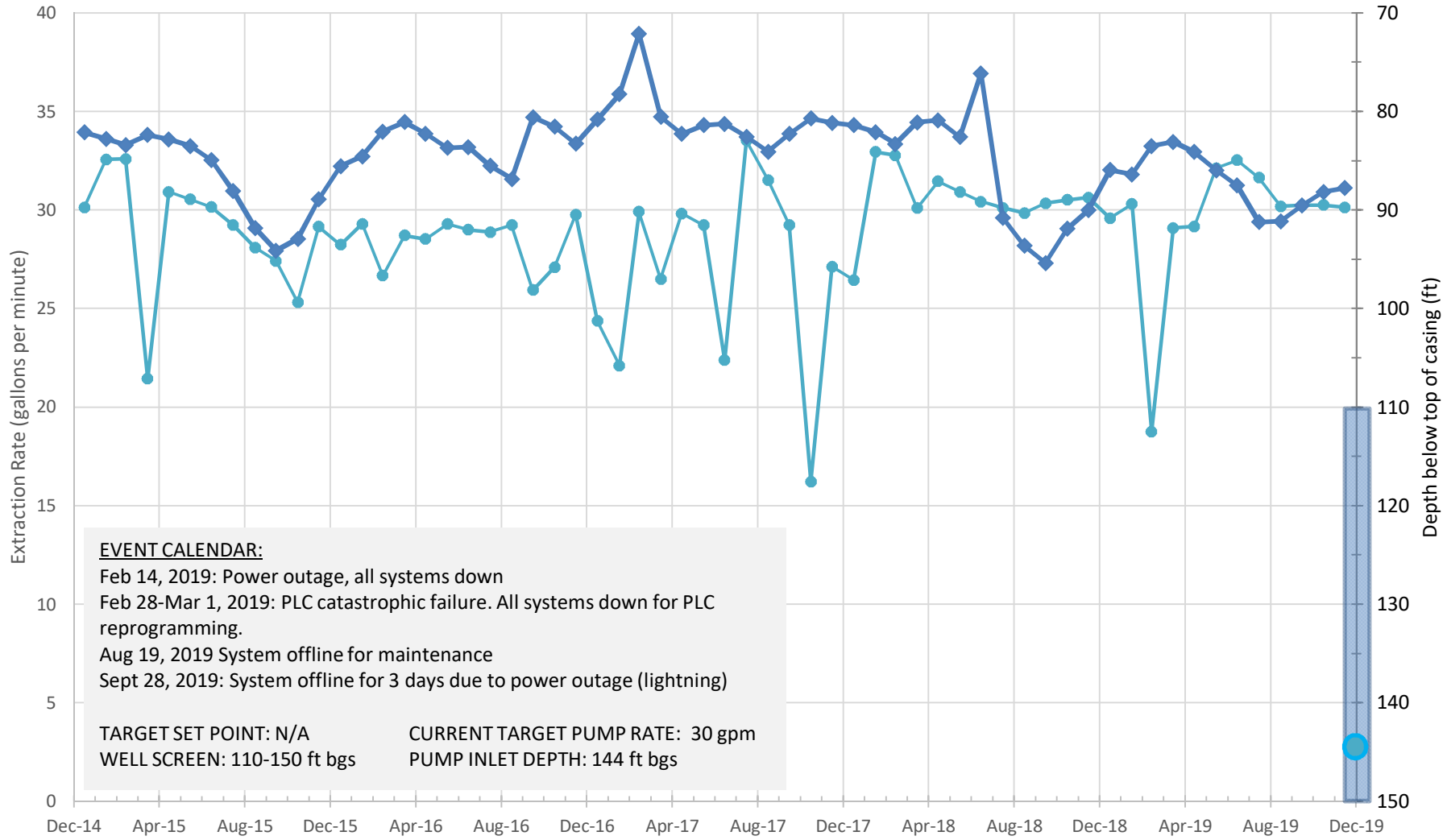
Geosyntec consultants

Cascade Corporation Gresham, Oregon	**EW-2 Monthly Average Extraction Rate** **TSA Remedy**	Figure A-1



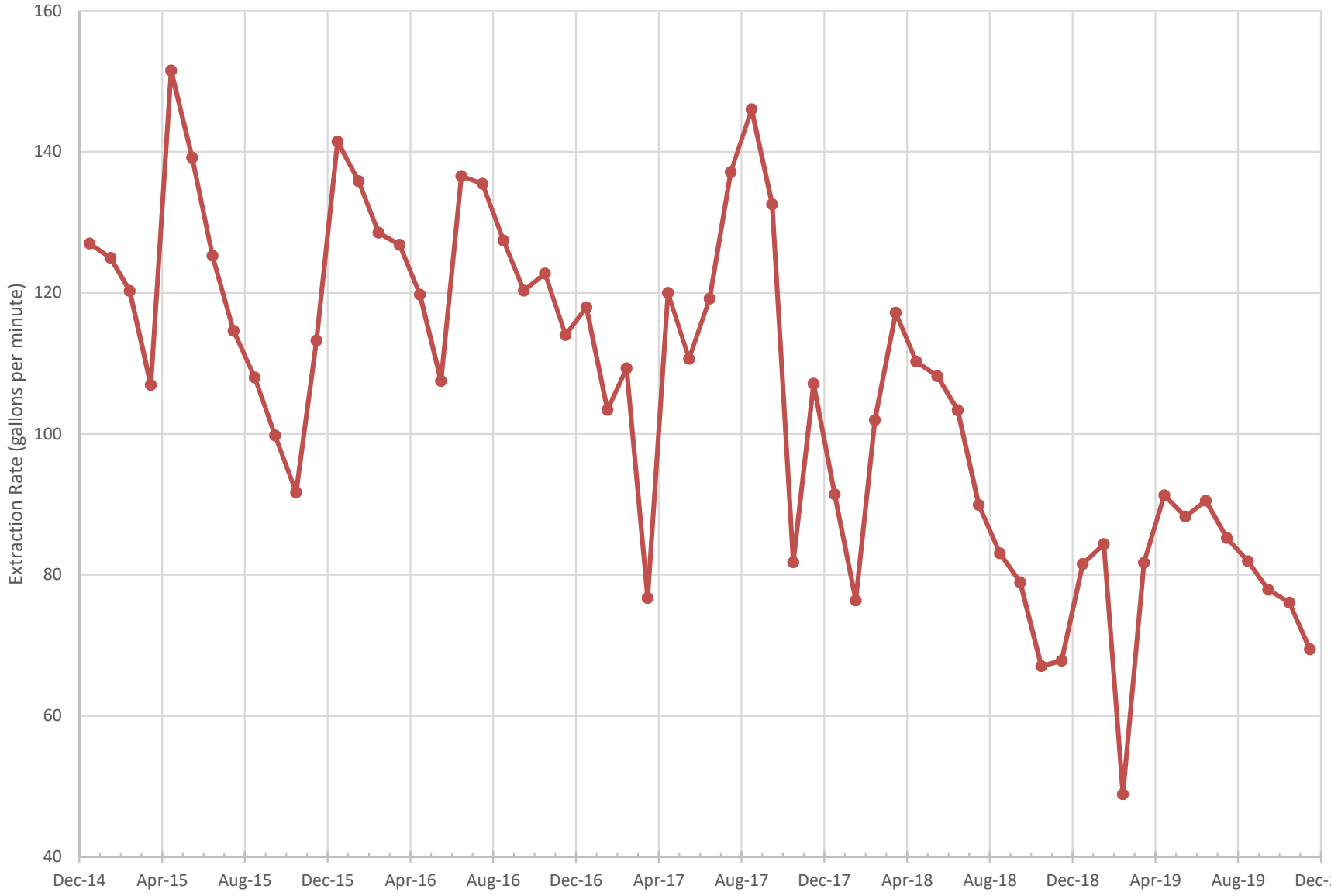
Geosyntec consultants

Cascade Corporation Gresham, Oregon	**EW-14 Monthly Average Extraction Rate** **TSA Remedy**	Figure A-2



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**EW-23 Monthly Average Extraction Rate** **TSA Remedy**	Figure A-3



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**Total Extraction Rate for Remedy All Wells** **TSA Remedy**	Figure A-4

EW-Total Monthly Average Extraction Rate

APPENDIX B
Well Decommissioning

MULT 133562

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

12/11/2019

WELL I.D. LABEL# L 89354

START CARD # 1043362

(1) LAND OWNER

Owner Well I.D. BOP-22R(DS)

First Name _____ Last Name _____

Company BOEING COMPANY

Address 19000 NE SANDY BLVD

City PORTLAND State OR Zip 97230

(2) TYPE OF WORK

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

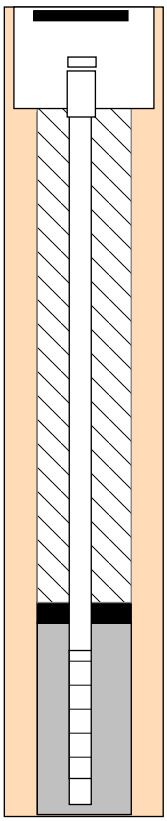
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud ☐ Reverse Rotary ☒ Other ABANDON IN PLACE

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 264.00 ft. Special Standard ☐



MONUMENT/VAULT Below Ground
From 0 To 1

BORE HOLE
Diameter 2 From 0 To 264

CASING
Dia. 2 From ☐ 0.05 To 244
Gauge Sch 40 Wld ☐ Thrd ☒
Material ◯ Steel ◉ Plastic

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

SEAL
From 0 To 2
Material Other
Amount 3 Sacks Grout weight _____

SCREEN
Casing/Liner Casing Material PVC - Sch 80
Diameter 2 From 244 To 264
Slot Size 0.010

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 56 °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 SW 1/4 Tax Lot 00500
Tax Map Number _____ Lot _____
Lat ° ' " or _____ DMS or DD
Long ° ' " or _____ DMS or DD

◯ Street address of well ◉ Nearest address

19000 NE SANDY BLVD (S OF NE SANDY BLVD AND EAST OF NE 185TH DR), GRESHAM, OR 97030

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening	11/11/2019		☐	73
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
Decom 2" MW in place as per Final Order	0	264

Date Started 11/11/2019 Completed 11/11/2019

(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 10512 Date 12/11/2019
Password : (if filing electronically) _____
Signed ARTURO MADRIGAL (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 12/11/2019
Password : (if filing electronically) _____
Signed PETER LARSEN (E-filed)
Contact Info (optional) 110-19-1133

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 133562

WELL I.D. LABEL# L 89354

START CARD # 1043362

12/11/2019

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight
C5	2	264	2	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

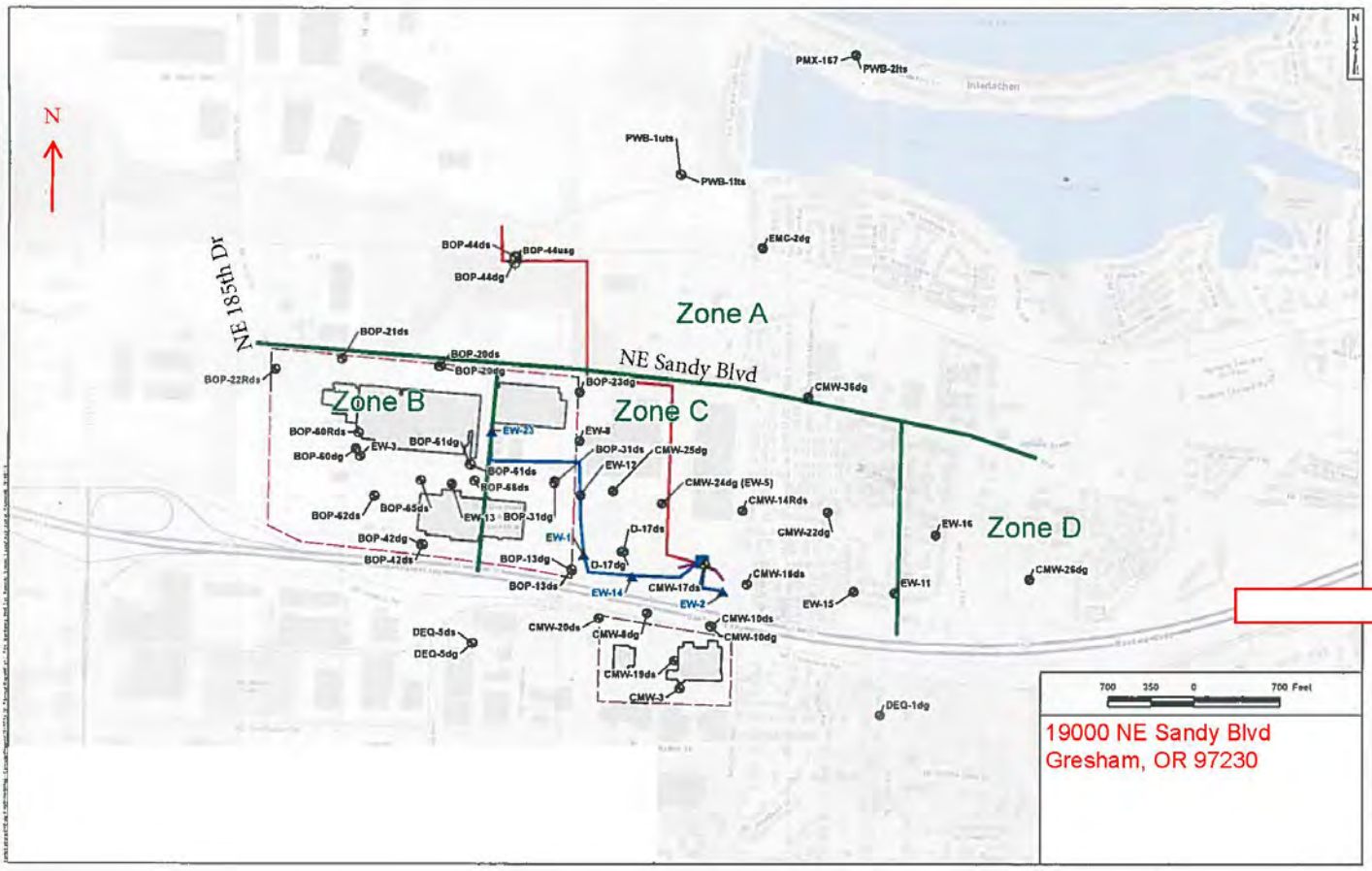
Abandon 2" MW in place as per Final Order. Remove upper portion of well and restore surface.
Original Start Card: 1004908
Original Well Tag: 89354

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

MULT 133562

12/11/2019

Map of Hole



MULT 133561

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

12/11/2019

WELL I.D. LABEL# L 102850

START CARD # 1043361

(1) LAND OWNER

Owner Well I.D. BOP-60R(DS)

First Name _____ Last Name _____

Company BOEING COMPANY

Address 19000 NE SANDY BLVD

City PORTLAND State OR Zip 97230

(2) TYPE OF WORK

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

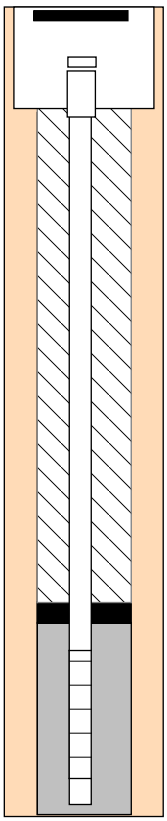
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud ☐ Reverse Rotary ☒ Other ABANDON IN PLACE

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 165.00 ft. Special Standard ☒



MONUMENT/VAULT Below Ground
From 0 To 1

BORE HOLE
Diameter 2 From 0 To 165

CASING
Dia. 2 From ☐ 0.05 To 155
Gauge Sch 80 Wld Thrd
Material ◯ Steel ◉ Plastic ☐ ☒

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

SEAL
From 0 To 2
Material Other
Amount 3 Sacks Grout weight _____

SCREEN
Casing/Liner Casing Material PVC - Sch 80
Diameter 2 From 155 To 165
Slot Size 0.020

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 56 °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 SW 1/4 Tax Lot 00500
Tax Map Number _____ Lot _____
Lat ° ' " or _____ DMS or DD
Long ° ' " or _____ DMS or DD

◉ Street address of well ◯ Nearest address

19000 NE SANDY BLVD, GRESHAM, OR 97030

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening	11/11/2019		☐	73
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
Decom 2" MW in place as per Final Order	0	165

Date Started 11/11/2019 Completed 11/11/2019

(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 10512 Date 12/11/2019
Password : (if filing electronically) _____
Signed ARTURO MADRIGAL (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 12/11/2019
Password : (if filing electronically) _____
Signed PETER LARSEN (E-filed)
Contact Info (optional) 110-19-1133

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 133561

12/11/2019

WELL I.D. LABEL# L 102850

START CARD # 1043361

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight
C5	2	165	1.5	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

Abandon 2" MW in place as per Final Order. Remove upper portion of well and restore surface.
Original Start Card: 1009299
Original Well Tag: 102850

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

MULT 133561

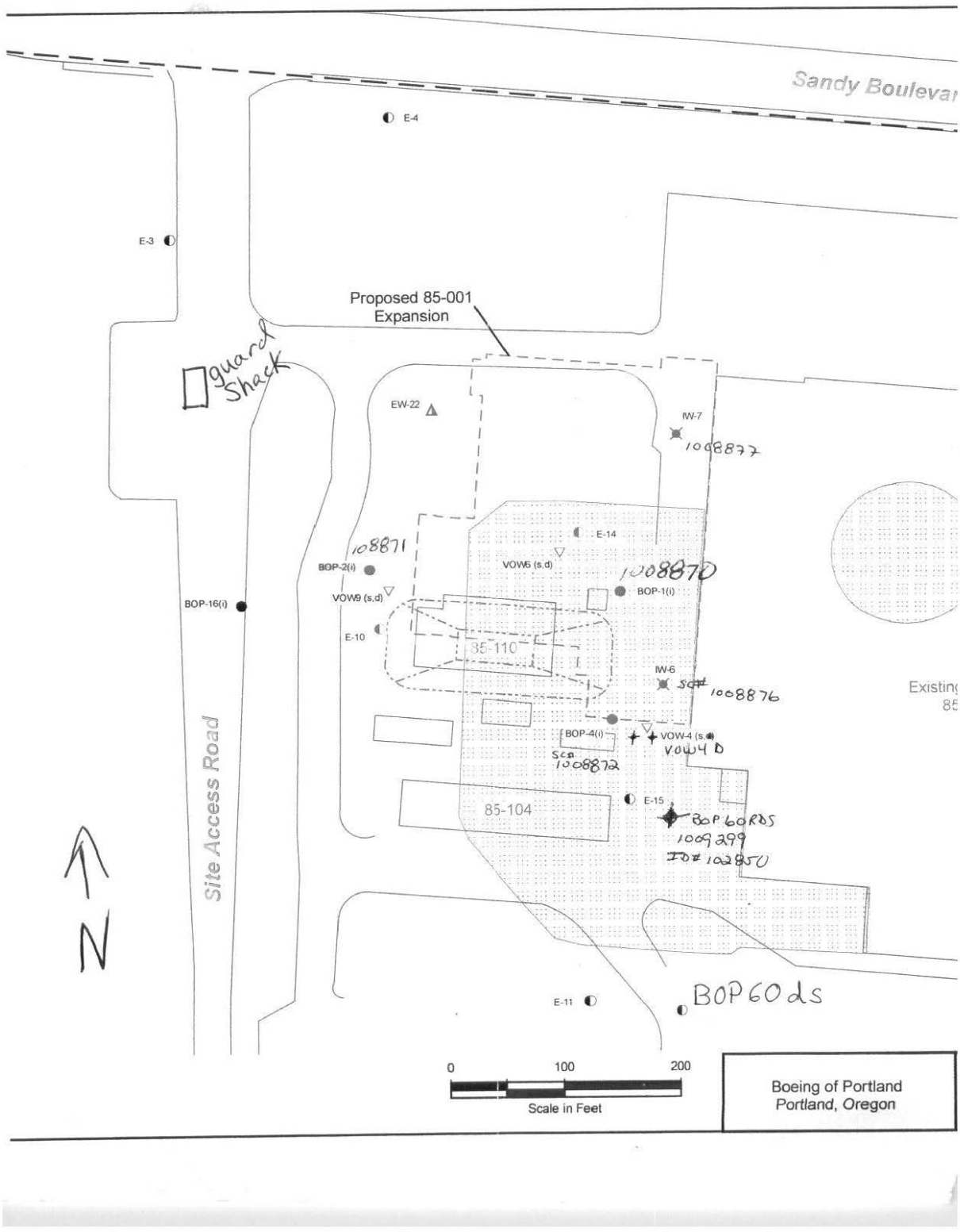
12/11/2019

Map of Hole

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

Map of well

19000 NE Sandy Blvd, Portland, OR



MULT 133691

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

12/30/2019

WELL I.D. LABEL# L

START CARD # 1042473

(1) LAND OWNER

Owner Well I.D. CMW3

First Name _____ Last Name _____

Company CASCADE CORP

Address 2201 NE 201ST AVE

City FAIRVIEW State OR Zip 97024

(2) TYPE OF WORK

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

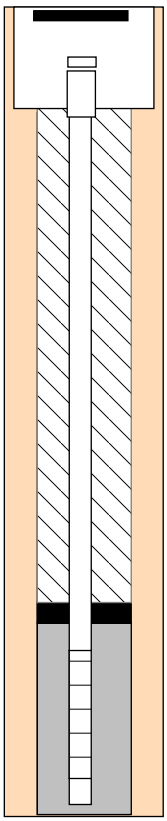
(3) DRILL METHOD

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

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 201.00 ft. Special Standard ☐



MONUMENT/VAULT _____
From _____ To _____

BORE HOLE
Diameter 8 From 0 To 120

CASING
Dia. _____ From ☐ _____ To _____
Gauge _____ Wld Thrd
Material ◯Steel ◯Plastic ☐ ☐

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

SEAL
From 0 To 5
Material Concrete
Amount 14 Sacks Grout weight _____

SCREEN
Casing/Liner _____ Material _____
Diameter _____ From _____ To _____
Slot Size _____

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 _____ °F Lab analysis ☐ Yes By _____

Supervising Geologist/Engineer _____

Water quality concerns? ☐ Yes (describe below) TDS amount 300 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 NE 1/4 of the SE 1/4 Tax Lot 2300
Tax Map Number _____ Lot _____
Lat ° ' " or 45.53836751 DMS or DD
Long ° ' " or -122.45830827 DMS or DD
◉ Street address of well ◯ Nearest address
2201 NE 201ST AVE, FAIRVIEW, OR 97024

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
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
Well abandonment by overdrill method	0	201

Date Started 12/27/2019 Completed 12/29/2019

(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 _____ Date _____
Password : (if filing electronically) _____
Signed _____

(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 10432 Date 12/30/2019
Password : (if filing electronically) _____
Signed DONALD LARSON (E-filed)
Contact Info (optional) _____

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 133691

WELL I.D. LABEL# L____________

START CARD # 1042473

12/30/2019

(4) CONSTRUCTION

BORE HOLE

Dia	From	To
6	120	201

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight
Bentonite Chips	5	20	700	P	
Bentonite Grout	20	201	9	S	

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

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

MULT 133691

12/30/2019

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: 45.5383675055 Datum: WGS84
Longitude: -122.45830827179
Township/Range/Section/Quarter-Quarter Section:
WM 1N 3E 29 NESE
Address of Well:
2201 NE 201ST AVE, FAIRVIEW, OR 97024

Hole Nbr: CMW3

Printed: December 30, 2019

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 132022

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

7/18/2019

WELL I.D. LABEL# L

START CARD # 1042474

(1) LAND OWNER

Owner Well I.D. DEQ-1 DG

First Name FEIMUN Last Name LUM
Company
Address 2081 NE 205TH AVE
City FAIRVIEW State OR Zip 97024

(2) TYPE OF WORK

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

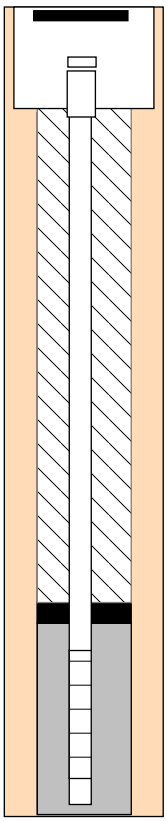
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☒ Other GROUT INPLACE

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 224.00 ft. Special Standard ☒



MONUMENT/VAULT B
From To

BORE HOLE
Diameter 2 From 0 To 224

CASING
Dia. From To
Gauge Wld Thrd
Material ◯Steel ◯Plastic ☐ ☐

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

SEAL
From 0 To 224
Material C5
Amount 540 Pounds Grout weight

SCREEN
Casing/Liner Material
Diameter From To
Slot Size

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 °F Lab analysis ☐ Yes By

Supervising Geologist/Engineer

Water quality concerns? ☐ Yes (describe below) TDS amount 300 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 1303
Tax Map Number Lot
Lat ° ' " or 45.53763000 DMS or DD
Long ° ' " or -122.45234400 DMS or DD

◉ Street address of well ◯ Nearest address

2081 NE 205TH AVE, FAIRVIEW, OR 97024

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening				
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
well abandonment by grout inplace method	0	224

Date Started 7/11/2019 Completed 7/11/2019

(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 Date
Password : (if filing electronically)
Signed

(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 10432 Date 7/18/2019
Password : (if filing electronically)
Signed DONALD LARSON (E-filed)
Contact Info (optional)

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 132022

WELL I.D. LABEL# L

START CARD # 1042474

7/18/2019

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight

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

2" PVC monitoring well abandonment by grout in-place method.

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

MULT 132022

7/18/2019

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: 45.53763 Datum: WGS84
Longitude: -122.452344
Township/Range/Section/Quarter-Quarter Section:
WM 1N 3E 28 NWSW
Address of Well:
2081 NE 205TH AVE, FAIRVIEW, OR 97024

Hole Nbr: DEQ-1 DG

Printed: July 18, 2019

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 132020

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

7/18/2019

WELL I.D. LABEL# L

START CARD # 1042476

(1) LAND OWNER

Owner Well I.D. DEQ-5DG

First Name _____ Last Name _____

Company AJZ LLC

Address PO BOX 1597

City SANDY State OR Zip 97055

(2) TYPE OF WORK

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

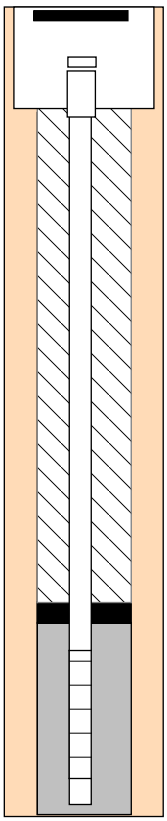
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud
☐ Reverse Rotary ☒ Other GROUT INPLACE

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 235.00 ft. Special Standard ☒



MONUMENT/VAULT
From _____ To _____

BORE HOLE
Diameter 2 From 0 To 235

CASING
Dia. _____ From ☐ _____ To _____
Gauge _____ Wld Thrd
Material ◯Steel ◯Plastic ☐ ☐

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

SEAL
From 0 To 235
Material C5
Amount 564 Pounds Grout weight _____

SCREEN
Casing/Liner _____ Material _____
Diameter _____ From _____ To _____
Slot Size _____

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 _____ °F Lab analysis ☐ Yes By _____

Supervising Geologist/Engineer _____

Water quality concerns? ☐ Yes (describe below) TDS amount 300 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 NW 1/4 of the SE 1/4 Tax Lot 0600
Tax Map Number _____ Lot _____
Lat ° ' " or 45.53911470 DMS or DD
Long ° ' " or -122.46488859 DMS or DD
◉ Street address of well ◯ Nearest address
2271 NE 194TH, PORTLAND, OR 97230

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
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
well abandonment by grout inplace method	0	235

Date Started 7/10/2019 Completed 7/10/2019

(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 _____ Date _____
Password : (if filing electronically) _____
Signed _____

(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 10432 Date 7/18/2019
Password : (if filing electronically) _____
Signed DONALD LARSON (E-filed)
Contact Info (optional) _____

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 132020

WELL I.D. LABEL# L

START CARD # 1042476

7/18/2019

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight

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

2" PVC monitoring well abandonment - grout in-place

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

MULT 132020

7/18/2019

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: 45.5391146963 Datum: WGS84
Longitude: -122.46488859392
Township/Range/Section/Quarter-Quarter Section:
WM 1N 3E 29 NWSE
Address of Well:
2271 NE 194TH, PORTLAND, OR 97230

Hole Nbr: DEQ-5DG

Printed: July 18, 2019

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 132021

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

7/18/2019

WELL I.D. LABEL# L

START CARD # 1042475

(1) LAND OWNER

Owner Well I.D. DEQ-5-DS

First Name _____ Last Name _____

Company AJZ LLC

Address PO BOX 1597

City SANDY State OR Zip 97055

(2) TYPE OF WORK

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

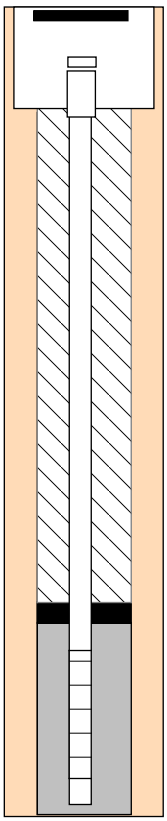
(3) DRILL METHOD

☐ Rotary Air ☐ Rotary Mud ☐ Cable ☐ Hollow Stem Auger ☐ Cable Mud ☐ Reverse Rotary ☒ Other GROUT INPLACE

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 156.50 ft. Special Standard ☒



MONUMENT/VAULT

From _____ To _____

BORE HOLE

Diameter 2 From 0 To 156.5

CASING

Dia. _____ From ☐ _____ To _____

Gauge _____ Wld Thrd

Material ◯Steel ◯Plastic ☐ ☐

LINER

Dia. _____ From ☐ _____ To _____

Gauge _____ Wld Thrd

Material ◯Steel ◯Plastic ☐ ☐

SEAL

From 0 To 156.5

Material C5

Amount 375 Pounds Grout weight _____

SCREEN

Casing/Liner _____ Material _____

Diameter _____ From _____ To _____

Slot Size _____

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 _____ °F Lab analysis ☐ Yes By _____

Supervising Geologist/Engineer _____

Water quality concerns? ☐ Yes (describe below) TDS amount 300 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 NW 1/4 of the SE 1/4 Tax Lot 00600

Tax Map Number _____ Lot _____

Lat ° ' " or 45.53912597 DMS or DD

Long ° ' " or -122.46497979 DMS or DD

◉ Street address of well ◯ Nearest address

2271 NE 194TH, PORTLAND, OR 97230

(7) STATIC WATER LEVEL

	Date	SWL(psi)	+	SWL(ft)
Existing Well / Predeepening			☐	
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
well abandonment by grout inplace method	0	156.5

Date Started 7/10/2019 Completed 7/10/2019

(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 _____ Date _____

Password : (if filing electronically) _____

Signed _____

(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 10432 Date 7/18/2019

Password : (if filing electronically) _____

Signed DONALD LARSON (E-filed)

Contact Info (optional) _____

ORIGINAL - WATER RESOURCES DEPARTMENT

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

Form Version:

7/18/2019

START CARD # 1042475

(4) CONSTRUCTION

BORE HOLE

Dia	From	To

FILTER PACK

From	To	Material	Size

SEAL

Material	From	To	Amt	sacks/ lbs	grout weight

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

2" PVC monitoring well abandonment by grout in-place method

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

MULT 132021

7/18/2019

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: 45.5391259684 Datum: WGS84
Longitude: -122.46497978902
Township/Range/Section/Quarter-Quarter Section:
WM 1N 3E 29 NWSE
Address of Well:
2271 NE 194TH, PORTLAND, OR 97230

Hole Nbr: DEQ-5-DS

Printed: July 18, 2019

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

Oregon
Kate Brown, Governor

Water Resources Department
North Mall Office Building
725 Summer St NE, Ste A
Salem, OR 97301
Phone: 503-986-0900
Fax: 503-986-0904
www.Oregon.gov/OWRD

April 24, 2019

DONALD LARSON, MWC #10443
YELLOW JACKET DRILLING SERVICES, LLC
C/O 3939 NORTH MARINE DRIVE # 18
PORTLAND, OREGON 97217

FINAL ORDER

Dear Mr. Larson:

The Special Standards Request Form you submitted for owners: Cascade Corp, Feimun and AJZ LLC, Start Card numbers: 1042474 through 1042476 is Hereby approved for the following: You may abandon these monitoring wells in-place per OAR 690-240-0510(2). *Bentonite grout may only be used to abandon the portion of the wells that are below the static water level.* Above the static water level another approved sealing method sealing material must be used.

Unfortunately the Special Standards Request for Start Card Number 1042473 is denied. The basis for the denial of this Special Standards Request is that Trichloroethene (TCE), was detected in the last groundwater sample, at a level that exceeded the ODEQ's Risk Based Table, of concentrations, for Groundwater for the Ingestion and Inhalation from Tapwater Exposure Pathway for the Residential Receptor. All casing, screen, annular sealing material, drill cuttings, debris and filter pack material shall be removed prior to sealing.

All other monitoring well decommissioning standards must be adhered to. A copy of your Special Standards Request Form is enclosed.

If you have any questions regarding this letter, I may be contacted at (503) 986-0852, or by e-mail at Joel.W.Jeffery@oregon.gov.

Sincerely,

Joel Jeffery, Coordinator
Well Construction Program
Well Construction and Compliance Section

cc: Barry Sanford, Well Inspector, NW Region
File

This is a final order in other than contested case. This order is subject to judicial review under ORS 183.484. Any petition for judicial review must be filed within the 60 day time period specified by ORS 183.484(2). Pursuant to ORS 536.075 and OAR 137-004-0080 you may either petition for judicial review or petition the Director for reconsideration of this order. A petition for reconsideration may be granted or denied by the director, and if no action is taken within 60 days following the date the petition was filed, the petition shall be deemed denied.

APPENDIX C
SVE Data

Table C-1
Soil Vapor Extraction 1 January 2019 through 31 December 2019
East Multnomah County TSA Remedy

Well ID	Date	Time (hrs)	Temperature (degrees F)	Flow Rate[1] (scfm)	PID Measurement (ppm)	Calculated VOC Concentrations (µg/L)
Soil Vapor Extraction Outlet						
SVE System Outlet	01/08/19	7:40	90	421.2	NM	NM
SVE System Outlet	01/15/19	11:00	90	441.2	NM	NM
SVE System Outlet	01/22/19	7:20	90	428.6	NM	NM
SVE System Outlet	01/29/19	11:30	100	428.1	NM	NM
SVE System Outlet	02/04/19	13:30	90	428.9	0.4	2.34
SVE System Outlet	02/12/19	11:20	90	431.6	0.4	2.34
SVE System Outlet	02/19/19	11:50	90	424.6	0.4	2.34
SVE System Outlet	03/26/19	15:30	120	350.0	2.115	12.36
SVE System Outlet	04/02/19	9:00	160	386.5	0.1	0.58
SVE System Outlet	04/09/19	13:00	180	373.0	0.5	2.70
SVE System Outlet	04/16/19	11:40	180	384.0	0.484	2.83
SVE System Outlet	04/22/19	15:50	200	396.0	0.7	4.09
SVE System Outlet	04/30/19	9:40	180	395.1	0.886	5.18
SVE System Outlet	05/07/19	8:40	200	388.0	0.819	4.79
SVE System Outlet	05/14/19	8:10	200	390.6	0.925	5.41
SVE System Outlet	05/21/19	9:40	200	384.8	0.885	5.17
SVE System Outlet	05/28/19	14:50	200	396.1	0.886	5.18
SVE System Outlet	06/04/19	10:00	200	378.6	0.599	3.50
SVE System Outlet	06/11/19	9:00	210	374.6	0.677	3.96
SVE System Outlet	06/18/19	13:50	210	368.3	0.989	5.78
SVE System Outlet	06/25/19	8:00	210	369.7[2]	0.393	2.30
SVE System Outlet	07/02/19	15:40	220	371.2	7.85	45.89
SVE System Outlet	07/09/19	10:00	220	383.8	7.33	42.85
SVE System Outlet	07/16/19	14:40	225	410.6	0	0.00
SVE System Outlet	07/23/19	14:10	225	391.6	0.6	3.51
SVE System Outlet	07/30/19	11:30	185	386.0	0.4	2.34
SVE System Outlet	08/05/19	11:45	225	389.6	0.4	2.34
SVE System Outlet	08/13/19	15:30	160	367.8	0.4	2.34
SVE System Outlet	08/20/19	13:15	170	418.9	0.5	2.92
SVE System Outlet	08/27/19	10:00	200	310.0	0.4	2.34
SVE System Outlet	09/03/19	10:00	115	278.1	0.5	2.92
SVE System Outlet	09/10/19	10:00	100	219.1	0.5	2.92
SVE System Outlet	09/17/19	14:20	95	228.3	0.4	2.34
SVE System Outlet	09/23/19	14:55	110	311.6	0.5	2.92
SVE System Outlet	09/30/19	14:30	100	299.3	NM	NM
SVE System Outlet	10/08/19	13:10	95	328.6	NM	NM
SVE System Outlet	10/14/19	12:50	110	314.6	NM	NM
SVE System Outlet	10/22/19	16:10	130	351.6	0.4	2.34
SVE System Outlet	10/29/19	15:00	100	328.3	0.4	2.34
SVE System Outlet	11/05/19	13:00	100	373.1	0.6	3.51

Table C-1
Soil Vapor Extraction 1 January 2019 through 31 December 2019
East Multnomah County TSA Remedy

Well ID	Date	Time (hrs)	Temperature (degrees F)	Flow Rate[1] (scfm)	PID Measurement (ppm)	Calculated VOC Concentrations (µg/L)
Soil Vapor Extraction Outlet						
SVE System Outlet	11/12/19	15:30	100	396.8	0.5	2.92
SVE System Outlet	11/19/19	13:30	NM	388.1	0.6	3.51
SVE System Outlet	11/26/19	15:50	100	376.1	0.6	3.51
SVE System Outlet	12/03/19	13:00	100	396.1	0.5	2.92
SVE System Outlet	12/10/19	15:50	90	381.6	0.6	3.51
SVE System Outlet	12/17/19	9:20	90	372.6	0.5	2.92
SVE System Outlet	12/23/19	12:10	110	384.1	0.4	2.34
SVE System Outlet	12/30/19	16:00	110	388.6	0.5	2.92

Notes:
ID = identification
hrs = hours
F = Fahrenheit
scfm = standard cubic feet per minute
ppm = parts per million
µg/L = micrograms per liter
VOC = volatile organic compounds
Bold text indicates sample taken during week, shown on Table C-2
Calculated VOC concentrations are based on PID readings
NM = not measured
[1] Flow measurements taken using a hot-wire anomometer. Due to high SVE system outlet temperatures interfering with the measurement, SVE system inlet flow measurements shown.
[2] Inlet flow mont meausred during the event. The sum of the indvidual well flow measurements shown.

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)
System Outlet	01/08/19	43	530	35	608	460.4
	02/12/19	53	620	51	724	449.9
	03/26/19	59	680	43	782	418.5
	04/09/19	79	560	40	679	369.8
	05/07/19	63	630	50	743	387.2
	06/11/19	58	650	50	758	385.5
	07/09/19	96	670	53	819	373.5
	08/05/19	56	530	42	628	392.3
	09/10/19	66	680	58	804	330.6
	10/3/19[1]	76	630	49	755	264.6
	11/05/19	64.2	801	46.6	911.8	332.6
	12/03/19	53	470	53	576	386.0
Well VW17D-95.5	2/12/19	<2.1	4.3	<2.1	6.4	99.3
	5/7/19	<2.0	<2.0	<2.0	3.0	70.6
	8/5/19	27	250	18	295	72.1
	10/3/19[1]	42	330	19	391	61.3
	11/5/19	<1.98	3.87	<3.39	6.56	64.2
Well VMW-A	2/12/19	<2.1	<2.1	<2.1	3.2	124.1
	6/11/19	<2.2	<2.2	<2.2	3.3	---[2]
	10/3/19[1]	<2.0	<2.1	<2.0	3.1	60.1
Well VMW-B	2/12/19	<2.0	<2.0	<2.0	3.0	123.3
	6/11/19	<2.3	<2.3	<2.3	3.5	---[2]
	10/3/19[1]	<2.0	<2.1	<2.0	3.1	60.3
Well VMW-C	2/12/19	<2.0	<2.0	<2.0	3.0	121.9
	3/26/19	<2.0	11.0	<2.0	13	68.8
	5/7/19	<2.0	<2.0	<2.0	3.0	70.4
	8/5/19	51	700	58	809	70.3
	11/5/19	8.2	213.00	18.7	239.87	65.3
Well VMW-D	2/12/19	<2.0	<2.0	<2.0	3.0	121.1
	6/11/19	<2.2	<2.2	<2.2	3.3	---[2]
	10/3/19[1]	<2.0	<2.0	<1.9	3.0	59.2
Well VMW-E	3/26/19	220	1,300	98	1,618	63.3
	5/7/19	19	280	39	338	66.1
	8/5/19	78	980	66	1,124	71.2
	11/5/19	9	98	8.0	115	64.1
Well VMW-F	3/26/19	130	2,100	110	2,340	64.6
	5/7/19	140	1,400	93	1,633	72.3
	8/5/19	13	51	13	77	77.8
	11/5/19	56	98	14.0	168	65.6

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

Well ID	Date	cis-1,2-dichloroethene ($\mu g/m^3$)	Trichloro-ethene (µg/m3)	Tetrachloro-ethene (µg/m3)	Total VOCs (µg/m3)	Flow Rate (scfm)
Well VMW-G	3/26/19	85	250	85	420	68.5
	5/7/19	250	1,900	120	2,270	73.4
	8/5/19	32	280	22	334	76.1
	11/5/19	111	641	30.0	782	69.8
Well VMW-H	4/2/19	22	45	22	88	78.1
	5/7/19	75	240	11	326	70.8
	8/5/19	51	130	5.6	187	75.8
	11/5/19	7.41	62.2	3.93	74	63.1

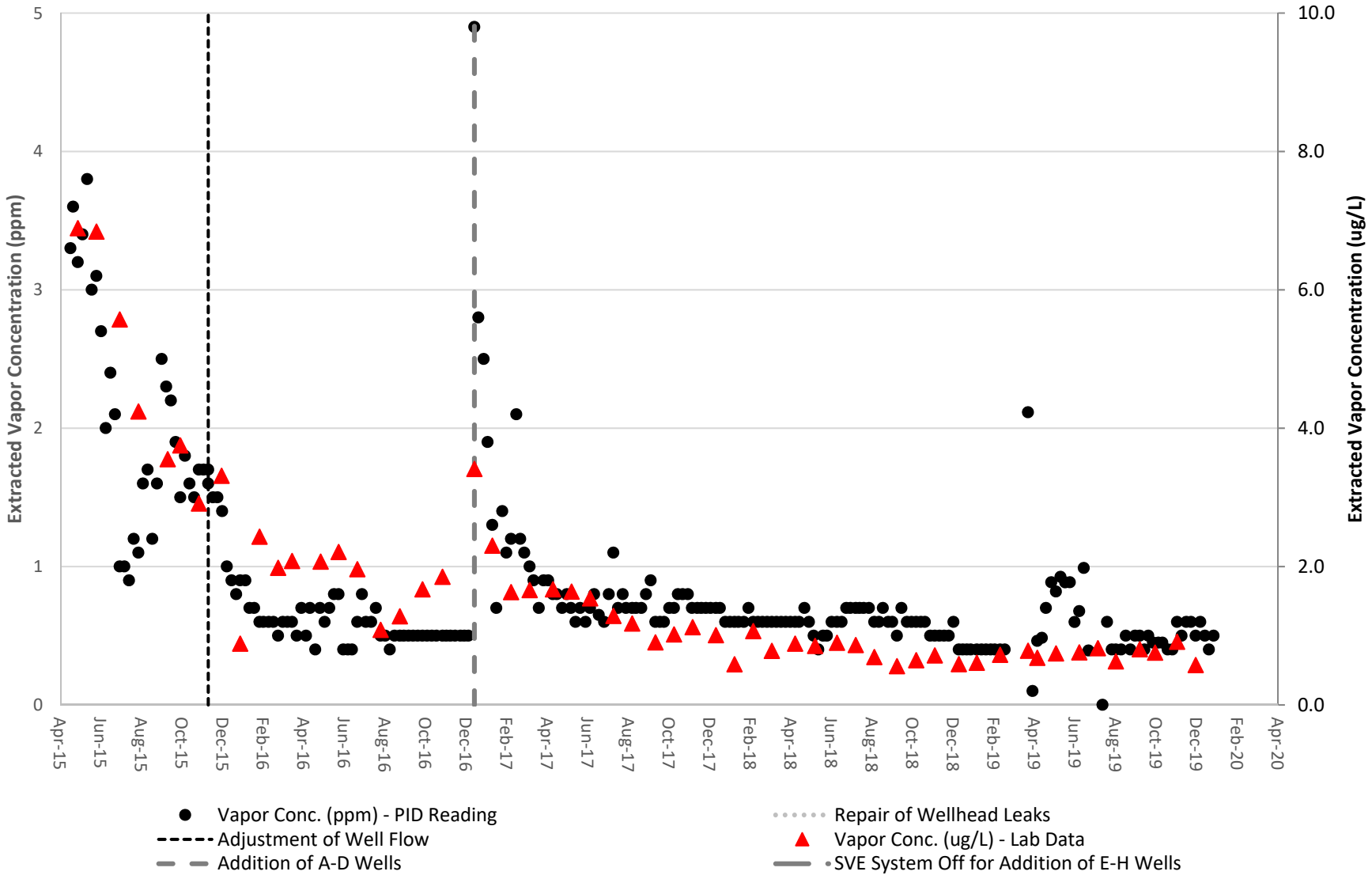
Notes:
ID = identification
scfm = standard cubic feet per minute
$\mu g/m^3$ = micrograms per cubic meter
VOC = volatile organic compounds
Total VOCs are the calculated sum of the three VOCs shown
[1] Samples collected on 10/3/19 were not collected during a weekly field visit; flow rates measured during the 9/30/19 field visit are shown.
[2] Monitoring wells VMW-A, -B, and -D were not operating during the 6/11/19 field event and therefore flow rates at these wells were not measured.

Table C-3
SVE TCE Mass Removal - April 2015 through December 2019
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
4/16/2015	0.00	0.00	0.00	0.00	0%
4/28/2015	1.13	1.13	1.30	1.30	87%
5/26/2015	2.57	3.71	2.95	4.25	87%
6/30/2015	2.46	6.17	2.80	7.05	88%
7/28/2015	1.44	7.60	1.64	8.69	88%
9/10/2015	1.68	9.29	1.93	10.62	87%
9/29/2015	0.79	10.08	0.90	11.52	88%
10/27/2015	0.95	11.03	1.09	12.61	87%
11/30/2015	1.31	12.33	1.50	14.11	87%
12/28/2015	0.84	13.17	0.96	15.07	87%
1/26/2016	0.84	14.01	0.98	16.04	86%
2/23/2016	1.07	15.08	1.24	17.28	86%
3/15/2016	0.73	15.81	0.85	18.13	86%
4/27/2016	1.51	17.32	1.74	19.88	87%
5/24/2016	1.05	18.37	1.21	21.09	86%
6/21/2016	0.98	19.35	1.14	22.23	86%
7/26/2016	0.91	20.27	1.05	23.28	87%
8/24/2016	0.59	20.86	0.69	23.97	86%
9/27/2016	0.84	21.70	1.00	24.96	85%
10/27/2016	0.85	22.55	1.00	25.96	85%
12/14/2016	1.84	24.40	2.11	28.07	87%
1/10/2017	1.51	25.91	1.73	29.80	87%
2/7/2017	1.95	27.86	2.25	32.05	86%
3/7/2017	1.66	29.52	1.95	34.00	85%
4/11/2017	1.85	31.37	2.20	36.20	84%
5/9/2017	1.48	32.85	1.75	37.95	85%
6/6/2017	1.51	34.35	1.77	39.72	85%
7/11/2017	1.63	35.99	1.92	41.64	85%
8/8/2017	1.16	37.15	1.36	43.00	85%
9/12/2017	1.24	38.39	1.46	44.46	85%
10/10/2017	0.92	39.31	1.08	45.54	85%
11/7/2017	0.98	40.29	1.14	46.68	86%
12/12/2017	1.31	41.60	1.52	48.20	86%
1/9/2018	0.74	42.34	0.87	49.07	85%
2/6/2018	0.78	43.12	0.90	49.97	87%
3/6/2018	0.89	44.00	1.01	50.98	88%
4/10/2018	1.00	45.01	1.15	52.13	87%
5/10/2018	0.79	45.80	0.91	53.04	87%
6/12/2018	1.05	46.85	1.20	54.25	87%
7/10/2018	0.85	47.70	0.97	55.22	87%
8/7/2018	0.76	48.46	0.87	56.09	87%
9/10/2018	0.75	49.21	0.86	56.95	87%

Table C-3
SVE TCE Mass Removal - April 2015 through December 2019
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
10/9/2018	0.62	49.83	0.72	57.67	87%
11/6/2018	0.69	50.52	0.79	58.46	87%
12/12/2018	0.84	51.36	0.98	59.44	86%
1/8/2019	0.58	51.94	0.66	60.10	87%
2/12/2019	0.83	52.77	0.96	61.06	86%
3/26/2019	1.07	53.83	1.24	62.29	86%
4/9/2019	0.31	54.14	0.36	62.66	85%
5/7/2019	0.56	54.70	0.67	63.33	84%
6/11/2019	0.78	55.48	0.91	64.24	85%
7/9/2019	0.63	56.11	0.75	65.00	84%
8/5/2019	0.56	56.67	0.67	65.67	83%
9/10/2019	0.70	57.37	0.83	66.50	84%
10/3/2019	0.36	57.73	0.42	66.92	84%
11/5/2019	0.70	58.43	0.81	67.73	86%
12/3/2019	0.56	58.99	0.66	68.39	85%
1/7/2020	0.64	59.63	0.77	69.16	83%



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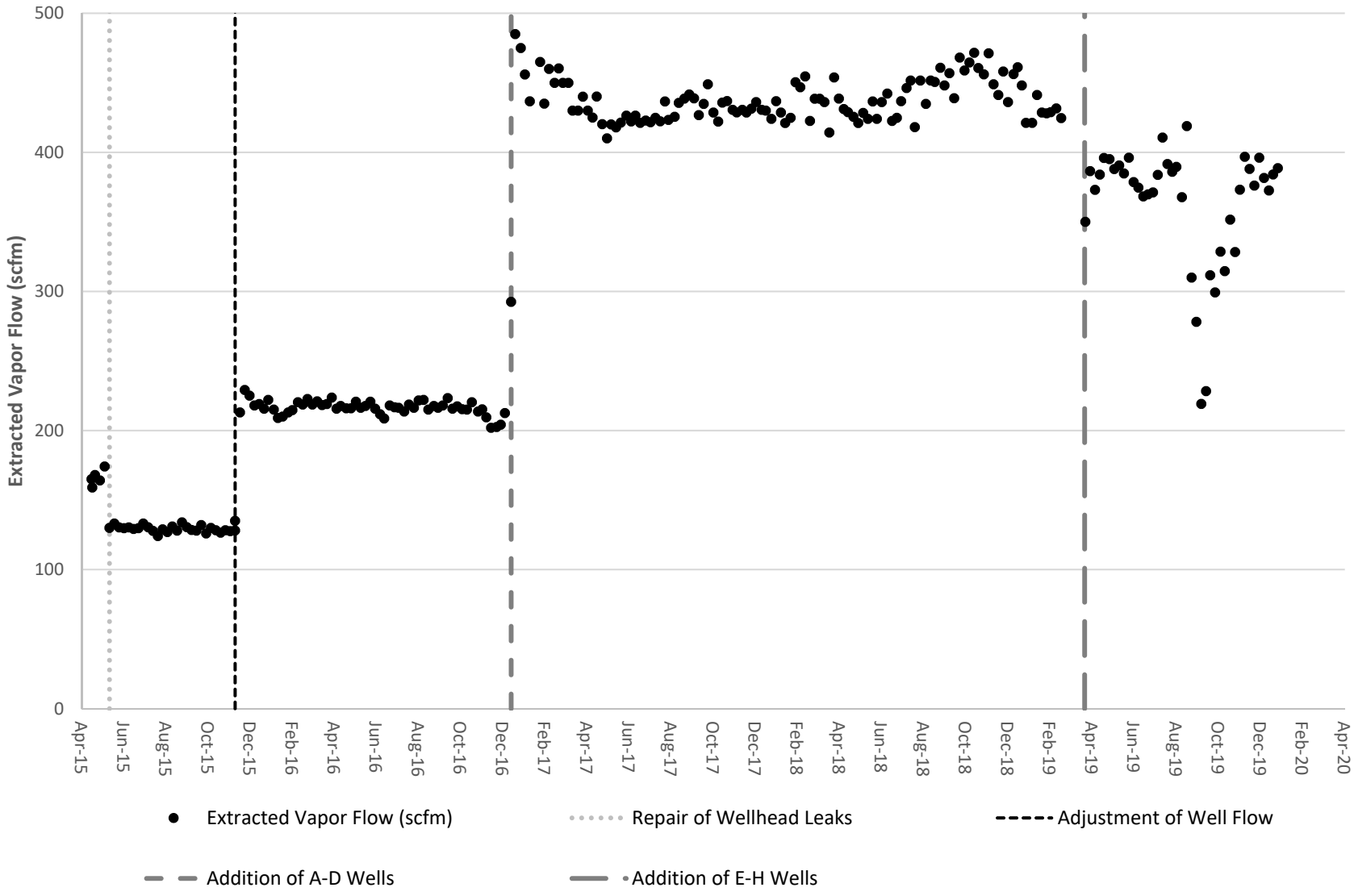
Cascade Corporation Gresham, Oregon	**SVE Effluent VOC Vapor Concentration** **TSA Remedy**	Figure C-1



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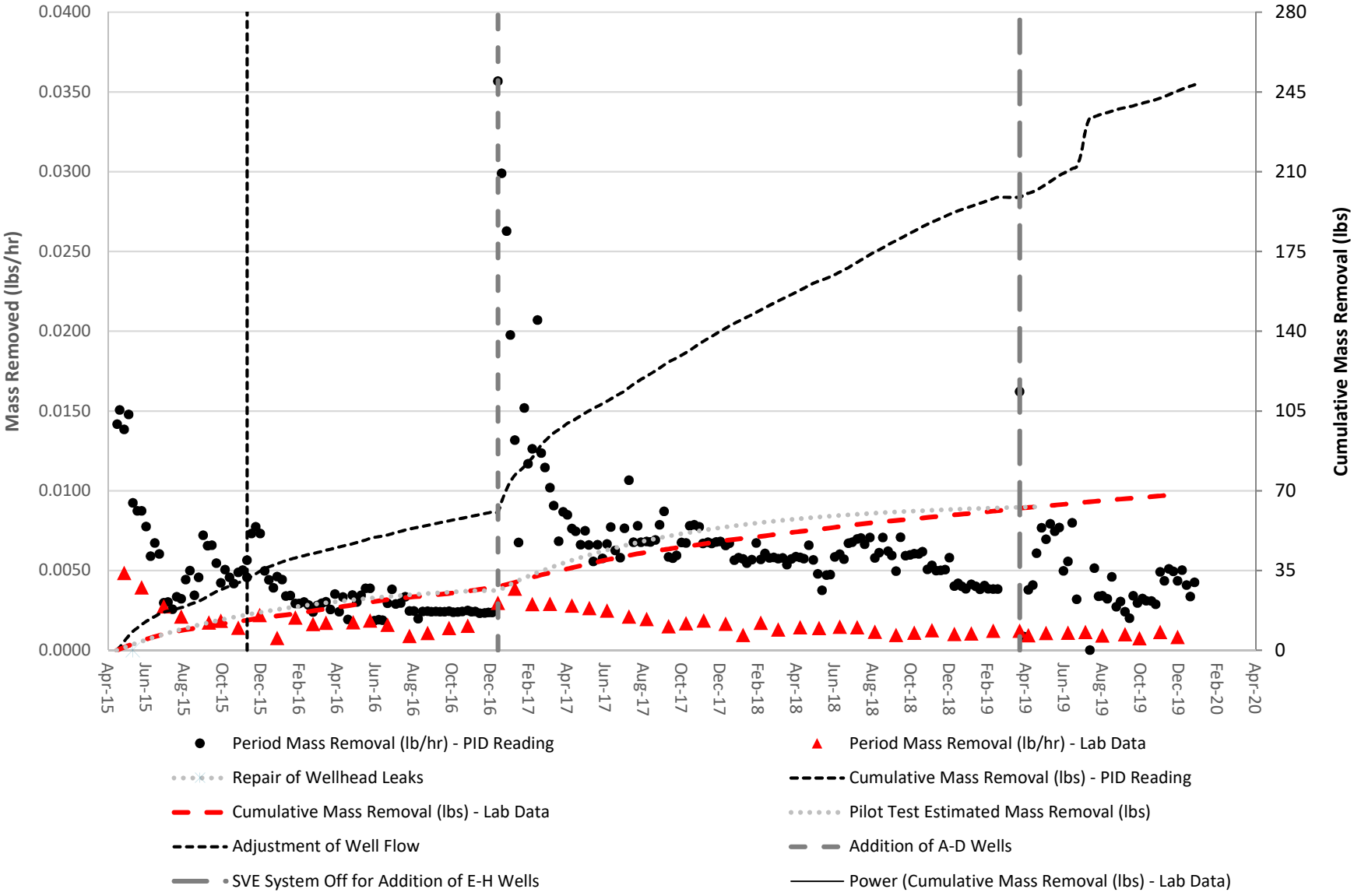
Cascade Corporation Gresham, Oregon	**SVE Extracted Vapor Flow (Weekly Average)** **TSA Remedy**	Figure C-2



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

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Portland, Oregon 97204
Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING VMW-E **SHEET** 1 OF 3
START DATE 2/21/2019 **Elevation** 131.00 FT. MSL
FINISH DATE 2/23/2019
PROJECT Cascade Corporation
LOCATION
PROJECT NUMBER PNG0564S18

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
1	TOPSOIL; with roots	12-inch diameter, above ground monument				100		SOIL	
2	Brown, medium dense, moist, low plasticity, sandy SILT	Bentonite chip seal from 0 feet - 5 feet					1.4	ML	
3		7-inch diameter boring from 0 feet - 50 feet							
4									
5									
6	--becomes gravelly sandy SILT		135				1.1	GM	
7	Grey, medium density, moist, silty sandy GRAVEL (rounded to subangular) [Troutdale Gravel Aquifer (TGA)]	2-inch diameter SCH 40							
8									
9									
10	--becomes drier (still moist) and loose					100	3.4		
11									
12									
13			140						
14									
15							7.3		
16									
17									
18									
19									
20			145			100	0.5		
21									
22									
23									
24									
25							5.5		
26									
27			150						
28									
29									
30	--increasing moisture (not wet)					100	2.5		
31	--increasing proportion of silt								
32									
33									
34			155						
35	Light brown, dense, moist, highly weathered, sandy SILTSTONE							SILTSTONE	
36							2.3		
37									
38									
39								SANDSTONE	
40	Dark grey, medium dense, moist, silty SANDSTONE					100	6.1		
41	--transitions to dense, sandy SILTSTONE		160					SILTSTONE	
42	[Confining Unit 1]								
43		Set bentonite chip seal from 43 ft.-50 ft. Step down to 6-inch boring from 50 feet - 170 feet							
44	--transitions to dense, SILTSTONE							SILTSTONE	
45							1.7		
46									
47									
48	Greyish green, very stiff, dry, SILTSTONE		165					SILTSTONE	
49							1.0		
50						100			
51									
52									
53									
54									
55							3.1		
56	Dark brown, very hard, dry, SILTSTONE							SILTSTONE	
57									
58									
59									
60							2.6		

CONTRACTOR Yellow Jacket Drilling **NORTHING** 5043122.000
EQUIPMENT Terrasonic T150 **EASTING** 542395.000
DRILL MTHD Sonic **ANGLE** 45
DIAMETER 8 in. to 6 in. **BEARING**
LOGGER B. Webb **REVIEWER** C. Bartlett **PRINTED** 10/28/19

REMARKS: Datum and projection is NAD83, UTM 10N

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

BORING LOG W/SV POINT (PORTLAND) CASCADE.GPJ PNW DEFAULT GINT LIBRARY.GLB 10/28/19

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Portland, Oregon 97204
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BOREHOLE LOG

BORING VMW-E **SHEET** 2 OF 3
START DATE 2/21/2019 **Elevation** 131.00 FT. MSL
FINISH DATE 2/23/2019
PROJECT Cascade Corporation
LOCATION
PROJECT NUMBER PNG0564S18

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION (ft)	SAMPLE NAME	TYPE	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
61	Very dark grey, strongly lithified, dry, weathered, vitric SANDSTONE [upper Troutdale Sandstone Aquifer (TSA)]				100		SANDSTONE	
62		175				1.4		
63								
64								
65								
66							SANDSTONE	
67	Brown, strongly lithified, dry, weathered, silty SANDSTONE							
68								
69		180				2.1		
70					100			
71								
72								
73								
74								
75						6.2		
76								
77		185						
78								
79								
80					100	3.2		
81								
82								
83								
84		190				3.0		
85	Grey, hard, dry, SILTSTONE						SILTSTONE	
86								
87							SANDSTONE	
88	Dark brownish grey, medium dense, dry, silty SANDSTONE					4.1		
89								
90					100			
91		195						
92								
93	--10% subangular pebbles from 91-93 ft.							
94								
95								
96						10.1		
97	--becomes dark grey, less dense							
98		200						
99								
100					45	4.8		
101								
102								
103								
104		205						
105								
106								
107						12.2		
108	--becomes light brown							
109								
110	Light brown, dense, dry, SANDSTONE				60	10.7	SANDSTONE	
111						15.5		
112		210						
113								
114								
115						8.9		
116								
117								
118								
119								
120								

CONTRACTOR Yellow Jacket Drilling **NORTHING** 5043122.000
EQUIPMENT Terrasonic T150 **EASTING** 542395.000
DRILL MTHD Sonic **ANGLE** 45
DIAMETER 8 in. to 6 in. **BEARING**
LOGGER B. Webb **REVIEWER** C. Bartlett **PRINTED** 10/28/19

REMARKS: Datum and projection is NAD83, UTM 10N

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GS FORM: CORE3 10/00

BOREHOLE LOG

BORING VMW-E **SHEET** 3 OF 3
START DATE 2/21/2019 **Elevation** 131.00 FT. MSL
FINISH DATE 2/23/2019
PROJECT Cascade Corporation
LOCATION
PROJECT NUMBER PNG0564S18

DEPTH (ft)	MATERIAL DESCRIPTION	SYMBOLIC LOG	WELL LOG	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
121								100	1.8		
122											
123											
124											
125									2.4		
126	--Cored through a basalt clast from 125-126 ft.										
127	--oxidized from 127-130 ft.										
128											
129											
130				Bentonite grout seal from 0 feet - 138 feet				100	4.0		
131											
132											
133											
134											
135									4.9		
136	--transitions to brown										
137											
138				12/20 silica sand filter pack from 138 feet - 170 feet							
139											
140								100	4.8		
141											
142											
143				2-inch diameter SCH 40 slotted filter from 140 feet - 170 feet							
144	--oxidized from 142-143 ft.										
145											
146									5.9		
147											
148											
149											
150								100	4.8		
151	--cored through a basalt clast from 150-151.8 ft.										
152											
153									5.4		
154	--cored through a basalt clast from 153-154 ft.										
155											
156											
157											
158											
159	--andesite clast entrained within sandstone; oxidation lithification observed at contact of sandstone								4.0		
160	matrix and andesite clast							100			
161											
162	Dark brownish grey, dense, wet, gravelly SAND; contains subrounded to rounded course gravel of basalt and quartzite. [lower Troutdale Sandstone Aquifer (TSA)]									SP	
163											
164									1.1		
165											
166											
167											
168											
169									2.6		
170											

CONTRACTOR Yellow Jacket Drilling **NORTHING** 5043122.000
EQUIPMENT Terrasonic T150 **EASTING** 542395.000
DRILL MTHD Sonic **ANGLE** 45
DIAMETER 8 in. to 6 in. **BEARING**
LOGGER B. Webb **REVIEWER** C. Bartlett **PRINTED** 10/28/19

REMARKS: Datum and projection is NAD83, UTM 10N

COORDINATE SYSTEM:

SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

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Portland, Oregon 97204
Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING VMW-F **SHEET** 1 OF 3
START DATE 2/18/2019 **Elevation** 125.00 FT. MSL
FINISH DATE 2/20/2019
PROJECT Cascade Corporation
LOCATION
PROJECT NUMBER PNG0564S18

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
1	Brown, loose, moist, TOPSOIL; with roots	12-inch diameter, above ground monument				100		SOIL	
2	Brown, loose, moist, SILT	Bentonite chip seal from 0 feet - 5 feet					2.1	ML	
3		7-inch diameter boring from 0 feet - 60 feet							
4		2-inch diameter SCH 40							
5	--transitions to orangish-brown, wet							FILL	
6	Dark brown, loose, wet, silty sandy GRAVEL; contains quartzite pebbles [Troutdale Gravel Aquifer (TGA)]						1.8		
7			130						
8							1.4		
9	--transitions to grey-brown, moist					100	1.2		
10									
11							3.4		
12									
13									
14			135						
15							2.8		
16									
17									
18									
19									
20	Grey, medium dense, wet, silty GRAVEL					100	1.1	GM	
21	Light-brown, medium dense, wet, low plasticity, SILTSTONE; with intercalated lenses of silty SANDSTONE		140					SI	
22							7.7		
23									
24									
25									
26							12.2		
27								SANDSTONE	
28	Light-brown, medium dense, wet, silty SANDSTONE								
29			145						
30						100			
31									
32									
33							9.8		
34									
35								SILTSTONE	
36	Light-brown, medium dense, wet, SILTSTONE [Confining Unit 1]		150				0.9		
37									
38							2.3		
39									
40	--becomes mottled grey and light-brown					100		SILTSTONE	
41	Greenish-grey, very dense, dry, SILTSTONE						1.3		
42									
43			155						
44									
45	Mottled greenish-grey and light-brown, very dense, dry, weathered silty SANDSTONE. [upper Troutdale Sandstone Aquifer]						0.0	SANDSTONE	
46									
47									
48									
49									
50	Very dark blueish-grey, very dense, dry, weathered silty SANDSTONE		160			100	0.1	SANDSTONE	
51									
52									
53		Set bentonite chip seal from 53 ft.-60 ft. Step down to 6-inch boring from 60 feet - 160 feet							
54							0.0		
55									
56									
57									
58									
59							0.2		
60									

CONTRACTOR Yellow Jacket Drilling **NORTHING** 5043150.000
EQUIPMENT Terrasonic T150 **EASTING** 542394.000
DRILL MTHD Sonic **ANGLE** 45
DIAMETER 8 in. to 6 in. **BEARING**
LOGGER B. Webb **REVIEWER** C. Bartlett **PRINTED** 10/28/19

REMARKS: Datum and projection is NAD83, UTM 10N

COORDINATE SYSTEM:
SEE KEY SHEET FOR SYMBOLS AND ABBREVIATIONS

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920 SW Sixth Avenue, Suite 600
Portland, Oregon 97204
Phone: 503.222.9518

GS FORM: CORE3 10/00

BOREHOLE LOG

BORING VMW-F **SHEET** 2 OF 3
START DATE 2/18/2019 **Elevation** 125.00 FT. MSL
FINISH DATE 2/20/2019
PROJECT Cascade Corporation
LOCATION
PROJECT NUMBER PNG0564S18

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION (ft)	SAMPLE NAME	TYPE	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
61	Brown, med-dense, dry, weathered silty SANDSTONE				100		SANDSTONE	
62						0.7		
63		170						
64								
65								
66								
67						0.7		
68								
69								
70					100		SILTSTONE	
71	Greenish-brown, medium dense, moist, low plasticity, highly weathered, sandy SILTSTONE	175						
72								
73						3.7	SANDSTONE	
74	Orangish-brown, medium dense, dry, highly weathered, silty SANDSTONE							
75								
76								
77								
78		180						
79								
80					100	0.4		
81								
82						5.2		
83	--becomes loose							
84								
85	--becomes brown	185						
86								
87								
88								
89								
90					100	4.5		
91							SANDSTONE	
92	Dark grey, dense, dry, SANDSTONE	190				17.1		
93								
94								
95						16.2		
96								
97								
98							SANDSTONE	
99	Light orangish-brown (oxidized), dense, dry, SANDSTONE	195				5.5		
100					80			
101								
102						17.1		
103								
104								
105								
106		200						
107								
108						3.2		
109							SANDSTONE	
110	Light-brown, loose, dry, graveley SANDSTONE				100			
111								
112								
113						3.4		
114								
115							SANDSTONE	
116	Light-grey, medium dense, dry, silty SANDSTONE						SANDSTONE	
117								
118	Light orangish-brown (oxidized), medium dense, dry, SANDSTONE					6.0		
119								
120								

CONTRACTOR Yellow Jacket Drilling **NORTHING** 5043150.000
EQUIPMENT Terrasonic T150 **EASTING** 542394.000
DRILL MTHD Sonic **ANGLE** 45
DIAMETER 8 in. to 6 in. **BEARING**
LOGGER B. Webb **REVIEWER** C. Bartlett **PRINTED** 10/28/19

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BOREHOLE LOG

BORING VMW-F **SHEET** 3 OF 3
START DATE 2/18/2019 **Elevation** 125.00 FT. MSL
FINISH DATE 2/20/2019
PROJECT Cascade Corporation
LOCATION
PROJECT NUMBER PNG0564S18

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
121	--becomes grey	Bentonite grout seal from 0 feet - 128 feet			100			
122								
123								
124								
125						6.6		
126								
127								
128		12/20 silica sand filter pack from 128 feet - 160 feet						
129						2.8		
130					100			
131		2-inch diameter SCH 40 slotted filter from 130 feet - 160 feet						
132								
133								
134						8.2		
135								
136								
137								
138								
139						3.2		
140					50			
141	--becomes moist							
142								
143								
144								
145								Bottom half of core fell out during extraction. Recovered material was presumably mixed
146								
147								
148								
149								
150					100		SANDSTONE	
151	Grey, medium dense, moist, graveley SANDSTONE							
152								
153								
154								
155						2.4		
156								
157								
158								
159								
160						6.4		

CONTRACTOR Yellow Jacket Drilling **NORTHING** 5043150.000
EQUIPMENT Terrasonic T150 **EASTING** 542394.000
DRILL MTHD Sonic **ANGLE** 45
DIAMETER 8 in. to 6 in. **BEARING**
LOGGER B. Webb **REVIEWER** C. Bartlett **PRINTED** 10/28/19

REMARKS: Datum and projection is NAD83, UTM 10N

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GS FORM: CORE3 10/00

BOREHOLE LOG

BORING VMW-G **SHEET** 1 OF 3
START DATE 2/23/2019 **Elevation** 121.00 FT. MSL
FINISH DATE 2/26/2019
PROJECT Cascade Corporation
LOCATION
PROJECT NUMBER PNG0564S18

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
1	TOPSOIL; with roots	12-inch diameter, above ground monument				100		SOIL	
2	Brown, low density, low plasticity, wet, SILT						0.1	ML	
3–8	--becomes moist	Bentonite chip seal from 0 feet - 5 feet	125				0.3		
9	Brown, medium dense, wet, sandy gravelly SILT. [Troutdale Gravel Aquifer (TGA)]	7-inch diameter boring from 0 feet - 40 feet				100	0.9	ML	
10–15		2-inch diameter SCH 40	130						
16	--increasing proportion of sand						5.4	GM	
17–21	Grey, loose, wet, silty sandy GRAVEL		135			100	2.3		
22	Light brown, dense, wet, silty SANDSTONE							SANDSTONE	
23–30			140			100	3.5		
31	Greyish green, dense, hard, nonplastic, dry, SILTSTONE [Confining Unit 1]						2.7	SILTSTONE	
32–33		Set bentonite chip seal from 33 ft.-40 ft. Step down to 6-inch boring from 50 feet - 170 feet							
34–40			145			100	1.3		
41–44	Brown and light brown mottled, dense, medium plasticity, dry, sandy SILTSTONE		150				0.8		
45–52	--transitions to brown (not mottled), silty SANDSTONE						0.2	SILTSTONE	
53–54			155			100	0.0		
55	Dark brown, dense, hard, moist, silty SANDSTONE [upper Troutdale Sandstone Aquifer (TSA)]							SANDSTONE	
56–57							0.0		
58	Dark grey, dense, hard, moist, silty SANDSTONE							SANDSTONE	
59–60							0.2		

CONTRACTOR Yellow Jacket Drilling **NORTHING** 5043173.000
EQUIPMENT Terrasonic T150 **EASTING** 542394.000
DRILL MTHD Sonic **ANGLE** 45
DIAMETER 8 in. to 6 in. **BEARING**
LOGGER B. Webb **REVIEWER** C. Bartlett **PRINTED** 10/28/19

REMARKS: Datum and projection is NAD83, UTM 10N

COORDINATE SYSTEM:
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GS FORM: CORE3 10/00

BOREHOLE LOG

BORING VMW-G **SHEET** 2 OF 3
START DATE 2/23/2019 **Elevation** 121.00 FT. MSL
FINISH DATE 2/26/2019
PROJECT Cascade Corporation
LOCATION
PROJECT NUMBER PNG0564S18

DEPTH (ft)	MATERIAL DESCRIPTION	ELEVATION (ft)	SAMPLE NAME	TYPE	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
61	Brown, medium plasticity, moist, highly weathered, silty SANDSTONE				100		SANDSTONE	
62		165						
63								
64								
65						1.4		
66								
67								
68								
69								
70	--becomes greyish brown	170			100	0.7	SILTSTONE	
71	Greyish brown, medium dense, nonplastic, dry, sandy SILTSTONE							
72								
73	--becomes light brownish grey, SILTSTONE							
74						2.0		
75								
76								
77	--becomes dark brown	175						
78								
79								
80					100	1.3	SANDSTONE	
81	Dark grey, dense, moist, silty SANDSTONE							
82								
83								
84		180						
85						7.8		
86								
87								
88							SANDSTONE	
89	Brown and light brown mottled, dense, moist, weathered, silty SANDSTONE					5.8		
90					80			
91								
92		185						
93								
94								
95						3.2		
96								
97	--becomes lighter brown; silt proportion and moisture content decreases; lithification increases							
98						2.6		
99		190						
100					100			
101								
102								
103	--becomes light greyish brown and dry							
104						2.8		
105		195						
106								
107								
108								
109						0.7		
110					80			
111								
112		200						
113								
114								
115						2.1		
116								
117								
118								
119						3.1		
120								

CONTRACTOR Yellow Jacket Drilling **NORTHING** 5043173.000
EQUIPMENT Terrasonic T150 **EASTING** 542394.000
DRILL MTHD Sonic **ANGLE** 45
DIAMETER 8 in. to 6 in. **BEARING**
LOGGER B. Webb **REVIEWER** C. Bartlett **PRINTED** 10/28/19

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BOREHOLE LOG

BORING VMW-G **SHEET** 3 OF 3
START DATE 2/23/2019 **Elevation** 121.00 FT. MSL
FINISH DATE 2/26/2019
PROJECT Cascade Corporation
LOCATION
PROJECT NUMBER PNG0564S18

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
121	--becomes dark greyish brown with increased lithification	Bentonite grout seal from 0 feet - 128 feet			100			
125						6.0		
128		12/20 silica sand filter pack from 128 feet - 160 feet						
129	--becomes greyish brown				100	6.9		
132	--becomes coarser grained sandstone; contains minor subrounded gravel and angular basalt clasts	2-inch diameter SCH 40 slotted filter from 130 feet - 160 feet						
135	--cored through an 8 inch basalt clast					5.2		
138	--extensive iron-oxide cementation with relative increase in lithification from 137-140 ft.							
140					100	3.9		
145						2.5		
150	Brown, loose, wet, gravelly SAND [lower Troutdale Sandstone Aquifer (TSA)]				100		SP	
154						1.6		
156	--transitions to sandy GRAVEL							
159						2.1		
160								

CONTRACTOR Yellow Jacket Drilling
EQUIPMENT Terrasonic T150
DRILL MTHD Sonic
DIAMETER 8 in. to 6 in.
LOGGER B. Webb **REVIEWER** C. Bartlett

NORTHING 5043173.000
EASTING 542394.000
ANGLE 45
BEARING
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GS FORM: CORE3 10/00

BOREHOLE LOG

BORING VMW-H **SHEET** 1 OF 2
START DATE 2/27/2019 **Elevation** 124.00 FT. MSL
FINISH DATE 2/28/2019
PROJECT Cascade Corporation
LOCATION
PROJECT NUMBER PNG0564S18

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	ELEVATION (ft)	SAMPLES: SAMPLE NAME	SAMPLES: TYPE	SAMPLES: % RECOVERY	SAMPLES: PID READING (ppm)	USCS Classification	COMMENTS
1	TOPSOIL; with roots	12-inch diameter, above ground monument	125			100		SOIL	
2	Brown, low density, wet low plasticity, silty sandy GRAVEL [Troutdale Gravel Aquifer (TGA)]	Bentonite chip seal from 0 feet - 5 feet						SM-GM	
3		7-inch diameter boring from 0 feet - 50 feet							
4		2-inch diameter SCH 40							
5							0.0		
6			130			100			
7								SW	
8	Brown, loose, wet, SAND; with trace fines						0.2		
9								SM	
10	Brown, medium dense, moist, low plasticity, silty SAND								
11			135					SILTSTONE	
12	Brown, dry, SILTSTONE lens [Confining Unit 1]								
13								SANDSTONE	
14	Brown, medium dense, dry, silty SANDSTONE						0.6		
15									
16			140			100	0.8		
17								SILTSTONE	
18	Brown, dry, SILTSTONE lens								
19								SILTSTONE	
20	Grayish-green, dense, dry, SILTSTONE;								
21			145				0.5		
22									
23									
24									
25		Set bentonite chip seal from 25 ft.-30 ft. Step down to 6-inch boring from 30 feet - 106 feet							
26			150			100	0.6		
27	Dark grey and dark brown mottled, medium density, slightly moist, silty SANDSTONE							SANDSTONE	
28							0.6		
29									
30	--oxidized lens from 30-31 ft.					100	0.7		
31			155						
32							0.4		
33									
34									
35									
36	--transitions to sandy SILTSTONE		160			100	0.2		
37									
38									
39									
40								SILTSTONE	
41	Brown, dense, dry, very low plasticity, sandy SILTSTONE		165				0.2		
42									
43									
44									
45							0.4		
46	--oxidized lens from 45-46 ft.		170			100		SANDSTONE	
47	Orangish brown, weakly lithified, moist, weathered, silty SANDSTONE [upper Troutdale Sandstone Aquifer (TSA)]								
48									
49									
50									
51			175				0.7		
52									
53									
54									
55									
56						100	0.7		
57									
58									
59									
60									

CONTRACTOR Yellow Jacket Drilling **NORTHING** 5043214.000
EQUIPMENT Terrasonic T150 **EASTING** 542246.000
DRILL MTHD Sonic **ANGLE** 90
DIAMETER 8 in. to 6 in. **BEARING** ------
LOGGER B. Webb **REVIEWER** C. Bartlett **PRINTED** 10/28/19

REMARKS: Datum and projection is NAD83, UTM 10N

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GS FORM: CORE3 10/00

BOREHOLE LOG

BORING VMW-H **SHEET** 2 OF 2
START DATE 2/27/2019 **Elevation** 124.00 FT. MSL
FINISH DATE 2/28/2019
PROJECT Cascade Corporation
LOCATION
PROJECT NUMBER PNG0564S18

DEPTH (ft)	MATERIAL DESCRIPTION	WELL CONSTRUCTION MATERIAL	SAMPLE NAME	TYPE	% RECOVERY	PID READING (ppm)	USCS Classification	COMMENTS
61	Greenish grey, dense/hard, strongly lithified, dry, vitric SANDSTONE					0.5	SANDSTONE	
66	Brown, weakly lithified (loose/friable), dry, SANDSTONE; contains a few thin (1-2 in.) lenses of iron cementation				100	0.7	SANDSTONE	
71						0.9		
76		Bentonite grout seal from 0 feet - 84 feet			50	1.0		
81	--becomes more strongly lithified (medium), with dark iron cementation					1.4		Driller notes resistence drilling from 78-81 ft. Bottom 5 ft. of core sample fell out during bit extraction
84		12/20 silica sand filter pack from 84 feet - 106 feet						
86					150			
89		2-inch diameter SCH 40 slotted filter from 86 feet - 106 feet						
90					100	0.7		Recovered mixed fallout from previous core plus new core to 90 ft.
96	Dark greyish brown, moist, SANDSTONE; contains some subangular gravels and cobbles, trace silt				100		SANDSTONE	
103	--becomes dark grey							
106								

CONTRACTOR Yellow Jacket Drilling **NORTHING** 5043214.000
EQUIPMENT Terrasonic T150 **EASTING** 542246.000
DRILL MTHD Sonic **ANGLE** 90
DIAMETER 8 in. to 6 in. **BEARING** ------
LOGGER B. Webb **REVIEWER** C. Bartlett **PRINTED** 10/28/19

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APPENDIX D
Groundwater Elevation Data

Table D-1
Groundwater Elevations - 1 January 2019 through 31 December 2019
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	2/5/2019	10:45	127.63	164.63	-37.00
Lower	EW-14	5/2/2019	13:45	127.63	149.22	-21.59
Lower	EW-14	8/6/2019	15:50	127.63	152.92	-25.29
Lower	EW-14	11/4/2019	9:05	127.63	158.51	-30.88
Lower	EW-2	2/5/2019	11:00	126.01	160.17	-34.16
Lower	EW-2	5/2/2019	13:40	126.01	155.81	-29.80
Lower	EW-2	8/6/2019	15:55	126.01	153.01	-27.00
Lower	EW-2	11/4/2019	8:58	126.01	150.75	-24.74
Lower	EW-23	2/5/2019	10:30	83.93	86.48	-2.55
Lower	EW-23	5/2/2019	16:10	83.93	83.40	0.53
Lower	EW-23	8/6/2019	10:04	83.93	90.47	-6.54
Lower	EW-23	11/4/2019	8:26	83.93	88.78	-4.85
Monitoring Wells						
Upper	BOP-13ds	2/4/2019	9:34	128.94	119.80	9.14
Upper	BOP-13ds	5/1/2019	12:30	128.94	118.66	10.28
Upper	BOP-13ds	8/1/2019	9:15	128.94	117.80	11.14
Upper	BOP-13ds	11/4/2019	9:35	128.94	120.21	8.73
Upper	BOP-20ds	2/4/2019	11:35	77.45	66.30	11.15
Upper	BOP-20ds	8/1/2019	12:40	77.45	69.82	7.63
Upper	BOP-20ds	8/23/2019	14:50	77.45	73.10	4.35
Upper	BOP-20ds	9/16/2019	11:55	77.45	71.7	5.75
Upper	BOP-20ds	11/4/2019	12:09	77.45	68.39	9.06
Upper	BOP-21ds	8/1/2019	13:04	78.02	71.56	6.46
Upper	BOP-21ds	8/23/2019	11:45	78.02	74.81	3.21
Upper	BOP-21ds	11/4/2019	12:26	78.02	68.83	9.19
Upper	BOP-22Rds	8/1/2019	19:40	82.91	77.82	5.09
Upper	BOP-22Rds	8/23/2019	11:45	82.91	81.04	1.87
Upper	BOP-22Rds	11/4/2019	12:33	82.91	73.56	9.35
Upper	BOP-31ds	2/4/2019	10:30	99.04	89.04	10.00
Upper	BOP-31ds	5/1/2019	11:56	99.04	85.21	13.83
Upper	BOP-31ds	8/1/2019	11:50	99.04	88.15	10.89
Upper	BOP-31ds	11/4/2019	13:46	99.04	90.40	8.64
Upper	BOP-42ds	8/1/2019	9:30	130.74	120.52	10.22
Upper	BOP-42ds	11/4/2019	9:29	130.74	121.10	9.64
Upper	BOP-44ds	9/17/2019	9:51	35.24	26.78	8.46
Upper	BOP-61ds	2/4/2019	13:09	94.64	85.80	8.84
Upper	BOP-61ds	8/1/2019	11:25	94.64	87.54	7.10
Upper	BOP-61ds	11/4/2019	13:35	94.64	87.87	6.77
Upper	BOP-62ds	8/1/2019	9:45	112.29	105.29	7.00
Upper	BOP-62ds	9/16/2019	16:00	112.29	106.55	5.74
Upper	BOP-62ds	11/4/2019	9:54	112.29	103.20	9.09
Upper	BOP-65ds	8/1/2019	10:15	104.22	96.30	7.92
Upper	BOP-65ds	9/16/2019	15:30	104.22	98.38	5.84
Upper	BOP-65ds	11/4/2019	10:30	104.22	95.14	9.08
Upper	BOP-66ds	2/4/2019	12:48	102.97	92.49	10.48
Upper	BOP-66ds	8/1/2019	11:40	102.97	93.86	9.11
Upper	BOP-66ds	11/4/2019	10:46	102.97	94.45	8.52
Upper	CMW-10ds	2/6/2019	13:20	134.54	123.88	10.66

Table D-1
Groundwater Elevations - 1 January 2019 through 31 December 2019
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	CMW-10ds	5/3/2019	10:25	134.54	122.63	11.91
Upper	CMW-10ds	8/6/2019	14:30	134.54	122.20	12.34
Upper	CMW-10ds	11/4/2019	11:48	134.54	123.28	11.26
Upper	CMW-17ds	2/5/2019	14:15	121.89	102.89	19.00
Upper	CMW-17ds	5/2/2019	14:30	121.89	102.52	19.37
Upper	CMW-17ds	8/6/2019	10:28	121.89	102.63	19.26
Upper	CMW-17ds	11/4/2019	9:26	121.89	103.45	18.44
Upper	CMW-18ds	2/6/2019	10:05	117.66	104.18	13.48
Upper	CMW-18ds	5/3/2019	9:20	117.66	103.50	14.16
Upper	CMW-18ds	8/6/2019	14:45	117.66	103.53	14.13
Upper	CMW-18ds	11/4/2019	11:18	117.66	103.71	13.95
Upper	CMW-19ds	2/6/2019	12:40	144.08	130.92	13.16
Upper	CMW-19ds	5/3/2019	10:05	144.08	129.78	14.30
Upper	CMW-19ds	8/6/2019	14:05	144.08	129.39	14.69
Upper	CMW-19ds	11/4/2019	11:31	144.08	130.48	13.60
Upper	CMW-20ds	2/6/2019	15:51	152.72	140.87	11.85
Upper	CMW-20ds	8/6/2019	14:10	152.72	138.35	14.37
Upper	DEQ-5ds	2/6/2019	16:14	155.68	143.19	12.49
Upper	EW-3	8/1/2019	10:55	94.26	89.92	4.34
Upper	EW-3	11/4/2019	11:14	94.26	87.39	6.87
Upper	PWB-1uts	8/6/2019	13:25	15.98	6.34	9.64
Upper	PWB-1uts	9/17/2019	8:36	15.98	7.51	8.47
Lower	BOP-13dg	2/4/2019	9:19	128.71	120.57	8.14
Lower	BOP-13dg	5/1/2019	12:26	128.71	117.90	10.81
Lower	BOP-13dg	8/1/2019	9:20	128.71	117.83	10.88
Lower	BOP-13dg	11/4/2019	9:38	128.71	120.00	8.71
Lower	BOP-20dg	2/4/2019	11:44	77.32	66.13	11.19
Lower	BOP-20dg	8/1/2019	12:32	77.32	69.73	7.59
Lower	BOP-20dg	11/4/2019	12:15	77.32	68.30	9.02
Lower	BOP-23dg	8/1/2019	12:00	76.96	67.88	9.08
Lower	BOP-23dg	9/16/2019	11:19	76.96	70.78	6.18
Lower	BOP-23dg	11/4/2019	11:25	76.96	68.17	8.79
Lower	BOP-31dg	2/4/2019	10:43	98.51	87.97	10.54
Lower	BOP-31dg	5/1/2019	11:58	98.51	85.70	12.81
Lower	BOP-31dg	8/1/2019	11:53	98.51	87.90	10.61
Lower	BOP-31dg	11/4/2019	13:43	98.51	89.51	9.00
Lower	BOP-42dg	8/1/2019	9:35	130.71	121.61	9.10
Lower	BOP-42dg	11/4/2019	9:25	130.71	121.44	9.27
Lower	BOP-44usg	8/12/2019	15:36	34.25	91.12	-56.87
Lower	BOP-44usg	9/17/2019	10:00	34.25	45.08	-10.83
Lower	BOP-44dg	9/17/2019	9:54	35.15	27.13	8.02
Lower	BOP-60dg	8/1/2019	11:05	93.59	87.23	6.36
Lower	BOP-60dg	11/4/2019	11:10	93.59	84.51	9.08
Lower	BOP-61dg	2/4/2019	13:06	94.43	85.64	8.79
Lower	BOP-61dg	8/1/2019	11:20	94.43	87.64	6.79
Lower	BOP-61dg	11/4/2019	13:26	94.43	87.68	6.75
Lower	CMW-10dg	2/6/2019	13:14	135.05	128.11	6.94
Lower	CMW-14Rds	2/6/2019	10:20	83.48	64.49	18.99
Lower	CMW-14Rds	8/6/2019	9:22	83.48	62.84	20.64

Table D-1
Groundwater Elevations - 1 January 2019 through 31 December 2019
East Multnomah County TSA Remedy

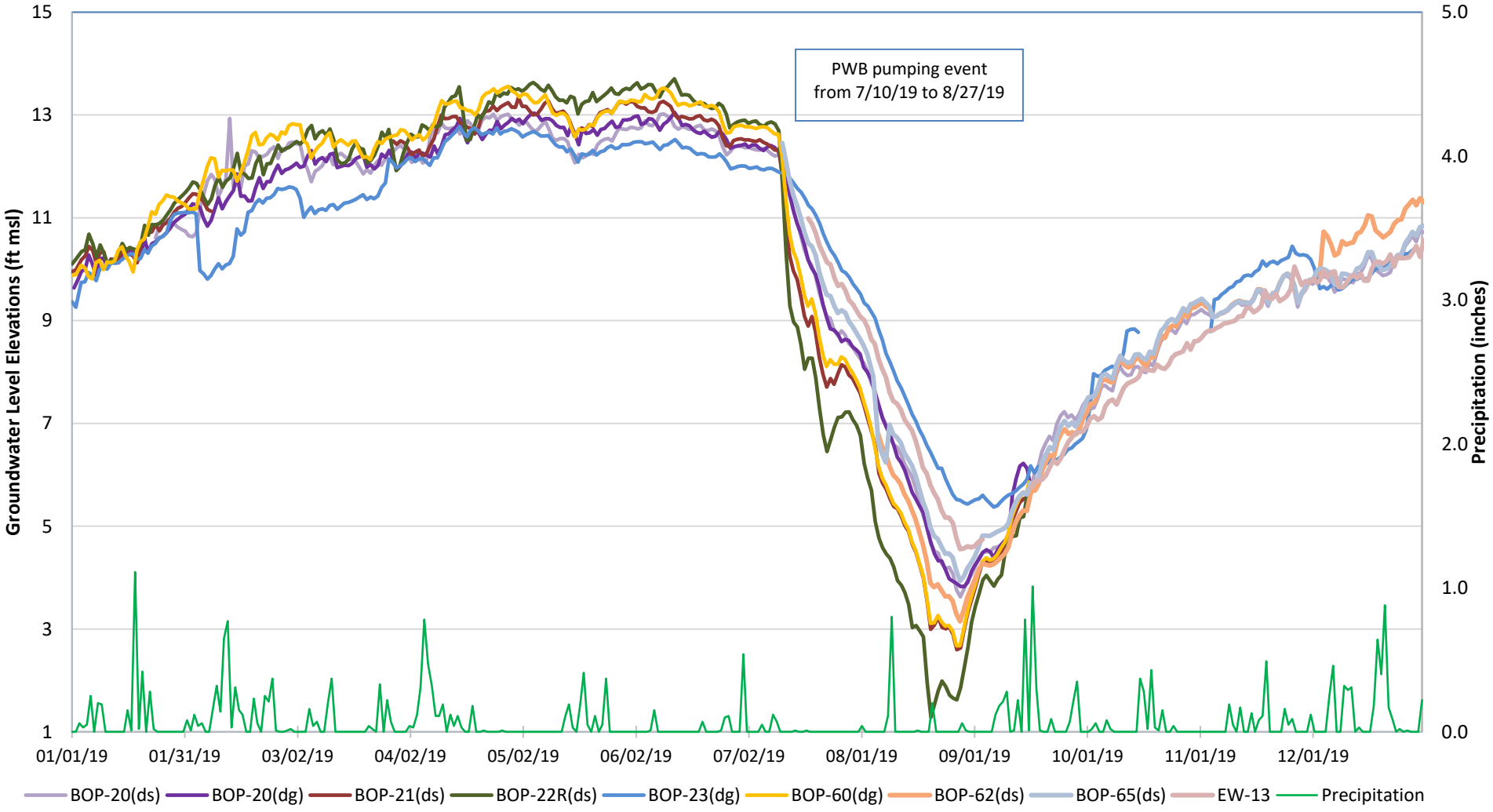
TSA Zone	Well ID	Date	Time	Top of Casing Elevation (ft MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft MSL)
Lower	CMW-22dg	2/6/2019	15:11	81.65	67.06	14.59
Lower	CMW-22dg	8/6/2019	9:50	81.65	66.63	15.02
Lower	CMW-22dg	9/17/2019	10:25	81.65	67.66	13.99
Lower	CMW-24dg (EW-5)	2/6/2019	12:15	77.74	65.44	12.30
Lower	CMW-24dg (EW-5)	8/6/2019	11:25	77.74	63.92	13.82
Lower	CMW-25dg	2/6/2019	11:55	75.28	64.32	10.96
Lower	CMW-25dg	8/6/2019	11:05	75.28	63.41	11.87
Lower	CMW-26dg	2/6/2019	11:20	108.98	95.38	13.60
Lower	CMW-26dg	8/6/2019	12:20	108.98	95.15	13.83
Lower	CMW-36dg	2/6/2019	10:55	78.84	65.05	13.79
Lower	CMW-36dg	8/6/2019	12:35	78.84	66.78	12.06
Lower	CMW-36dg	9/17/2019	10:08	78.84	67.94	10.90
Lower	CMW-8dg	2/6/2019	13:33	136.21	129.51	6.70
Lower	D-17dg	2/6/2019	8:40	124.61	116.23	8.38
Lower	D-17dg	5/3/2019	8:20	124.61	114.32	10.29
Lower	D-17dg	8/6/2019	15:05	124.61	114.61	10.00
Lower	D-17dg	8/18/2019	12:30	124.61	114.62	9.99
Lower	D-17dg	11/4/2019	10:53	124.61	116.43	8.18
Lower	D-17ds	2/6/2019	9:00	123.28	114.34	8.94
Lower	D-17ds	5/3/2019	8:30	123.28	112.28	11.00
Lower	D-17ds	8/6/2019	15:15	123.28	112.39	10.89
Lower	D-17ds	8/18/2019	12:40	123.28	114.96	8.32
Lower	D-17ds	11/4/2019	10:47	123.28	114.61	8.67
Lower	DEQ-1dg	2/6/2019	--	150.58	NM	NM
Lower	DEQ-5dg	2/6/2019	16:10	155.95	144.58	11.37
Lower	EMC-2dg	9/17/2019	10:42	43.51	37.43	6.08
Lower	EW-11	8/6/2019	--	114.73	NM	NM
Lower	EW-11	9/17/2019	12:35	114.73	99.41	15.32
Lower	EW-12	2/6/2019	9:40	94.14	84.02	10.12
Lower	EW-12	5/3/2019	8:55	94.14	81.38	12.76
Lower	EW-12	8/6/2019	15:35	94.14	82.75	11.39
Lower	EW-12	11/4/2019	11:01	94.14	84.92	9.22
Lower	EW-13	8/1/2019	10:32	103.59	95.03	8.56
Lower	EW-13	9/16/2019	9:55	103.59	97.84	5.75
Lower	EW-13	11/4/2019	10:52	103.59	94.84	8.75
Lower	EW-15	8/6/2019	11:40	116.21	50.69	65.52
Lower	EW-16	2/5/2019	14:40	83.71	66.38	17.33
Lower	EW-16	8/6/2019	12:00	83.71	66.49	17.22
Lower	EW-8	2/5/2019	9:10	77.16	66.78	10.38
Lower	EW-8	8/6/2019	10:22	77.16	66.41	10.75
Lower	PWB-1lts	2/6/2019	15:20	16.48	6.02	10.46
Lower	PWB-1lts	8/6/2019	13:00	16.48	6.88	9.60
Lower	PWB-1lts	9/17/2019	10:52	16.48	8.23	8.25
Vapor Monitoring Wells						
Upper	VMW-A	2/5/2019	12:45	123.34	103.33	20.01
Upper	VMW-A	5/2/2019	12:45	123.34	103.38	19.96
Upper	VMW-A	8/6/2019	16:05	123.34	103.39	19.95
Upper	VMW-A	11/4/2019	12:28	123.34	104.11	19.23
Upper	VMW-B	2/5/2019	13:15	123.25	98.74	24.51

Table D-1
Groundwater Elevations - 1 January 2019 through 31 December 2019
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-B	5/2/2019	13:10	123.25	99.57	23.68
Upper	VMW-B	8/6/2019	17:00	123.25	99.71	23.54
Upper	VMW-B	11/4/2019	13:35	123.25	99.61	23.64
Upper	VMW-C	2/5/2019	12:04	124.17	102.53	21.64
Upper	VMW-C	5/2/2019	12:55	124.17	102.91	21.26
Upper	VMW-C	8/6/2019	16:20	124.17	102.16	22.01
Upper	VMW-C	11/4/2019	12:48	124.17	103.61	20.56
Upper	VMW-D	2/5/2019	13:40	122.67	99.70	22.97
Upper	VMW-D	5/2/2019	13:20	122.67	101.94	20.73
Upper	VMW-D	8/6/2019	17:15	122.67	101.78	20.89
Upper	VMW-D	11/4/2019	13:55	122.67	104.00	18.67
Upper	VMW-E [1]	5/2/2019	--	130.59	NM	NM
Upper	VMW-E [1]	8/6/2019	--	130.59	NM	NM
Upper	VMW-E [1]	11/4/2019	--	130.59	NM	NM
Upper	VMW-F [1]	5/2/2019	--	126.40	NM	NM
Upper	VMW-F [1]	8/6/2019	--	126.40	NM	NM
Upper	VMW-F [1]	11/4/2019	--	126.40	NM	NM
Upper	VMW-G [1]	5/2/2019	--	121.97	NM	NM
Upper	VMW-G [1]	8/6/2019	--	121.97	NM	NM
Upper	VMW-G [1]	11/4/2019	--	121.97	NM	NM
Upper	VMW-H	5/2/2019	13:55	124.06	103.90	20.16
Upper	VMW-H	8/6/2019	16:35	124.06	102.60	21.46
Upper	VMW-H	11/4/2019	13:12	124.06	105.29	18.77

Notes:
ft MSL = feet above mean sea level
TOC = top of casing
-- = data were not available
NM = Not Measured

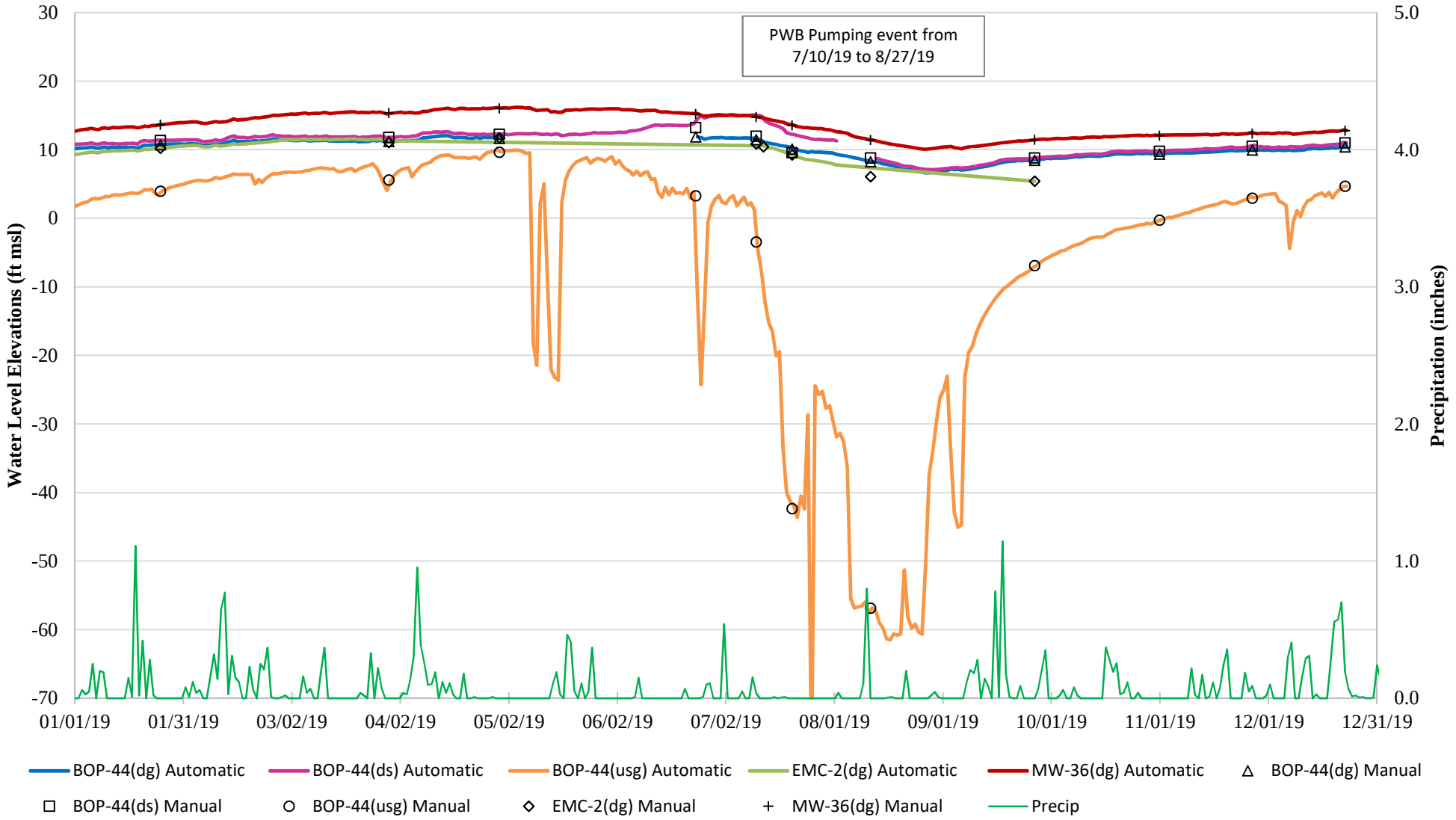
[1] Wells VMW-E, VMW-F, VMW-G are angled wells and depth to water could not be measured.



Datalogger installation: BOP-62(ds), BOP-65(ds), and EW-13 on 7/10/19 to 7/18/19.

Discontinued dataloggers (per ODEQ authorization): BOP-20(dg), BOP-21(ds), and BOP-23(dg) on 9/16/19

East Multnomah County Cleanup	**Hydrograph for Zone B TSA Wells January - December 2019**	Figure D-1



Geosyntec consultants

Note: MW-36(dg) is located on the boundary between Zone A and Zone C.

Cascade Corporation Gresham, Oregon	**Hydrograph for Zone A TSA Wells** **1 January 2019 through 31 December 2019**	Figure D-2

APPENDIX E
Groundwater Quality Data

Table E-1
Groundwater Analytical Results
1 January 2019 through 31 December 2019
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-020519	2/5/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Eff	TS-C-EFF-020519-DUP	2/5/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	1
Lower	TS-C-Eff	TS-C-EFF-050319	5/3/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Eff	TS-C-EFF-050319-DUP	5/3/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	1
Lower	TS-C-Eff	TS-C-EFF-080619	8/6/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Eff	TS-C-EFF-080619-DUP	8/6/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	1
Lower	TS-C-Eff	TS-C-EFF-110419	11/4/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Eff	TS-C-EFF-110419-DUP	11/4/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	1
Lower	TS-C-Inf	TS-C-INF-020519	2/5/2019	4.91	0.552	0.644	< 0.500	< 0.500	
Lower	TS-C-Inf	TS-C-INF-050319	5/3/2019	7.19	0.562	0.878	< 0.500	< 0.500	
Lower	TS-C-Inf	TS-C-INF-080619	8/6/2019	4.84	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	TS-C-Inf	TS-C-INF-110419	11/4/2019	7.30	< 0.500	0.952	< 0.500	< 0.500	
Extraction Wells									
Lower	EW-14	EW14-020519	2/5/2019	8.19	0.613	1.29	< 0.500	< 0.500	
Lower	EW-14	EW14-050219	5/2/2019	5.94	< 0.50	0.860	< 0.500	< 0.500	
Lower	EW-14	EW14-080619	8/6/2019	5.95	0.635	0.942	< 0.500	< 0.500	
Lower	EW-14	EW14-110419	11/4/2019	7.64	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-2	EW2-020519	2/5/2019	12.0	0.921	1.55	< 0.500	< 0.500	
Lower	EW-2	EW2-050219	5/2/2019	11.2	0.855	1.15	< 0.500	< 0.500	
Lower	EW-2	EW2-080619	8/6/2019	11.7	1.00	1.31	< 0.500	< 0.500	
Lower	EW-2	EW2-110419	11/4/2019	13.5	0.939	< 0.500	< 0.500	< 0.500	
Lower	EW-23	EW23-020519	2/5/2019	1.72	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-23	EW23-080619	8/6/2019	1.74	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-23	EW23-110419	11/4/2019	2.12	< 0.500	< 0.500	< 0.500	< 0.500	
Monitoring Wells									
Upper	BOP-13ds	BOP-13DS;BOP-13DS-0219;20190204	2/4/2019	2.30	< 0.200	0.300	< 0.200	< 0.200	
Upper	BOP-13ds	BOP-13DS;BOP-Z-0219;20190204	2/4/2019	2.40	< 0.200	0.300	< 0.200	< 0.200	1
Upper	BOP-13ds	BOP-13DS;BOP-13DS-0519;20190501	5/1/2019	2.30	< 0.200	0.300	< 0.200	< 0.200	
Upper	BOP-13ds	BOP-13DS;BOP-13DS-0819;20190809	8/9/2019	2.70	< 0.200	0.400	< 0.200	< 0.200	
Upper	BOP-13ds	BOP-13DS;BOP-13DS-1119;20191104	11/4/2019	2.50	< 0.200	0.400	< 0.200	< 0.200	
Upper	BOP-20ds	BOP-20DS;BOP-20DS-0819;20190808	8/8/2019	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	
Upper	BOP-20ds	BOP-20DS;BOP-Z-0819;20190808	8/8/2019	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	1
Upper	BOP-20ds	BOP-20DS-0919	9/16/2019	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	
Upper	BOP-21ds	BOP-21DS;BOP-21DS-0819;20190808	8/8/2019	< 0.200	< 0.200	< 0.200	< 0.200	0.400	
Upper	BOP-22Rds	BOP-22RDS;BOP-22RDS-0819;20190807	8/7/2019	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	
Upper	BOP-31ds	BOP-31DS;BOP-31DS-0219;20190204	2/4/2019	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	
Upper	BOP-31ds	BOP-31DS;BOP-31DS-0519;20190501	5/1/2019	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	
Upper	BOP-31ds	BOP-31DS;BOP-31DS-0819;20190808	8/8/2019	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	
Upper	BOP-31ds	BOP-31DS;BOP-31DS-1119;20191104	11/4/2019	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	
Upper	BOP-42ds	BOP-42DS;BOP-42DS-0819;20190808	8/8/2019	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	
Upper	BOP-61ds	BOP-61DS;BOP-61DS-0219;20190204	2/4/2019	4.70	0.200	0.600	< 0.200	< 0.200	
Upper	BOP-61ds	BOP-61DS;BOP-61DS-0819;20190808	8/8/2019	3.50	< 0.200	0.300	< 0.200	< 0.200	
Upper	BOP-62ds	BOP-62DS;BOP-62DS-0819;20190808	8/8/2019	0.800	< 0.200	0.300	< 0.200	< 0.200	
Upper	BOP-62ds	BOP-62DS-0919	9/16/2019	0.4	< 0.2	< 0.2	< 0.2	< 0.2	
Upper	BOP-65ds	BOP-65DS;BOP-65DS-0819;20190808	8/8/2019	0.400	< 0.200	< 0.200	< 0.200	< 0.200	
Upper	BOP-65ds	BOP-65DS-0919	9/16/2019	0.3	< 0.2	< 0.2	< 0.2	< 0.2	

Table E-1
Groundwater Analytical Results
1 January 2019 through 31 December 2019
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	BOP-66ds	BOP-66DS;BOP-66DS-0219;20190204	2/4/2019	1.50	< 0.200	< 0.200	< 0.200	< 0.200	
Upper	BOP-66ds	BOP-66DS;BOP-66DS-0819;20190808	8/8/2019	0.700	< 0.200	< 0.200	< 0.200	< 0.200	
Upper	CMW-10ds	CMW10DS-020619	2/6/2019	17.3	0.652	< 0.500	< 0.500	< 0.500	
Upper	CMW-10ds	CMW10DS-050219	5/3/2019	13.9	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-10ds	CMW10DS-080619	8/6/2019	14.0	0.712	< 0.500	< 0.500	< 0.500	
Upper	CMW-10ds	CMW10DS-110419	11/4/2019	15.8	0.565	< 0.500	< 0.500	< 0.500	
Upper	CMW-17ds	CMW17DS-020519	2/5/2019	44.1	1.85	6.99	< 0.500	< 0.500	
Upper	CMW-17ds	CMW17DS-020519-DUP	2/5/2019	43.7	1.94	6.82	< 0.500	< 0.500	1
Upper	CMW-17ds	CMW17DS-050219	5/2/2019	57.7	2.62	8.91	< 0.500	< 0.500	
Upper	CMW-17ds	CMW17DS-080619	8/6/2019	61.1	3.05	8.60	< 0.500	< 0.500	
Upper	CMW-17ds	CMW17DS-080619-DUP	8/6/2019	61.2	3.0	8.89	< 0.500	< 0.500	1
Upper	CMW-17ds	CMW17DS-110419	11/4/2019	51.0	1.92	7.85	< 0.500	< 0.500	
Upper	CMW-18ds	CMW18DS-020619	2/6/2019	94.3	3.75	15.9	< 0.500	< 0.500	
Upper	CMW-18ds	CMW18DS-050219	5/3/2019	66.3	3.26	10.2	< 0.500	< 0.500	
Upper	CMW-18ds	CMW18DS-050219-DUP	5/3/2019	64	3.38	9.13	< 0.500	< 0.500	1
Upper	CMW-18ds	CMW18DS-080619	8/6/2019	64.3	2.25	9.37	< 0.500	< 0.500	
Upper	CMW-18ds	CMW18DS-080619-DUP	8/6/2019	65.1	1.98	9.56	< 0.500	< 0.500	1
Upper	CMW-18ds	CMW18DS-110419	11/4/2019	101	3.08	14.9	< 0.500	< 0.500	
Upper	CMW-18ds	CMW18DS-110419	11/4/2019	102	3.33	15.1	< 0.500	< 0.500	
Upper	CMW-19ds	CMW19DS-020619	2/6/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-19ds	CMW19DS-050219	5/3/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-19ds	CMW19DS-080619	8/6/2019	0.518	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-19ds	CMW19DS-110419	11/4/2019	5.33	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	CMW-20ds	CMW20DS-080619	8/6/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	EW-3	EW-3;EW-3-0819;20190808	8/8/2019	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	
Upper	PWB-1uts	PWB-1(UTS)-080619	8/6/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	PWB-1uts	PWB1UTS-091719	9/17/2019	0.703	< 0.50	< 0.50	< 0.50	< 0.50	
Lower	BOP-13dg	BOP-13DG;BOP-13DG-0219;20190204	2/4/2019	0.200	< 0.200	< 0.200	< 0.200	< 0.200	
Lower	BOP-13dg	BOP-13DG;BOP-13DG-0519;20190501	5/1/2019	0.200	< 0.200	< 0.200	< 0.200	< 0.200	
Lower	BOP-13dg	BOP-13DG;BOP-13DG-0819;20190809	8/9/2019	1.30	< 0.200	< 0.200	< 0.200	< 0.200	
Lower	BOP-13dg	BOP-13DG;BOP-13DG-1119;20191104	11/4/2019	0.700	< 0.200	< 0.200	< 0.200	< 0.200	
Lower	BOP-20dg	BOP-20DG;BOP-20DG-0819;20190808	8/8/2019	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	
Lower	BOP-23dg	BOP-23DG;BOP-23DG-0819;20190808	8/8/2019	0.700	< 0.200	< 0.200	< 0.200	< 0.200	
Lower	BOP-23dg	BOP-23DG-0919	9/16/2019	1	< 0.2	< 0.2	< 0.2	< 0.2	
Lower	BOP-31dg	BOP-31DG;BOP-31DG-0219;20190204	2/4/2019	2.90	0.300	0.300	< 0.200	< 0.200	
Lower	BOP-31dg	BOP-31DG;BOP-31DG-0519;20190501	5/1/2019	3.30	0.400	0.300	< 0.200	< 0.200	
Lower	BOP-31dg	BOP-31DG;BOP-31DG-0819;20190808	8/8/2019	3.00	0.400	0.300	< 0.200	< 0.200	
Lower	BOP-31dg	BOP-31DG;BOP-31DG-1119;20191104	11/4/2019	3.00	0.400	0.300	< 0.200	< 0.200	
Lower	BOP-42dg	BOP-42DG;BOP-42DG-0819;20190808	8/8/2019	2.30	< 0.200	0.800	< 0.200	< 0.200	
Lower	BOP-60dg	BOP-60DG;BOP-60DG-0819;20190808	8/8/2019	2.90	< 0.200	0.300	< 0.200	< 0.200	
Lower	BOP-60dg	BOP-60DG;BOP-Y-0819;20190808	8/8/2019	2.90	< 0.200	0.300	< 0.200	< 0.200	
Lower	BOP-61dg	BOP-61DG;BOP-61DG-0219;20190204	2/4/2019	< 0.200	< 0.200	< 0.200	< 0.200	< 0.200	
Lower	BOP-61dg	BOP-61DG;BOP-61DG-0819;20190808	8/8/2019	4.30	< 0.200	0.400	< 0.200	< 0.200	
Lower	CMW-14Rds	CMW14RDS-020619	2/6/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-14Rds	CMW14RDS-080619	8/6/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-22dg	CMW22DG-080619	8/6/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-22dg	CMW22DG-091719	9/17/2019	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	

Table E-1
Groundwater Analytical Results
1 January 2019 through 31 December 2019
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
Lower	CMW-24dg (EW-5)	CMW24DG-020619-L	2/6/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-24dg (EW-5)	CMW24DG-080619	8/6/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-25dg	CMW25DG-020619	2/6/2019	0.533	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-25dg	CMW25DG-080619	8/6/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-26dg	CMW26DG-020619	2/6/2019	6.51	0.530	< 0.500	< 0.500	< 0.500	
Lower	CMW-26dg	CMW26DG-080619	8/6/2019	6.27	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-36dg	CMW36DG-020619	2/6/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-36dg	CMW36DG-081319	8/13/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	CMW-36dg	CMW36DG-091719	9/17/2019	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	
Lower	D-17dg	D17DG-010219	1/2/2019	1.23	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	D-17dg	D17DG-020619	2/6/2019	1.13	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	D-17dg	D17DG-050219	5/3/2019	0.944	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	D-17dg	D17DG-080619	8/6/2019	0.796	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	D-17dg	D17DG-110419	11/4/2019	0.801	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	D-17ds	D17DS-020619	2/6/2019	53.7	1.59	12.1	< 0.500	< 0.500	
Lower	D-17ds	D17DS-050219	5/3/2019	61.2	1.83	12.6	< 0.500	< 0.500	
Lower	D-17ds	D17DS-080619	8/6/2019	58.4	1.83	13.7	< 0.500	< 0.500	
Lower	D-17ds	D17DS-110419	11/4/2019	57.5	1.34	15.1	< 0.500	< 0.500	
Lower	EW-1	EW1-020519	2/5/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-1	EW1-050219	5/2/2019	4.65	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-1	EW1-080619	8/6/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-1	EW1-110419	11/4/2019	7.14	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-8	EW8-080619	8/6/2019	1.67	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-11	EW11-091719	9/17/2019	1.11	< 0.50	< 0.50	< 0.50	< 0.50	
Lower	EW-12	EW12-020619-L	2/6/2019	2.09	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-12	EW12-050219	5/3/2019	2.33	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-12	EW12-080619	8/6/2019	2.12	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-12	EW12-110419	11/4/2019	2.26	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-13	EW-13;EW-13-0819;20190808	8/8/2019	0.200	< 0.200	< 0.200	< 0.200	< 0.200	
Lower	EW-13	EW-13-0919	9/16/2019	0.6	< 0.2	< 0.2	< 0.2	< 0.2	
Lower	EW-15	EW15-080619	8/6/2019	< 0.500	0.643	< 0.500	< 0.500	< 0.500	
Lower	EW-16	EW16-020519	2/5/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	EW-16	EW16-080619	8/6/2019	< 0.500	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	PWB-1lts	PWB1LTS-091719	9/17/2019	1.45	< 0.50	< 0.50	< 0.50	< 0.50	
Lower	PWB-1lts	PWB-1(LTS)-020619	2/6/2019	1.39	< 0.500	< 0.500	< 0.500	< 0.500	
Lower	PWB-1lts	PWB-1(LTS)-080619	8/6/2019	1.42	< 0.500	< 0.500	< 0.500	< 0.500	
Vapor Monitoring Wells									
Upper	VMW-A	VMWA-020519	2/5/2019	5.98	< 0.500	0.959	< 0.500	< 0.500	
Upper	VMW-A	VMWA-050219	5/2/2019	5.36	< 0.500	0.807	< 0.500	< 0.500	
Upper	VMW-A	VMWA-080619	8/6/2019	4.60	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-A	VMWA-110419	11/4/2019	4.97	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-B	VMWB-020519	2/5/2019	21.5	1.02	3.82	< 0.500	< 0.500	
Upper	VMW-B	VMWB-050219	5/2/2019	28.8	1.37	4.27	< 0.500	< 0.500	
Upper	VMW-B	VMWB-080619	8/6/2019	24.3	1.22	3.88	< 0.500	< 0.500	
Upper	VMW-B	VMWB-110419	11/4/2019	24.4	1.11	4.11	< 0.500	< 0.500	
Upper	VMW-C	VMWC-020519	2/5/2019	30.7	1.00	3.15	< 0.500	< 0.500	
Upper	VMW-C	VMW-C-032519	3/25/2019	32.0	< 0.500	2.39	< 0.500	< 0.500	

Table E-1
Groundwater Analytical Results
1 January 2019 through 31 December 2019
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-050219	5/2/2019	26.6	0.608	1.98	< 0.500	< 0.500	
Upper	VMW-C	VMWC-080619	8/6/2019	15.9	0.705	1.04	< 0.500	< 0.500	
Upper	VMW-C	VMWC-110419	11/4/2019	28.6	0.569	< 0.500	< 0.500	< 0.500	
Upper	VMW-D	VMWD-020519	2/5/2019	20.4	0.893	3.89	< 0.500	< 0.500	
Upper	VMW-D	VMWD-050219	5/2/2019	3.53	< 0.500	0.691	< 0.500	< 0.500	
Upper	VMW-D	VMWD-080619	8/6/2019	7.80	< 0.500	0.518	< 0.500	< 0.500	
Upper	VMW-D	VMWD-110419	11/4/2019	3.67	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-E	VMW-E-032519	3/25/2019	43.4	2.62	6.66	< 0.500	< 0.500	
Upper	VMW-E	VMWE-050219	5/2/2019	40.6	2.11	7.25	< 0.500	< 0.500	
Upper	VMW-E	VMWE-080619	8/6/2019	33.6	2.17	5.37	< 0.500	< 0.500	
Upper	VMW-E	VMWE-110419	11/4/2019	7.04	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-F	VMW-F-032519	3/25/2019	18.0	0.635	2.56	< 0.500	< 0.500	
Upper	VMW-F	VMWF-050219	5/2/2019	1.37	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-F	VMWF-080619	8/6/2019	2.31	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-F	VMWF-110419	11/4/2019	5.18	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-G	VMW-G-032519	3/25/2019	< 2.50	< 2.50	< 2.50	< 2.50	< 2.50	
Upper	VMW-G	VMWG-050219	5/2/2019	24.2	< 0.500	9.33	< 0.500	< 0.500	
Upper	VMW-G	VMWG-080619	8/6/2019	15.7	0.581	6.44	< 0.500	< 0.500	
Upper	VMW-G	VMWG-110419	11/4/2019	12.5	< 0.500	5.46	< 0.500	< 0.500	
Upper	VMW-H	VMW-H-032519	3/25/2019	0.604	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-H	VMWH-050219	5/2/2019	1.06	< 0.500	1.22	< 0.500	< 0.500	
Upper	VMW-H	VMWH-080619	8/6/2019	1.87	< 0.500	< 0.500	< 0.500	< 0.500	
Upper	VMW-H	VMWH-110419	11/4/2019	1.63	< 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.

< = 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

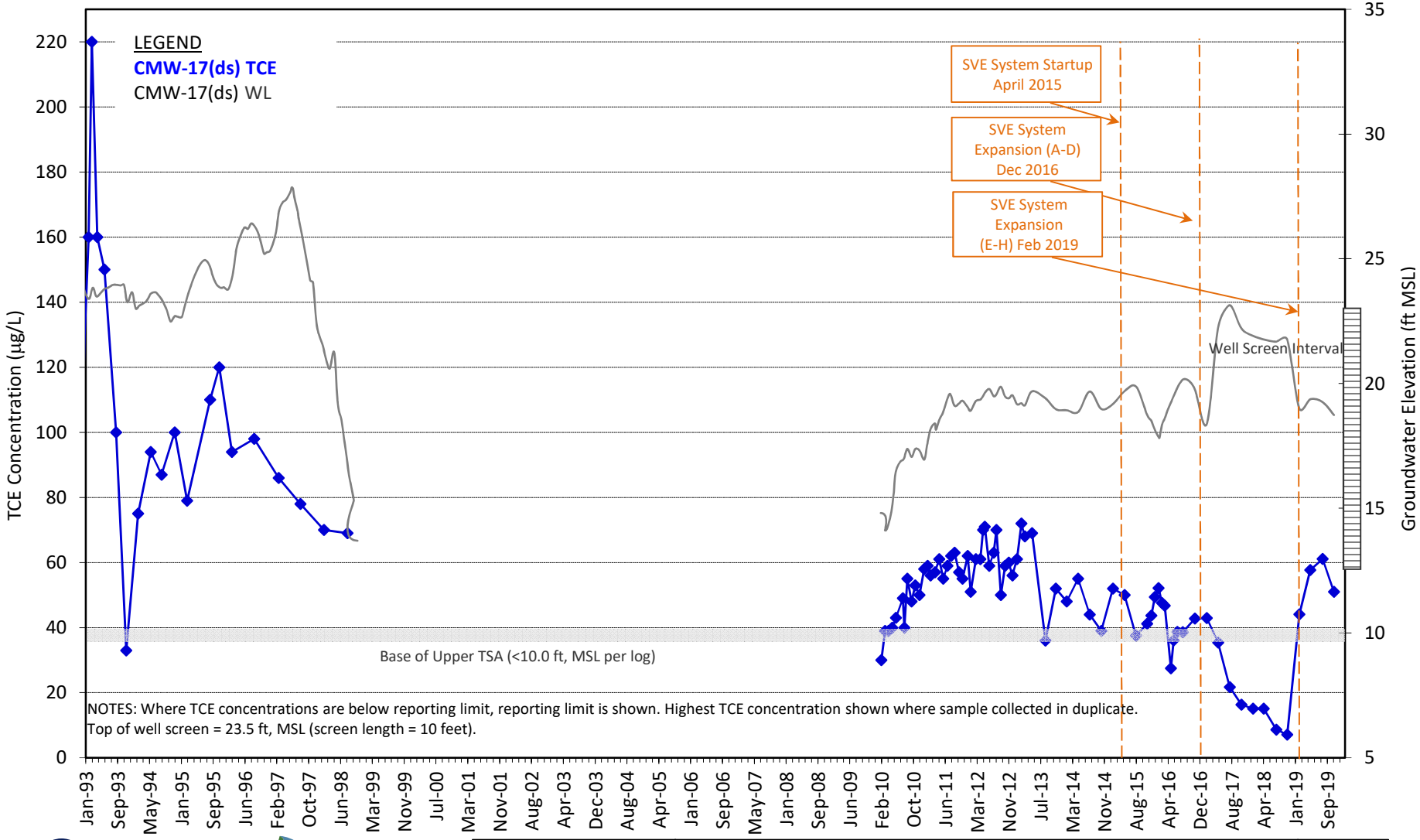
Table E-2
TCE Mass Removal - January 1998 through December 2019
TSA Remedy - East Multnomah County

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

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

	Pounds of TCE Removed Per Well										
Date	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
Total (5 years)	2.45	6.60	0.00	0.00	3.35	0.00	0.00	0.00	0.00	1.44	13.85
Total (10 years)	8.99	17.67	1.07	0.20	10.87	0.23	0.46	0.08	0.00	4.48	44.06

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.



NOTES: Where TCE concentrations are below reporting limit, reporting limit is shown. Highest TCE concentration shown where sample collected in duplicate.
Top of well screen = 23.5 ft, MSL (screen length = 10 feet).

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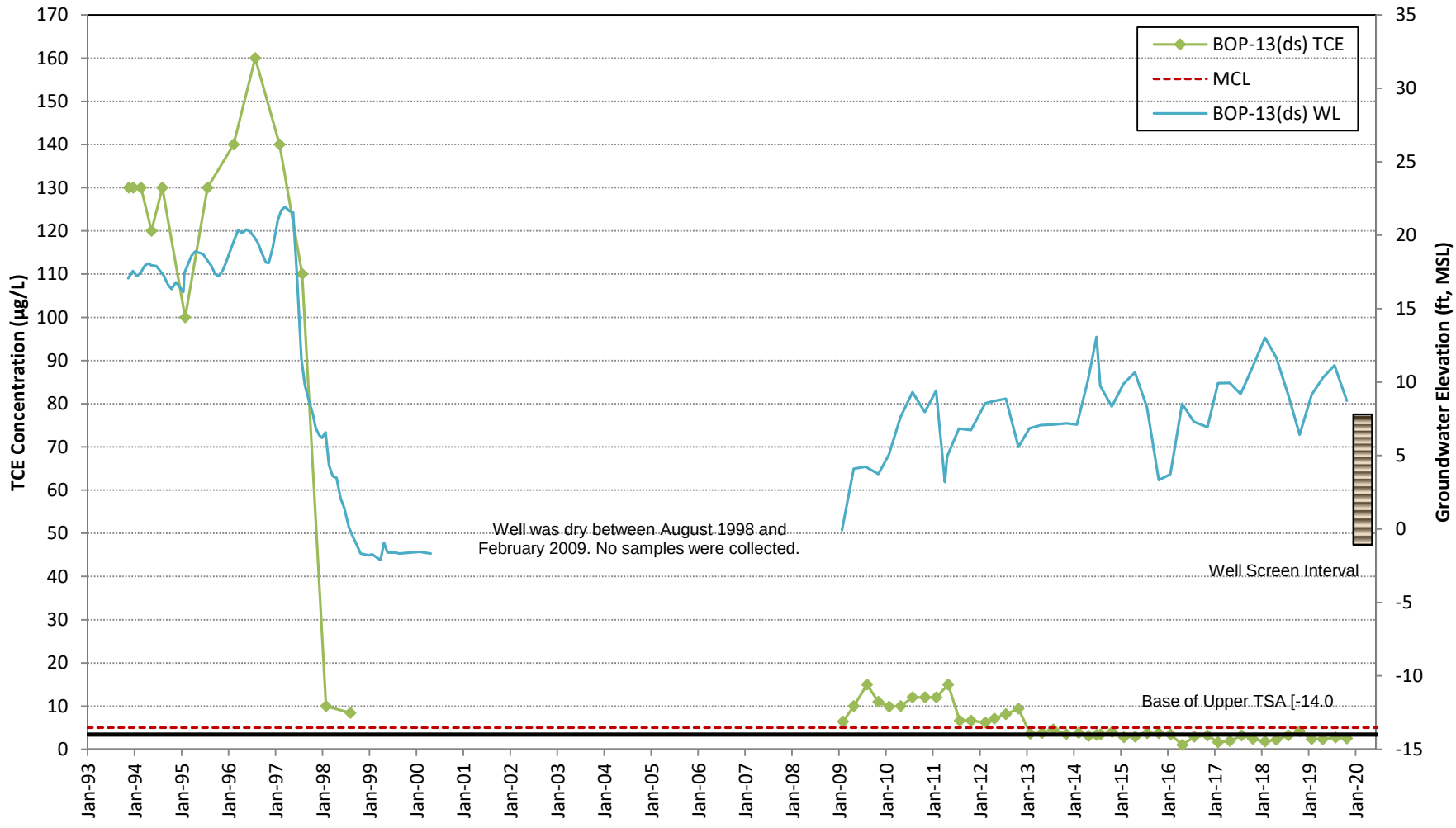
Cascade Corporation Gresham, Oregon	**TCE Concentration Profile CMW-17(ds)** **TSA Remedy**	Figure E-1

P:\025\116\WIP\R\TSA\2019 Annual Report\SourceFiles\BOP13ds-BOP31ds-TCE-WL



NOTES: Where TCE concentrations are below reporting limit, reporting limit is shown. Highest TCE concentration shown where sample collected in duplicate .

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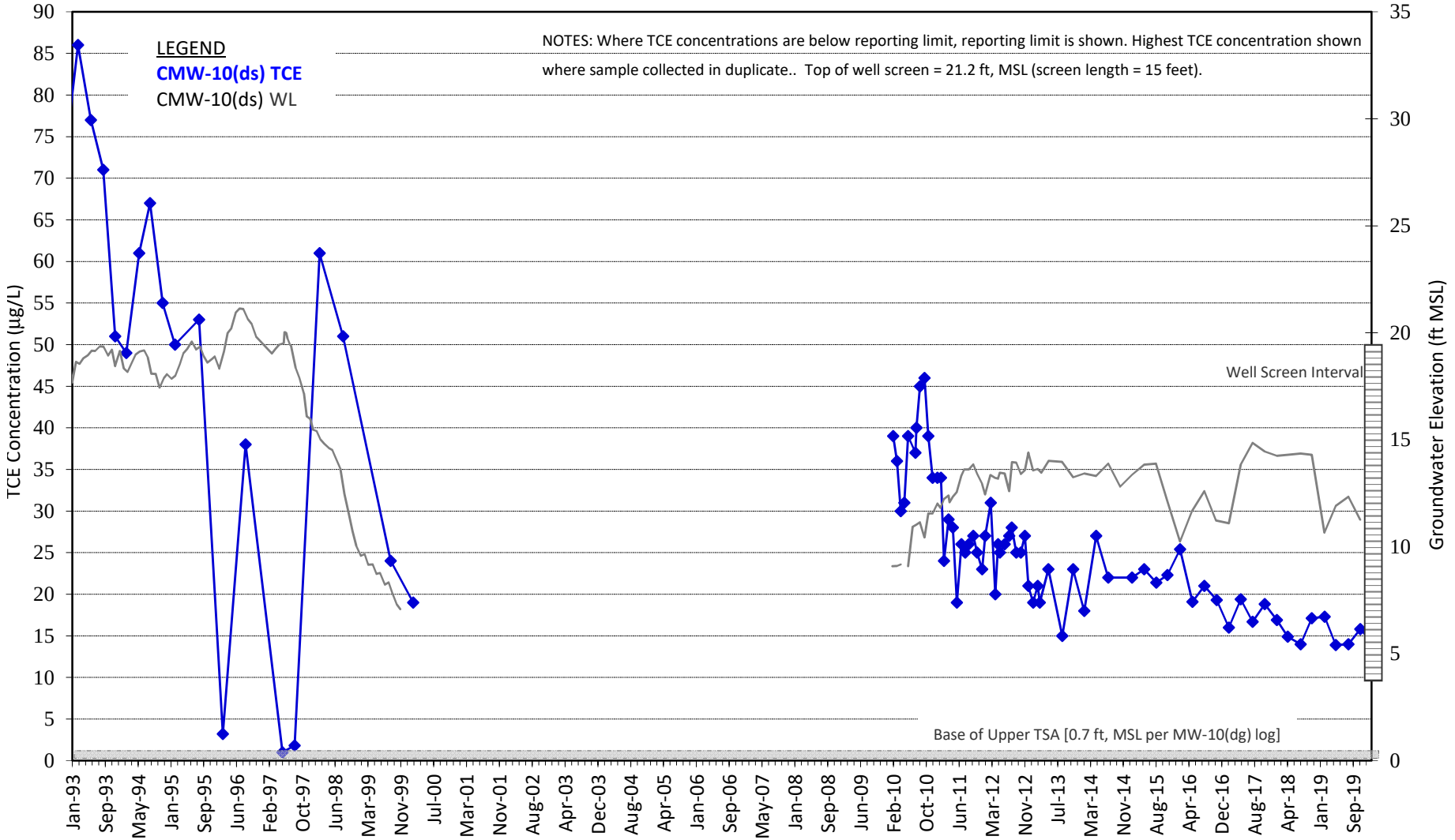
East Multnomah County Cleanup Project
Portland, Oregon

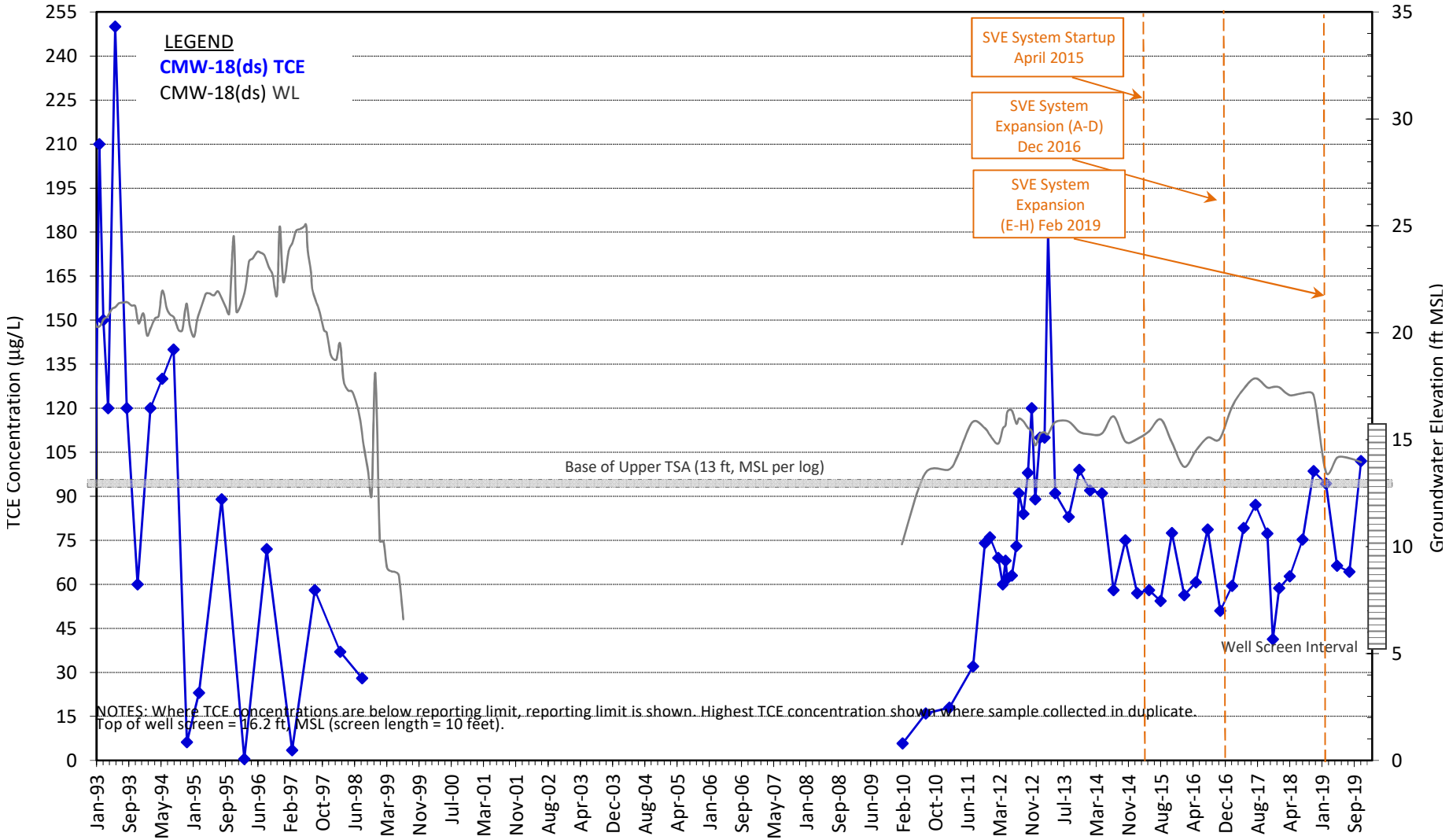
BOP-13(ds)
TCE and Groundwater Elevation

Figure
E-2



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**TCE Concentration Profile CMW-10(ds)** **TSA Remedy**	Figure E-3



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**TCE Concentration Profile CMW-18(ds)** **TSA Remedy**	Figure E-4

P:\025\116\WIP\R\TSA\2019 Annual Report\SourceFiles\BOP13ds-BOP31ds-TCE-WL

NOTES: Where TCE concentrations are below reporting limit, reporting limit is shown. Highest TCE concentration shown where sample collected in duplicate. Top of

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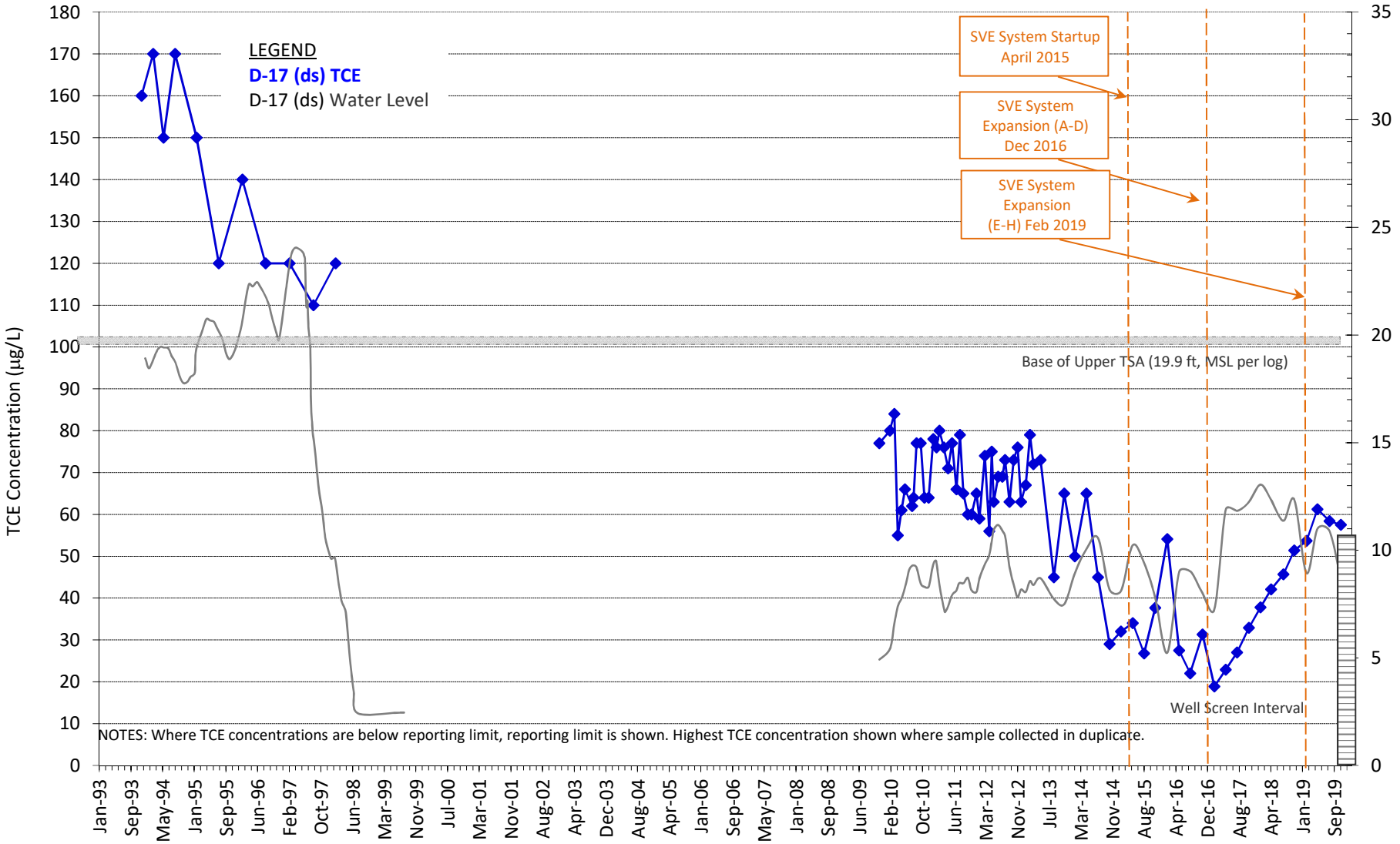
East Multnomah County Cleanup Project
Portland, Oregon

BOP-31(dg)
TCE and Groundwater Elevation

Figure
E-5



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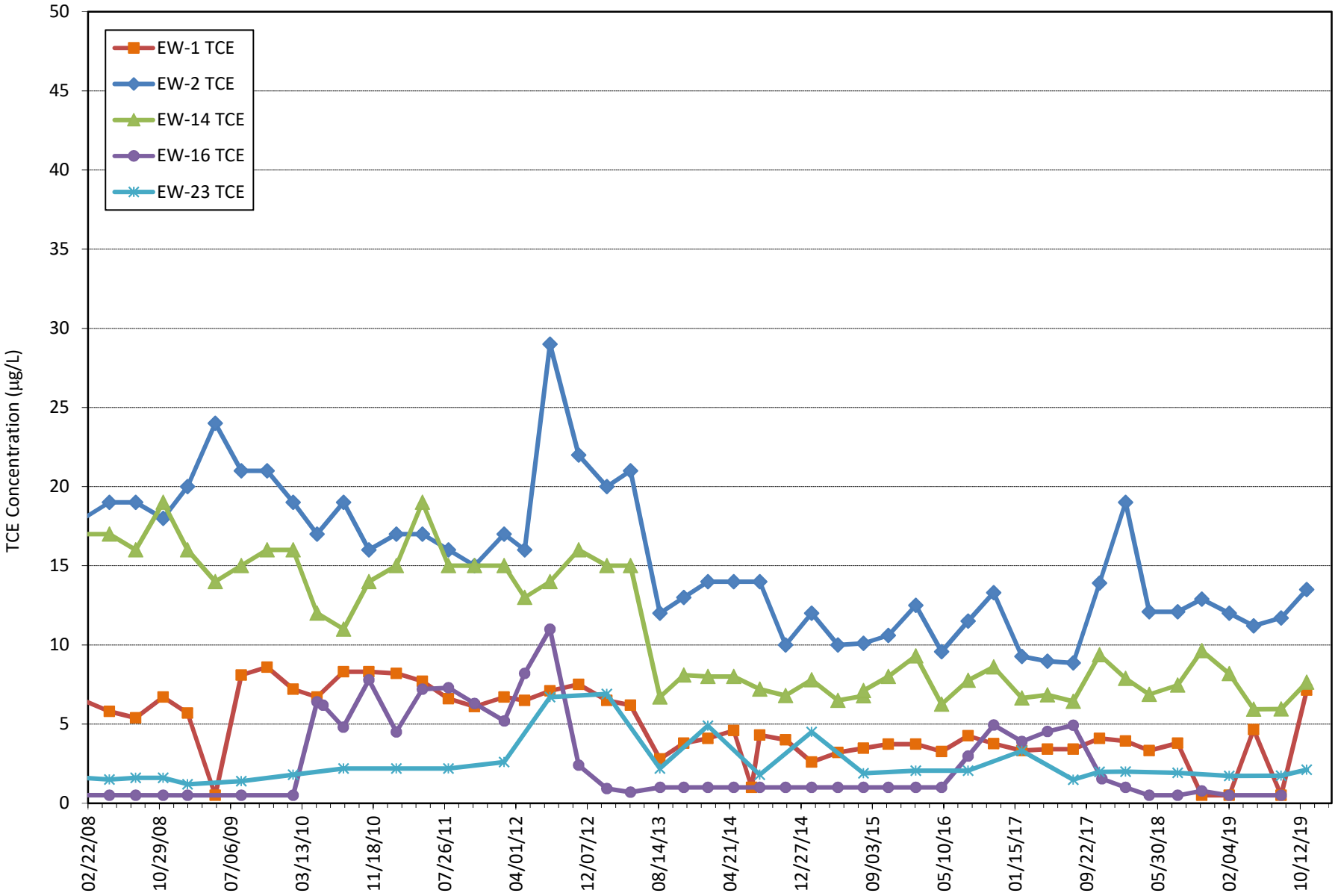
Cascade Corporation Gresham, Oregon	**TCE Concentration Profile D-17(ds)** **TSA Remedy**	Figure E-6



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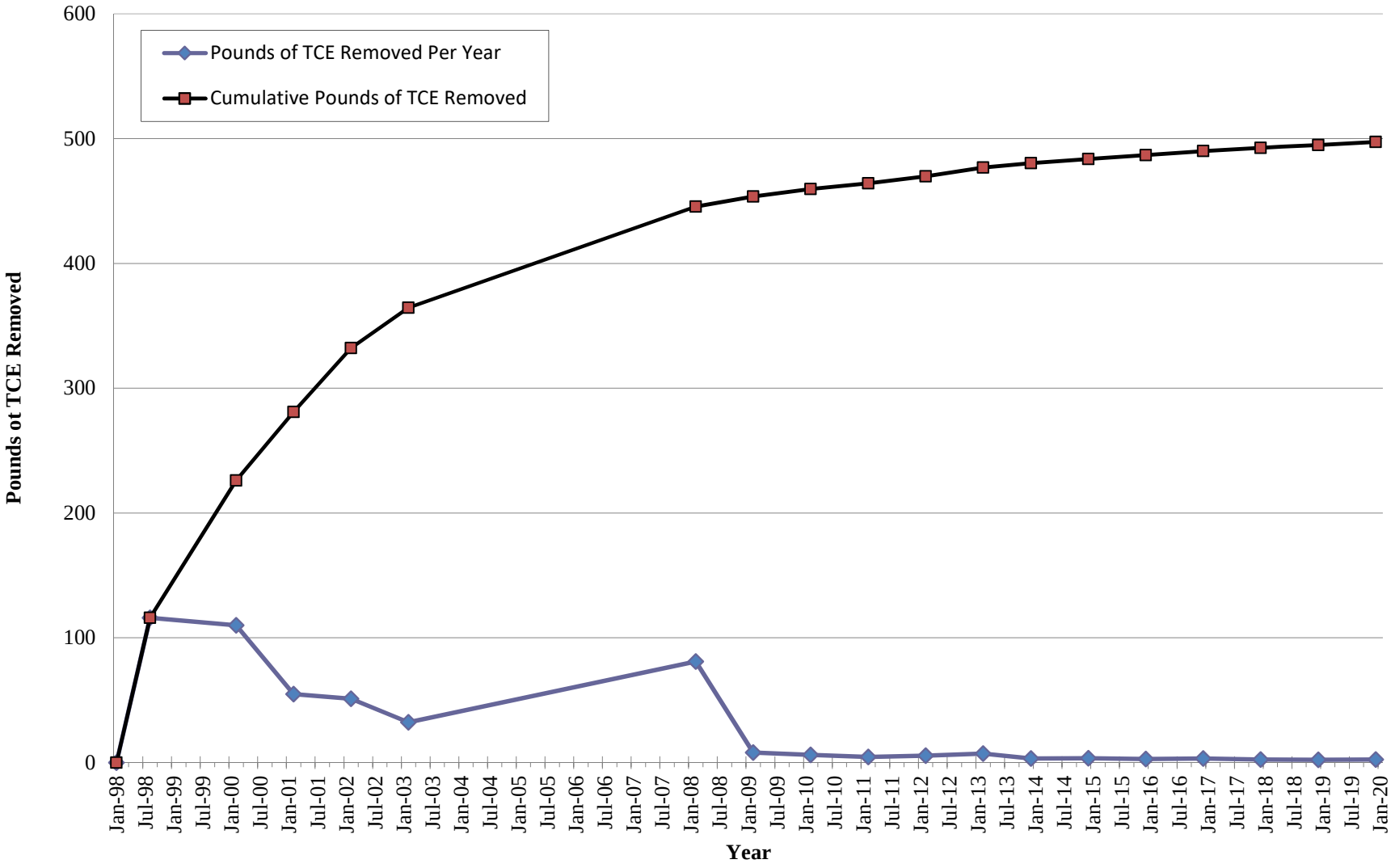
Cascade Corporation Gresham, Oregon	**Operating Extraction Wells TCE Concentration Profiles TSA Remedy**	Figure E-7

FigsE_2019 TSA TCE GW charts_20200113.xlsx



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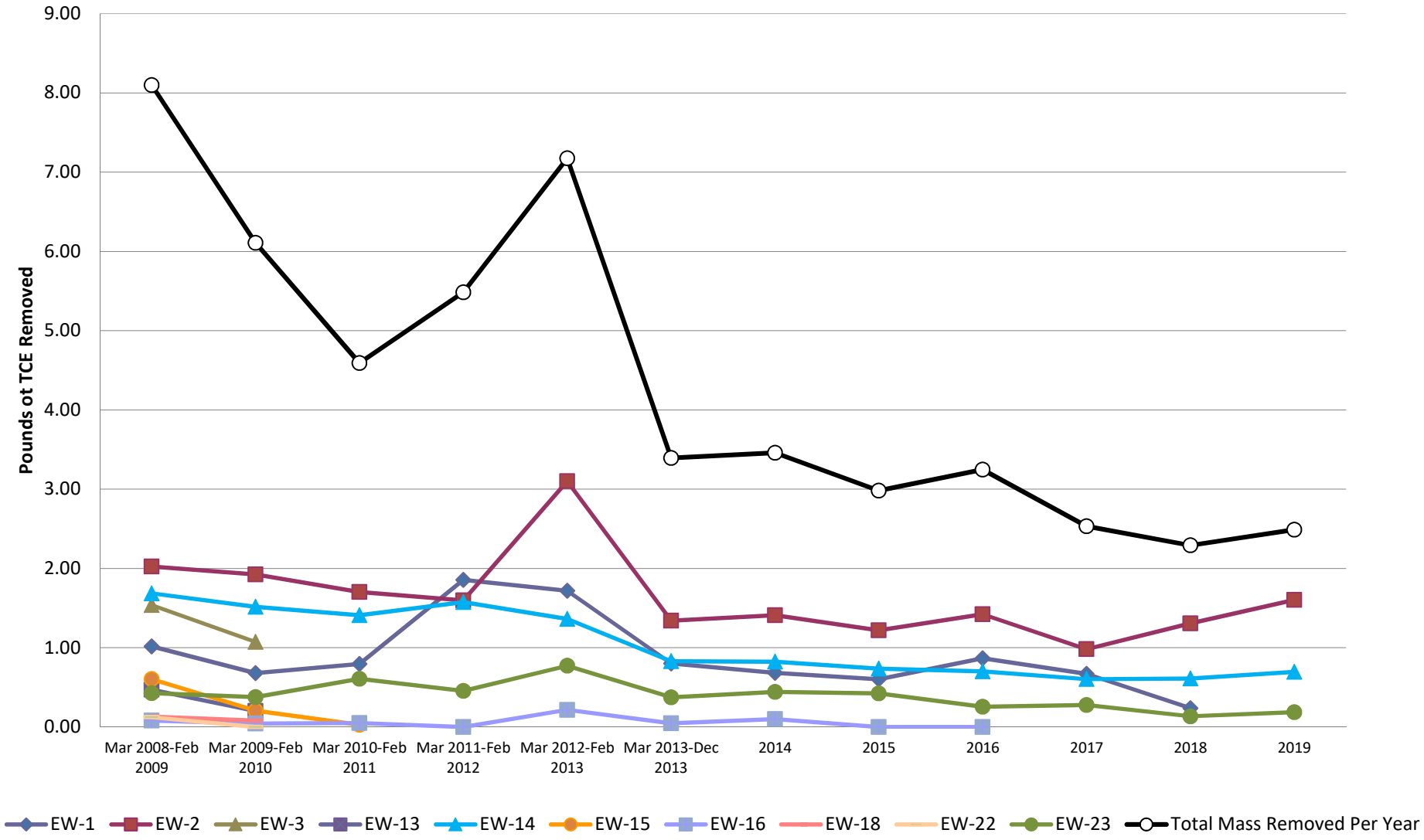
Cascade Corporation Gresham, Oregon	**TCE Mass Removal** **TSA Remedy**	Figure E-8



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

APPENDIX F

Data Validation Memoranda

Laboratory Reports (CD)

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

Technical Memorandum

TO: Chris Kimmel, Project Manager

FROM: Kristi Schultz and Danille Jorgensen

DATE: March 8, 2019

RE: **Boeing Portland (TSA)**
First Quarter 2019 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 first quarter 2019 TSA water quality sampling event at Boeing Portland. Samples were analyzed by Eurofins Lancaster Laboratories Environmental LLC (LLI), located in Lancaster, Pennsylvania. This data quality evaluation covers LLI data package 2028663. Samples submitted to LLI 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 2016). 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 LLI, 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-Z-0219/BOP-13ds-0219) was submitted for analysis with data package 2028663.

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. 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. 2016. National Functional Guidelines for Superfund Organic Methods Data Review. edited by Office of Superfund Remediation and Technology Innovation (OSRTI). Washington, DC: US Environmental Protection Agency.

Technical Memorandum

TO: Chris Kimmel, Project Manager

FROM: Kristi Schultz and Danille Jorgensen

DATE: May 17, 2019

RE: **Boeing Portland (TSA)**
Second Quarter 2019 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 2019 TSA water quality sampling event at Boeing Portland. Samples were analyzed by Eurofins Lancaster Laboratories Environmental LLC (LLI), located in Lancaster, Pennsylvania. This data quality evaluation covers LLI data package 2041709. Samples submitted to LLI 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 2016). 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 LLI, 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

No blind field duplicates were submitted with this sample batch. No qualification of the data was determined 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. 2016. National Functional Guidelines for Superfund Organic Methods Data Review. edited by Office of Superfund Remediation and Technology Innovation (OSRTI). Washington, DC: US Environmental Protection Agency.

Technical Memorandum

TO: Chris Kimmel, Project Manager

FROM: Kristi Schultz and Danille Jorgensen

DATE: September 20, 2019

RE: **Boeing Portland (TSA)**
Third Quarter 2019 Groundwater Quality Sampling
Laboratory Data Quality Evaluation

This technical memorandum provides the results of a focused data validation associated with 20 groundwater samples and 1 trip blank collected during the third quarter 2019 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 LLI data package 2058749. 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 2016). 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 validation 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 LLI, 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. Two pairs of blind field duplicate water samples (BOP-Y-0819/BOP-60dg-0819 and BOP-Z-0819/BOP-20ds-0819) were submitted for analysis with data package 2058749.

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 case narrative indicated the CCV recoveries were low for chloromethane and/or hexanone associated with several samples in data package 2058749. The associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.

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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Table 1. Summary of Data Qualifiers

References

EPA. 2016. National Functional Guidelines for Superfund Organic Methods Data Review. edited by Office of Superfund Remediation and Technology Innovation (OSRTI). Washington, DC: US Environmental Protection Agency.

Table 1
Summary of Data Qualifiers
Boeing Portland TSA Phase I

Data Package	Analyte	Result	Qualifier	Sample Number	Reason
2058749	Chloromethane	0.5 U	UJ	BOP-13ds-0819	Low continuing calibration recovery
2058749	2-Hexanone	5 U	UJ	BOP-13ds-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-13dg-0819	Low continuing calibration recovery
2058749	2-Hexanone	5 U	UJ	BOP-13dg-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-20ds-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-20dg-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-21ds-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-22Rds-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-23dg-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-31ds-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-31dg-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-42ds-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-42dg-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-60dg-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-61ds-0819	Low continuing calibration recovery
2058749	2-Hexanone	5 U	UJ	BOP-61ds-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-62ds-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-65ds-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-66ds-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-y-0819	Low continuing calibration recovery
2058749	2-Hexanone	5 U	UJ	BOP-y-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-z-0819	Low continuing calibration recovery
2058749	2-Hexanone	5 U	UJ	BOP-z-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	EW-3-0819 (orig)	Low continuing calibration recovery
2058749	2-Hexanone	5 U	UJ	EW-3-0819 (orig)	Low continuing calibration recovery
2058749	Acetone	360 E	DNR	EW-3-0819 (orig)	Do not report; use dilution result
2058749	Benzene	2 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Bromodichloromethane	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Bromoform	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Bromomethane	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	2-Butanone	50 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Carbon Disulfide	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Carbon Tetrachloride	2 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Chlorobenzene	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Chloroethane	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Chloroform	2 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Chloromethane	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Dibromochloromethane	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	1,1-Dichloroethane	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	1,2-Dichloroethane	2 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	1,1-Dichloroethene	2 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	cis-1,2-Dichloroethene	2 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	trans-1,2-Dichloroethene	2 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	1,2-Dichloropropane	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	cis-1,3-Dichloropropene	2 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	trans-1,3-Dichloropropene	2 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Ethylbenzene	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	2-Hexanone	50 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	4-Methyl-2-pentanone	50 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Methylene Chloride	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Styrene	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result

Table 1
Summary of Data Qualifiers
Boeing Portland TSA Phase I

Data Package	Analyte	Result	Qualifier	Sample Number	Reason
2058749	1,1,2,2-Tetrachloroethane	2 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Tetrachloroethene	2 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Toluene	2 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	1,1,2-Trichloro-1,2,2-trifluoroethane	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	1,1,1-Trichloroethane	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	1,1,2-Trichloroethane	2 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Trichloroethene	2 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Trichlorofluoromethane	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Vinyl Acetate	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Vinyl Chloride	2 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	m,p-Xylene	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	o-Xylene	5 U	DNR	EW-3-0819 (DL)	Do not report; use original result
2058749	Chloromethane	0.5 U	UJ	EW-13-0819	Low continuing calibration recovery
2058749	2-Hexanone	5 U	UJ	EW-13-0819	Low continuing calibration recovery
2058749	Chloromethane	0.5 U	UJ	BOP-61dg-0819	Low continuing calibration recovery
2058749	2-Hexanone	5 U	UJ	BOP-61dg-0819	Low continuing calibration recovery

J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.

Technical Memorandum

TO: Chris Kimmel, Project Manager

FROM: Kristi Schultz and Danille Jorgensen

DATE: December 1, 2019

RE: **Boeing Portland (TSA)**
Fourth Quarter 2019 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 fourth quarter 2019 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 LLI data package 2073408. 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 2016). 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 validation 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 LLI, 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

No blind field duplicates were submitted with this sample batch. No qualification of the data was determined 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 case narrative indicated the CCV recoveries were low for trichlorofluoromethane, vinyl acetate, and bromoform associated with several samples in data package 2073408. The associated sample results were qualified as estimated (J, UJ), as indicated in Table 1.

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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Attachment

Table 1. Summary of Data Qualifiers

References

EPA. 2016. National Functional Guidelines for Superfund Organic Methods Data Review. edited by Office of Superfund Remediation and Technology Innovation (OSRTI). Washington, DC: US Environmental Protection Agency.

Table 1
Summary of Data Qualifiers
Boeing Portland TSA Phase I

Data Package	Analyte	Result	Qualifier	Sample Number	Reason
2073408	Trichlorofluoromethane	0.5 U	UJ	BOP-13ds-1119	Low continuing calibration recovery
2073408	Vinyl Acetate	0.5 U	UJ	BOP-13ds-1119	Low continuing calibration recovery
2073408	Bromoform	0.5 U	UJ	BOP-13ds-1119	Low continuing calibration recovery
2073408	Trichlorofluoromethane	0.5 U	UJ	BOP-13dg-1119	Low continuing calibration recovery
2073408	Vinyl Acetate	0.5 U	UJ	BOP-13dg-1119	Low continuing calibration recovery
2073408	Bromoform	0.5 U	UJ	BOP-13dg-1119	Low continuing calibration recovery
2073408	Trichlorofluoromethane	0.5 U	UJ	BOP-31ds-1119	Low continuing calibration recovery
2073408	Vinyl Acetate	0.5 U	UJ	BOP-31ds-1119	Low continuing calibration recovery
2073408	Bromoform	0.5 U	UJ	BOP-31ds-1119	Low continuing calibration recovery
2073408	Trichlorofluoromethane	0.5 U	UJ	BOP-31dg-1119	Low continuing calibration recovery
2073408	Vinyl Acetate	0.5 U	UJ	BOP-31dg-1119	Low continuing calibration recovery
2073408	Bromoform	0.5 U	UJ	BOP-31dg-1119	Low continuing calibration recovery

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

UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.

Geosyntec consultants

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Knoxville, TN 37922
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Memorandum

Date: 19 March 2019

To: Cindy Bartlett, RG, LG

Geosyntec Consultants, Portland, Oregon

From: Mary Tyler

Jennifer Pinion

Subject: Stage 2A Data Validations - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1067715 and L1067718 and ALS Environmental Service Request Numbers P1900825 and P1900092.

SITE: Cascade Corp., Fairview Oregon; Job No: PNG0564

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of twenty-five water samples, two field duplicate samples and two trip blanks collected 2/5-6/18, and seven air samples collected on January 8 and February 12, 2019 as part of the site investigation activities for the Cascade Corp., Fairview Oregon.

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

- EPA Method 8260B - Volatile Organic Compounds (VOCs)

The air samples were analyzed by ALS Environmental, Simi Valley, California for the following analytical test:

- EPA Method TO-15 using Selected Ion Monitoring (SIM) – 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 meeting project objectives.

The data were reviewed based on the USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, January 2017 (EPA-540-R-2017-002), the pertinent methods referenced in the data package and professional and technical judgment.

The following samples were analyzed in the data set:

Laboratory ID	Client ID
L1067715-01	TS-C-INF-020519
L1067715-02	TS-C-EFF-020519
L1067715-03	TS-C-EFF-020519-DUP
L1067715-04	TRIP BLANK LOT #414
L1067718-01	EW16-020519
L1067718-02	EW23-020519
L1067718-03	EW14-020519
L1067718-04	EW2-020519
L1067718-05	EW1-020519
L1067718-06	VMWA-020519
L1067718-07	VMWB-020519
L1067718-08	VMWC-020519
L1067718-09	VMWD-020519
L1067718-10	CMW17DS-020519
L1067718-11	CMW17DS-020519-DUP
L1067718-12	D17DG-020619
L1067718-13	D17DS-020619
L1067718-14	EW12-020619-L

Laboratory ID	Client ID
L1067718-15	CMW18DS-020619
L1067718-16	CMW14RDS-020619
L1067718-17	CMW26DG-020619
L1067718-18	CMW36DG-020619
L1067718-19	CMW25DG-020619
L1067718-20	CMW24DG-020619-L
L1067718-21	CMW19DS-020619
L1067718-22	CMW10DS-020619
L1067718-23	PWB-1(LTS)-020619
L1067718-24	TRIP BLANK LOT #414
P1900092-001	VMW EFF-010819
P1900825-001	VMWEFF-021219
P1900825-002	VMW95.5-021219
P1900825-003	VMW A-021219
P1900825-004	VMW B-021219
P1900825-005	VMW C-021219
P1900825-006	VMW D-021219

The water samples were received at the laboratory within the temperature criteria of 0-6^{o}C.

Incorrect error corrections were observed on the chain of custody (COC) in report L1067718, instead of the proper procedure of a single strike through, correction, and initials and date of person making the corrections.

No collection times were listed for the trip blanks on the COCs in laboratory reports L1067715 and L1067718; the laboratory assigned collection times of 00:00. In addition, both trip blanks had collection dates of 10/15/18. The laboratory assigned collection dates of 2/6/19.

The year was not included in the receiving documentation on the COCs in laboratory reports L1067715 and L1067718.

It was noted that the COCs were not paginated as part of the Pace Analytical laboratory reports.

1.0 VOLATILE ORGANIC COMPOUNDS BY EPA METHOD 8260B

The water samples were analyzed for VOCs per EPA Method 8260B.

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 Time
- ✓ Method Blank
- ✓ Matrix Spike/Matrix Spike Duplicate
- ✓ Laboratory Control Sample
- ✓ Surrogates
- ✓ Field Duplicate
- ✓ Trip Blank
- ✓ Sensitivity
- ✓ Electronic Data Deliverables Review

1.1 Overall Assessment

The VOC data reported in these sample sets are considered usable for meeting project objectives. 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%.

1.2 Holding Time

The holding time for the VOC analysis of a preserved water 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 WG1234087, WG1234213, WG1236071 and WG1234172). VOCs were not detected in the method blank above the method detection limits (MDLs) with the following exceptions.

Hexachloro-1,3-butadiene, naphthalene, and 1,2,3-trichlorobenzene were detected in the method blank in batch 1234087 at estimated concentrations greater than the MDLs and less than the

reporting limits (RLs). Since hexachloro-1,3-butadiene, naphthalene, and 1,2,3-trichlorobenzene 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.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One LCS and three LCS/LCS duplicate (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 Field Duplicate

Two field duplicate samples were collected with the sample set, TS-C-EFF-020519-DUP and CMW17DS-020519-DUP. Acceptable precision (RPD $\leq$30%) was demonstrated between the field duplicates and the original samples, TS-C-EFF-020519 and CMW17DS-020519, respectively.

1.8 Trip Blank

Two trip blanks accompanied the sample shipments, both identified as TRIP BLANK LOT 414. VOCs were not detected in the trip blanks above the MDLs.

1.9 Sensitivity

The sample results were reported to the MDLs. No elevated non-detect results were reported.

1.10 Electronic Data Deliverable (EDD) Review

Results and sample IDs in the EDDs 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 data were reported in units of parts per million (ppm) in the EDDs, while the sample data were reported in units of parts per billion (or microgram per liter, µg/L) in the level II reports. This

did not affect the quality of the data. No other discrepancies were identified between the level II reports and the EDDs.

2.0 SELECTED VOLATILE ORGANIC COMPOUNDS BY EPA METHOD TO-15

The air samples were analyzed for selected VOCs per EPA Method TO-15 using SIM (1,1-Dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride).

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 Time
- ✓ Method Blank
- ✓ Laboratory Control Sample
- ✓ Laboratory Duplicate
- ✓ Surrogates
- ✓ Field Duplicate
- ✓ Trip Blank
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

2.1 Overall Assessment

The VOC data reported in these sample sets are considered usable for meeting project objectives. 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%.

2.2 Holding Time

The holding time for the VOC analysis of an air sample collected in a SUMMA® 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 P190116,

P190117 and P190222). 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 LCSs were reported. The recovery results were within the laboratory specified acceptance criteria.

2.5 Laboratory Duplicate

A laboratory duplicate was not reported.

2.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

2.7 Field Duplicate

A field duplicate was not collected with the air samples.

2.8 Trip Blank

A trip blank did not accompany the sample shipment.

2.9 Sensitivity

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

2.10 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. It was noted that the samples were reported to the MRLs in the level II reports; both the MRLs and the MDLs were listed in the EDDs. It was also noted that the data were reported in micrograms per cubic meter ($\mu g/m^3$) in the EDDs, while the sample data were reported in both $\mu g/m^3$ and parts per billion by volume (ppbv) in the level II reports. This did not affect the quality of the data. No other 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	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 and RPD outside limits (LCS/LCSD)
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

RPD-relative percent difference

Geosyntec consultants

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Memorandum

Date:	3 July 2019
To:	Cindy Bartlett, RG, LG
	Geosyntec Consultants, Portland, Oregon
From:	Kristoffer Henderson
Subject:	**Stage 2A Data Validations - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1082939, L1095432 and L1095434 and ALS Environmental Service Request Numbers P1901838, P1902025 and P1902643R.**

SITE: Cascade Corp., Fairview Oregon; Job No: PNG0564

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of twenty-five groundwater samples, two field duplicate samples and two trip blanks and nine air samples, collected between March 25, 2019 and May 7, 2019 as part of the site investigation activities for the Cascade Corp., Fairview Oregon.

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

- EPA Method 8260C - Volatile Organic Compounds (VOCs)

The air samples were analyzed by ALS Environmental, Simi Valley, California for the following analytical test:

- EPA Method TO-15 using Selected Ion Monitoring (SIM) – 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 meeting project objectives. The qualified data should be used within the limitations of the qualifications.

The data were reviewed based on the USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, January 2017 (EPA-540-R-2017-002), the pertinent methods referenced in the data package and professional and technical judgment.

The following samples were analyzed in the data sets:

Laboratory ID	Client ID
L1082939-01	VMW-H-032519
L1082939-02	VMW-C-032519
L1082939-03	VMW-G-032519
L1082939-04	VMW-F-032519
L1082939-05	VMW-E-032519
L1082939-06	TRIP BLANK LOT #370
L1095432-01	VMWA-050219
L1095432-02	VMWC-050219
L1095432-03	VMWB-050219
L1095432-04	VMWD-050219
L1095432-05	VMWH-050219
L1095432-06	VMWG-050219
L1095432-07	VMWF-050219
L1095432-08	CMW17DS-050219
L1095432-09	VMWE-050219
L1095432-10	EW1-050219
L1095432-11	EW2-050219
L1095432-12	EW14-050219
L1095432-13	D17DG-050219

Laboratory ID	Client ID
L1095432-14	D17DS-050219
L1095432-15	EW12-050219
L1095432-16	CMW18DS-050219
L1095432-17	CMW18DS-050219-DUP
L1095432-18	CMW19DS-050219
L1095432-19	CMW10DS-050219
L1095432-20	TRIP LOT #414
L1095434-01	TS-C-EFF-050319
L1095434-02	TS-C-EFF-050319-DUP
L1095434-03	TS-C-INF-050319
P1901838-001	VMW-H-040219
P1902025-001	SVE-EFF-040919
P1902643-001	VMWEFF-050719
P1902643-002	VMW95.5-050719
P1902643-003	VMWC-050719
P1902643-004	VMWE-050719
P1902643-005	VMWF-050719
P1902643-006	VMWG-050719
P1902643-007	VMWH-050719

The water samples were received at the laboratory within the temperature criteria of 0-6^{o}C.

Incorrect error corrections were observed on the chain of custody (COC) in report L1095432, instead of the proper procedure of a single strike through, correction, and initials and date of person making the corrections.

No collection times were listed for the trip blanks on the COCs in laboratory reports L1082939 and L1095432; the laboratory assigned collection times of 00:00. In addition, no collection date was listed for the trip blank in laboratory report L1095432; the laboratory assigned a collection date of May 3, 2019.

The COCs were not paginated as part of the Pace Analytical laboratory reports.

ALS laboratory report P1902643R was revised on June 26, 2019 to correct the results for samples VMWE-050719 and VMWF-050719 which were originally reported from the wrong canisters. The revised report was identified as P1902643R.

1.0 VOLATILE ORGANIC COMPOUNDS BY EPA METHOD 8260C

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

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 Time
✓ Method Blank
✓ Matrix Spike/Matrix Spike Duplicate
✓ Laboratory Control Sample
✓ Surrogates
✓ Field Duplicate
✓ Trip Blank
✓ Sensitivity
✓ Electronic Data Deliverables Review

1.1 Overall Assessment

The VOC data reported in these sample sets are considered usable for meeting project objectives. 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%.

The laboratory J0 flagged the bromomethane results in L1082939 and the acetone, chloromethane and 2-butanone results in L1095432. J0 was defined in the laboratory reports as, “the identification of the analyte is acceptable, but the reported concentration is an estimate”. The laboratory was contacted and provided additional information; they indicated that the results were flagged due to continuing calibration verification (CCV) recoveries outside the limit of 80-120% recovery as following:

- Laboratory report L1082939: Bromomethane CCV recovery 77.3%.
- Laboratory report L1095432: Acetone, chloromethane and 2-butanone CCV recoveries 66.3%, 71.6% and 79.8%, respectively.

Since the percent differences (%Ds) of these compounds in the CCVs indicated were within the validation specified acceptance criteria 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 water 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). Five method blanks were reported (batches WG1257024, WG1257766, WG1276798, WG1277794 and WG1277852). VOCs were not detected in the method blank above the method detection limits (MDLs) with the following exceptions.

L1095432: Butylbenzene, sec-butylbenzene, hexachlorobutadiene, p-cymene, naphthalene, 1,2,3-trichlorobenzene, 1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene and 1,3,5-trimethylbenzene were detected in the method blank in batch WG1276798 at estimated concentrations greater than the MDLs and less than the reporting limits (RLs). 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.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four LCSs and one LCS/LCS duplicate (LCSD) pair 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 Field Duplicate

Two field duplicate samples were collected with the sample set, CMW18DS-050219-DUP and TS-C-EFF-050319-DUP. Acceptable precision (RPD $\leq$30%] was demonstrated between the field duplicates and the original samples, CMW18DS-050219 and TS-C-EFF-050319, respectively.

1.8 Trip Blank

Two trip blanks accompanied the sample shipments, TRIP BLANK LOT #370 and TRIP LOT #414. VOCs were not detected in the trip blanks above the MDLs.

1.9 Sensitivity

The sample results were reported to the MDLs. Elevated non-detect results were reported for sample VMW-G-032519 due to dilution analyzed.

1.10 Electronic Data Deliverable (EDD) Review

Results and sample IDs in the EDDs 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 data were reported in units of parts per million (ppm) in the EDDs, while the sample data were reported in units of parts per billion (or microgram per liter, µg/L) in the level II reports. This did not affect the quality of the data. No other discrepancies were identified between the level II reports and the EDDs.

2.0 SELECTED VOLATILE ORGANIC COMPOUNDS BY EPA METHOD TO-15

The air samples were analyzed for selected VOCs per EPA method TO-15 using SIM (1,1-dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride).

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 Time
✓ Method Blank
✓ Laboratory Control Sample
✓ Laboratory Duplicate
✓ Surrogates
✓ Field Duplicate
✓ Trip Blank
✓ Sensitivity
✓ Electronic Data Deliverable Review

2.1 Overall Assessment

The VOC data reported in the sample sets are considered usable for meeting project objectives. 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 sets is 100%.

The final canister vacuum for sample SVE-EFF-040919 was -2.0 pounds per square inch gauge (psig) when shipped to the laboratory after sampling, and approximately atmospheric at -0.24 psig upon receipt by the laboratory. The loss in vacuum in comparison to the other canister vacuums in the sample sets, as well as the final measured vacuum at near ambient, indicates a potential leak. Therefore, based on professional and technical judgment, the non-detect results in sample SVE-EFF-040919 were UJ qualified as estimated less than the method reporting limits (MRLs) and the concentrations were J qualified as estimated.

Sample ID	Compound	Laboratory Result (µg/m^3)	Laboratory Flag	Validation Result (µg/m^3)	Validation Qualifier*	Reason Code**
SVE-EFF-040919	cis-1,2-Dichloroethene	79	NA	79	J	13
SVE-EFF-040919	Tetrachloroethene (PCE)	40	NA	40	J	13
SVE-EFF-040919	Trichloroethene (TCE)	560	D	560	J	13
SVE-EFF-040919	Vinyl Chloride	1.8	U	1.8	UJ	13
SVE-EFF-040919	1,1-Dichloroethene	1.8	U	1.8	UJ	13

µg/m^3-microgram per cubic meter
NA-not applicable
U-not detected at the MRL
D-laboratory flag indicating the result is from a dilution
* 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

2.2 Holding Time

The holding time for the VOC analysis of an air sample collected in a SUMMA® 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 P190410, P190419 and P190520). 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). Two LCSs and one LCS/LCSD pair were reported. The recovery and RPD results were within the laboratory specified acceptance criteria.

2.5 Laboratory Duplicate

One sample set specific laboratory duplicate was reported, using sample VMWH-050719. The RPD results were within the laboratory specified acceptance criteria.

2.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

2.7 Field Duplicate

A field duplicate was not collected with the air samples.

2.8 Trip Blank

A trip blank did not accompany the air samples.

2.9 Sensitivity

The sample results were reported to the MRLs. Elevated non-detect results were reported due to the dilutions analyzed; the narrative in report P1901838 indicated that sample VMW-H-040219 was analyzed at a dilution due to the presence of non-target analytes.

2.10 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. It was noted that the samples were reported to the MRLs in the level II reports; both the MRLs and the MDLs were listed in the EDDs. It was also noted that the data were reported in micrograms per cubic meter ($\mu g/m^3$) in the EDDs, while the sample data were reported in both $\mu g/m^3$ and parts per billion by volume (ppbv) in the level II reports. This did not affect the quality of the data. No other 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	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 and RPD outside limits (LCS/LCSD)
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

RPD-relative percent difference

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Memorandum

Date:	3 September 2019
To:	Cindy Bartlett, RG, LG
	Geosyntec Consultants, Portland, Oregon
From:	Matthew Richardson
	Kristoffer Henderson
CC:	J. Caprio
Subject:	**Stage 2A Data Validations - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1057797, L1114294, L1119044, L1127014, L1127015 and L1129331 and ALS Environmental Service Request Numbers P1901701, P1903475, P1904087 and P1904673.**

SITE: Cascade Corp., Fairview Oregon; Job No: PNG0564S18

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of thirty-four groundwater samples, seventeen air samples, three field duplicate samples, four investigation derived waste (IDW) samples and three trip blanks, collected between January 2, 2019 and August 13, 2019 as part of the site investigation activities for the Cascade Corp., Fairview Oregon.

The water and solid samples were analyzed by Pace Analytical [formerly ESC Lab Sciences (ESC)], Mt. Juliet, Tennessee for the following analytical tests:

- United States (US) Environmental Protection Agency (EPA) Methods 8260B and 8260C - Volatile Organic Compounds (VOCs) by Gas Chromatography/Mass Spectrometry (GC/MS)
- US EPA Method 6010D - Metals by Inductively Coupled Plasma (ICP)/ Atomic Emission Spectrometry (AES)
- US EPA Methods 1311/6010D – Toxicity Characteristic Leaching Procedure (TCLP) Chromium by ICP/AES
- US EPA Method 7471B – Mercury
- Standard Method 2540G - Percent Moisture/Solids

The air samples were analyzed by ALS Environmental, Simi Valley, California for the following analytical tests:

- US EPA Method TO-15 and US EPA Method TO-15 Modified – 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 USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, January 2017 (EPA-540-R-2017-002), USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Methods Data Review, January 2017 (EPA-540-R-2017-001), the pertinent methods referenced in the data package and professional and technical judgment.

The following samples were analyzed in the data sets:

Laboratory ID	Client ID
L1057797-01	D17DG-010219
L1057797-02	TRIP BLANK LOT # 414
L1114294-01	VMW_IDW01
L1114294-02	VMW_IDW02
L1114294-03	VMW_IDW03
L1119044-01	HOLD01
L1127014-01	EW1-080619
L1127014-02	EW2-080619
L1127014-03	EW14-080619
L1127014-04	EW23-080619
L1127014-05	D17DG-080619
L1127014-06	D17DS-080619
L1127014-07	EW8-080619
L1127014-08	EW12-080619
L1127014-09	EW15-080619
L1127014-10	EW16-080619
L1127014-11	CMW10DS-080619
L1127014-12	CMW14RDS-080619
L1127014-13	CMW17DS-080619
L1127014-14	CMW17DS-080619-DUP
L1127014-15	CMW18DS-080619
L1127014-16	CMW18DS-080619-DUP
L1127014-17	CMW19DS-080619
L1127014-18	CMW20DS-080619

Laboratory ID	Client ID
L1127014-19	CMW22DG-080619
L1127014-20	CMW24DG-080619
L1127014-21	CMW25DG-080619
L1127014-22	CMW26DG-080619
L1127014-23	PWB-1(UTS)-080619
L1127014-24	PWB-1(LTS)-080619
L1127014-25	VMWA-080619
L1127014-26	VMWB-080619
L1127014-27	VMWC-080619
L1127014-28	VMWD-080619
L1127014-29	VMWE-080619
L1127014-30	VMWF-080619
L1127014-31	VMWG-080619
L1127014-32	VMWH-080619
L1127014-33	TRIP BLANK#LOT 406
L1127015-01	TS-C-EFF-080619
L1127015-02	TS-C-EFF-080619-DUP
L1127015-03	TS-C-INF-080619
L1127015-04	TRIP BLANK #LOT 406
L1129331-01	CMW36DG-081319
L1129331-02	TRIP BLANK #404
P1901701-001	VMWEFF-032619
P1901701-002	VMWC-032619
P1901701-003	VMWE-032619

Laboratory ID	Client ID
P1901701-004	VMWF-032619
P1901701-005	VMWG-032619
P1903475-001	VMWA-061119
P1903475-002	VMWB-061119
P1903475-003	VMWD-061119
P1903475-004	EFF-061119
P1904087-001	SVE-EFF-070919

Laboratory ID	Client ID
P1904673-001	VMWEFF-080519
P1904673-002	VMW95.5-080519
P1904673-003	VMWC-080519
P1904673-004	VMWH-080519
P1904673-005	VMWE-080519
P1904673-006	VMWF-080519
P1904673-007	VMWG-080519

The water and solid samples were received at the laboratory within the temperature criteria of 0-6^{o}C.

The following issues were noted on the chain of custody (COC) forms. These issues did not have any impact on the data; therefore, no qualifications were applied to the data.

- Incorrect error corrections were observed on the COC in report P1903475, instead of the proper procedure of a single strike through, correction, and initials and date of person making the correction.

- Samples HOLD01, HOLD02 and HOLD03 were received on hold as noted by the COCs for laboratory reports L1114294 and L1119044. Sample HOLD01 was analyzed for chromium by TCLP in laboratory report L1119044 per the client's request. Samples HOLD02 and HOLD03 were not reported with the data.

- No collection times were listed for the trip blanks on the COCs in laboratory reports L1057797, L1127015, L1127014 and L1129331. The laboratory assigned the collection time of 00:00. The sample matrix was not listed for the trip blank in laboratory report L1129331.

- Sample VMWH-032619 was listed on the COC for laboratory report P1901701 but was cancelled by the client and was not reported.

Percent solids by Method 2540G was analyzed for dry-weight reporting in laboratory report L1114294; however, the data were not validated.

1.0 VOLATILE ORGANIC COMPOUNDS

The water samples were analyzed for VOCs per EPA method 8260B and 8260C.

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
✓ Field Duplicate
✓ Trip Blank
✓ Sensitivity
⊗ Electronic Data Deliverable Review

1.1 Overall Assessment

1.1.1 Completeness

The VOC data reported in these sample sets are considered usable for supporting project objectives. 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 sets is 100%.

1.1.2 Analysis Anomaly

Multiple results were flagged J0 to indicate the recoveries of the specified compound(s) in the continuing calibration verification (CCV) standards were outside the laboratory specified acceptance criteria. The laboratory provided the compounds and recoveries that were outside of the criteria.

L1127014 and L1127015: The recoveries of bromoform, bromomethane and chloroethane were low and outside the laboratory specified acceptance criteria in the CCV in batch WG1327324. Since the bromoform and chloroethane results in the CCV were within the validation specified acceptance criteria, no qualifications were applied to the bromoform and chloroethane data, based on professional and technical judgment. However, the non-detect bromomethane results in the associated samples were UJ qualified as estimated less than the reporting limit (RL).

L1127014: The recovery of naphthalene was low and outside the laboratory specified acceptance criteria in the CCV in batch WG1326885. Therefore, the non-detect naphthalene results in the associated samples were UJ qualified as estimated less than the RL.

L1127014: The recoveries of bromomethane, carbon tetrachloride, chloroethane, chloromethane and trichlorofluoromethane were low and outside the laboratory specified acceptance criteria in the CCV in batch WG1327140. Since the carbon tetrachloride, chloroethane, chloromethane and trichlorofluoromethane results in the CCV were within the validation specified acceptance criteria, no qualifications were applied to the carbon tetrachloride, chloroethane, chloromethane and trichlorofluoromethane data, based on professional and technical judgment. However, the non-detect bromomethane results in the associated samples were UJ qualified as estimated less than the RL.

Sample	Analyte	Laboratory Result (ppm)	Laboratory Flag	Validation Result (ppm)	Validation Qualifier	Reason Code
VMWD-080619	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
VMWE-080619	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
VMWF-080619	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
VMWG-080619	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
VMWH-080619	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
CMW22DG-080619	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
CMW24DG-080619	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
CMW25DG-080619	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
CMW26DG-080619	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
PWB-1(LTS)-080619	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
PWB-1(UTS)-080619	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
TS-C-EFF-080619	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
TS-C-EFF-080619-DUP	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
TS-C-INF-080619	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
VMWA-080619	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
VMWB-080619	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
VMWC-080619	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
TRIP BLANK #LOT 406	Methyl Bromide	0.00250	U,J0	0.00250	UJ	9
CMW10DS-080619	Naphthalene	0.00250	U,J0	0.00250	UJ	9
CMW14RDS-080619	Naphthalene	0.00250	U,J0	0.00250	UJ	9

Sample	Analyte	Laboratory Result (ppm)	Laboratory Flag	Validation Result (ppm)	Validation Qualifier	Reason Code
CMW19DS-080619	Naphthalene	0.00250	U,J0	0.00250	UJ	9
CMW20DS-080619	Naphthalene	0.00250	U,J0	0.00250	UJ	9
D17DG-080619	Naphthalene	0.00250	U,J0	0.00250	UJ	9
D17DS-080619	Naphthalene	0.00250	U,J0	0.00250	UJ	9
EW1-080619	Naphthalene	0.00250	U,J0	0.00250	UJ	9
EW12-080619	Naphthalene	0.00250	U,J0	0.00250	UJ	9
EW14-080619	Naphthalene	0.00250	U,J0	0.00250	UJ	9
EW15-080619	Naphthalene	0.00250	U,J0	0.00250	UJ	9
EW16-080619	Naphthalene	0.00250	U,J0	0.00250	UJ	9
EW2-080619	Naphthalene	0.00250	U,J0	0.00250	UJ	9
EW23-080619	Naphthalene	0.00250	U,J0	0.00250	UJ	9
EW8-080619	Naphthalene	0.00250	U,J0	0.00250	UJ	9
CMW17DS-080619	Naphthalene	0.00250	U,J0	0.00250	UJ	9
CMW17DS-080619-DUP	Naphthalene	0.00250	U,J0	0.00250	UJ	9
CMW18DS-080619	Naphthalene	0.00250	U,J0	0.00250	UJ	9
CMW18DS-080619-DUP	Naphthalene	0.00250	U,J0	0.00250	UJ	9

ppm-parts per million
J0-laboratory flag defined as the identification of the analyte is acceptable, but the reported concentration is an estimate. The calibration met method 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

1.2 Holding Time

The holding time for the VOC analysis of a preserved water sample is 14 days from collection to analysis. The holding times for VOC analysis of a water preserved soil sample collected in a Terra Core® sample are 48 hours from sample collection to freezing and 14 days from sample 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). Seven method blanks were reported (batches WG1219077, WG1307486, WG1326885, WG1327140, WG1327324, WG1330890 and WG1331185). VOCs were not detected in the method blanks above the method detection limits (MDLs), with the following exceptions.

L1057797: Naphthalene was detected in the method blank in batch WG1219077 at an estimated concentration greater than the MDL and less than the RL. Since naphthalene was not detected in the associated samples, no qualifications were applied to the data.

L1114294: 2-Butanone (0.0287 mg/kg) was detected in the method blank in batch WG1307486 at a concentration greater than the RL. Therefore, the 2-butanone concentration in sample VMW_IDW03 was J+ qualified as estimated with a high bias, based on technical and professional judgment.

L1127014: Acetone and tetrachloroethene were detected in the method blank in batch WG1326885 at estimated concentrations greater than the MDLs and less than the RLs. Since acetone and tetrachloroethene were either not detected or detected above the RLs in the associated samples, no qualifications were applied to the data.

L1127014: Acetone was detected in the method blank in batch WG1327140 at an estimated concentration greater than the MDL and less than the RL. Since acetone was either not detected or detected above the RL in the associated samples, no qualifications were applied to the data.

L1127014 & L1127015: Hexachloro-1,3-butadiene and 1,2,3-trichlorobenzene were detected in the method blank in batch WG1327324 at estimated concentrations greater than the MDLs and less than the RLs. Since hexachloro-1,3-butadiene and 1,2,3-trichlorobenzene were not detected in the associated samples, no qualifications were applied to the data.

Sample	Analyte	Laboratory Result (ppm)	Laboratory Flag	Validation Result (ppm)	Validation Qualifier	Reason Code
VMW_IDW03	2-Butanone	0.0508	B	0.0508	J+	3

ppm-parts per million
B-laboratory flag indicating analyte was detected in both the sample and associated method blank

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

MS/MSD pairs were not reported with the data.

1.5 Laboratory Control Sample (LCS)

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

L1057797: The recoveries of acrolein were high and outside the laboratory specified acceptance criteria in the LCS/LCSD pair in batch WG1219077. Since acrolein was not detected in the associated samples, no qualifications were applied to the data.

L1114294: The recovery of 1,2,3-trimethylbenzene was high and outside the laboratory specified acceptance criteria in the LCS in batch WG1307486. Since 1,2,3-trimethylbenzene was not detected in the associated samples, no qualifications were applied to the data.

L1127014: The recovery of carbon tetrachloride was high and outside the laboratory specified acceptance criteria in the LCS in in batch WG1326885. Since carbon tetrachloride was not detected in the associated samples, no qualifications were applied to the data.

L1127014: The recoveries of acrolein and the RPDs of naphthalene and 1,2,3-trichlorobenzene were high and outside the laboratory specified acceptance criteria in the LCS/LCSD pair in batch WG1327140. Since these compounds were not detected in the associated samples, no qualifications were applied to the data.

L1127014 and L1127015: One or both the recoveries of acrolein and 1,3-dichlorobenzene were high and outside the laboratory specified acceptance criteria in batch WG1327324. Since acrolein and 1,3-dichlorobenzene 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 Field Duplicate

Two field duplicate samples were collected with the sample set, CMW17DS-080619-DUP and

CMW18DS-080619-DUP. Acceptable precision (RPD $\leq$30%] was demonstrated between the field duplicates and the original samples, CMW17DS-080619 and CMW18DS-080619, respectively.

1.8 Trip Blank

Three trip blanks accompanied the sample shipments, TRIP LOT #414, TRIP BLANK#LOT 406 and TRIP BLANK #404. VOCs were not detected in the trip blanks above the RLs.

TRIP BLANK#LOT 406 was reported in both laboratory reports L1127014 and L1127015. Based on the sample receipt date and time and the analysis batch date and time it was determined to be the same trip blank.

1.9 Sensitivity

The sample results were reported to the RLs. No elevated non-detect results were reported with the following exception.

L1114294: Elevated non-detect results were reported for samples VMW_IDW01 and VMW_IDW03 due to dilutions analyzed.

1.10 Electronic Data Deliverable (EDD) Review

Results and sample IDs in the EDDs 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 data were reported in units of parts per million (ppm) in the EDDs, while the sample data were reported in units of parts per billion (or microgram per liter, µg/L) in the level II reports. This did not affect the quality of the data. No other discrepancies were identified between the level II reports and the EDDs.

2.0 SELECTED VOLATILE ORGANIC COMPOUNDS

The air samples were analyzed for selected VOCs per EPA method TO-15 and EPA method TO-15 modified (1,1-dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride).

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
✓ Laboratory Control Sample
✓ Laboratory Duplicate
✓ Surrogates
✓ Field Duplicate
✓ Sensitivity
✓ Electronic Data Deliverable Review

2.1 Overall Assessment

2.1.1 Completeness

The VOC data reported in the sample sets are considered usable for supporting project objectives. 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 sets is 100%.

2.1.2 Analysis Anomaly

The canister vacuum for sample VMWEFF-032619 was recorded as -1.96 pound per square inch gauge (psig) in the field and was recorded at a pressure above ambient of 1.04 psig after laboratory receipt. This loss in vacuum in comparison to the other canister vacuums in the batch, as well as

the final measured vacuum above ambient, indicates a potential leak. Therefore, based on professional and technical judgment, the non-detect results were UJ qualified as estimated less than the MRL and concentrations were J qualified as estimated in sample VMWEFF-032619.

Sample	Analyte	Laboratory Result (µg/m^3)	Laboratory Flag	Validation Result (µg/m3)	Validation Qualifier	Reason Code
VMWEFF-032619	Vinyl Chloride	1.7	U	1.7	UJ	13
VMWEFF-032619	1,1-Dichloroethene	1.7	U	1.7	UJ	13
VMWEFF-032619	cis-1,2-Dichloroethene	59	NA	59	J	13
VMWEFF-032619	Tetrachloroethene (PCE)	43	NA	43	J	13
VMWEFF-032619	Trichloroethene (TCE)	680	D	680	J+	13

µg/m^3-micrograms per cubic meter
U-not detected at or above the MRL
D-laboratory flag indicating result is from a dilution
NA-not applicable

2.2 Holding Time

The holding time for the VOC analysis of an air sample collected in a SUMMA® 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). Five method blanks were reported (batches P190408, P190624, P190717, P190818 and P190819). 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). Five LCSs were reported. The recovery results were within the laboratory specified acceptance criteria.

2.5 Laboratory Duplicate

A laboratory duplicate was not reported with the air samples.

2.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

2.7 Field Duplicate

A field duplicate was not collected with the air samples.

2.8 Sensitivity

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

2.9 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. It was noted that the samples were reported to the MRLs in the level II reports; both the MRLs and the MDLs were listed in the EDDs. It was also noted that the data were reported in micrograms per cubic meter ($\mu g/m^3$) in the EDDs, while the sample data were reported in both $\mu g/m^3$ and parts per billion by volume (ppbv) in the level II reports. This did not affect the quality of the data. No other discrepancies were identified between the level II reports and the EDDs.

3.0 METALS

The samples were analyzed for Metals by US EPA Method 6010B and TCLP Chromium by EPA Methods 1311/6010B. Mercury was assessed separately, in section 4.0, below.

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 over 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
- ✓ Laboratory Duplicate
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

3.1 Overall Assessment

The metals data reported in this package 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 the samples submitted for these analyses, for this sample set is 100%.

3.2 Holding Times

The holding time for the metals analysis of a solid sample is 180 days from sample collection to analysis. The holding times for TCLP are 180 days from collection to TCLP extraction and 180 days from TCLP extraction to analysis. The holding times were met for the sample analyses.

3.3 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 WG1307036 and WG1313684). Metals were not detected in the method blanks above the MDLs, with the following exception.

L1114294: Barium was detected in the method blank (batch WG1307036) at a concentration greater than the RL. Since the concentrations of barium in the associated samples was greater than ten times the method blank result, no qualifications were applied to the data based on technical and professional judgment.

3.4 Matrix Spike/Matrix Spike Duplicate

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One sample set specific MS/MSD pair was reported for TCLP chromium using sample HOLD01. The recovery and RPD results were within the laboratory specified acceptance criteria.

One batch MS/MSD pair was also reported. Since these were batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data.

3.5 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/LCSD pair was reported. The recovery and RPD results were within the laboratory specified acceptance criteria.

3.6 Laboratory Duplicate

A laboratory duplicate was not reported with the sample set.

3.7 Field Duplicate

A field duplicate was not submitted with the sample set.

3.8 Sensitivity

The sample results were reported to the MDLs. No elevated non-detect results were reported.

3.9 Electronic Data Deliverable Review

The 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.

4.0 MERCURY

The sample was analyzed for mercury by US EPA Method 7471B.

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 over 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
- ✓ Laboratory Duplicate
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

4.1 Overall Assessment

The mercury data reported in this package 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 the samples submitted for this analysis, for this sample set is 100%.

4.2 Holding Times

The holding time for mercury analyses of a solid sample is 28 days from sample collection to analysis. The holding times were met for the sample analyses.

4.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One method blank was reported (batch WG1307294). Mercury was not detected in the method blank above the MDL.

4.4 Matrix Spike/Matrix Spike Duplicate

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). One sample set specific MS/MSD pair was reported, using sample VMW_IDW01. The recovery and RPD results were within the laboratory specified acceptance criteria.

4.5 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/LCSD pair was reported. The recovery and RPD results were within the laboratory specified acceptance criteria.

4.6 Laboratory Duplicate

A laboratory duplicate was not reported with the sample set.

4.7 Field Duplicate

A field duplicate was not reported with the sample set.

4.8 Sensitivity

The samples were reported to the MDL. Elevated non-detect results were not reported.

4.9 Electronic Data Deliverable Review

The 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.

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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	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 and RPD outside limits (LCS/LCSD)
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

Geosyntec consultants

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Memorandum

Date:	9 December 2019
To:	Cindy Bartlett, RG, LG
	Geosyntec Consultants, Portland, Oregon
From:	Matthew Richardson
CC:	J. Caprio
Subject:	**Stage 2A Data Validations - Level II Data Deliverables – Pace Analytical Sample Delivery Groups L1157928 and L1157939 and ALS Environmental Service Request Number P1905977.**

SITE: Cascade Corp., Fairview Oregon; Job No: PNG0564S18

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of five air samples, five air samples collected on October 3, 2019 and twenty-two groundwater samples, one field duplicate sample, and one trip blank, collected on October 3, 2019 as part of the site investigation activities for the Cascade Corp., Fairview Oregon sampling event.

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

- United States (US) Environmental Protection Agency (EPA) Methods 8260C - Volatile Organic Compounds (VOCs) by Gas Chromatography/Mass Spectrometry (GC/MS)

The air samples were analyzed by ALS Environmental, Simi Valley, California for the following analytical tests:

- US EPA Method TO-15 and US EPA Method TO-15 Modified – 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 USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, January 2017 (EPA-540-R-2017-002) and the pertinent methods referenced in the data package and professional and technical judgment.

The following samples were analyzed in the data sets:

Laboratory ID	Client ID
L1157928-01	CMW17DS-110419
L1157928-02	EW1-110419
L1157928-03	EW2-110419
L1157928-04	EW14-110419
L1157928-05	EW23-110419
L1157928-06	D17DS-110419
L1157928-07	D17DG-110419
L1157928-08	EW12-110419
L1157928-09	CMW10DS-110419
L1157928-10	CMW18DS-110419
L1157928-11	CMW18DS-110419
L1157928-12	CMW19DS-110419
L1157928-13	VMWA-110419
L1157928-14	VMWB-110419
L1157928-15	VMWC-110419

Laboratory ID	Client ID
L1157928-16	VMWD-110419
L1157928-17	VMWE-110419
L1157928-18	VMWF-110419
L1157928-19	VMWG-110419
L1157928-20	VMWH-110419
L1157939-01	TS-C-EFF-110419
L1157939-02	TS-C-EFF-110419-DUP
L1157939-03	TS-C-INF-110419
L1157939-04	TRIP BLANK LOT#414
P1905977-001	VW-17d-95.5-100319
P1905977-002	VMW-A-100319
P1905977-003	VMW B-100319
P1905977-004	VMW D-100319
P1905977-005	SVE EFF-100319

The water samples were received at the laboratory within the temperature criteria of 0-6^{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.

- The sample matrix was not properly documented on the COC for laboratory report L1157939.
- Two samples were collected and identified as CMW18DS-110419 with two separate sample collection times.
- No collection times were listed for the trip blank on the COC in laboratory report L1157939. The laboratory assigned the collection time of 00:00.

1.0 VOLATILE ORGANIC COMPOUNDS

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

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
✓ Field Duplicate
✓ Trip Blank
✓ Sensitivity
⊗ Electronic Data Deliverable Review

1.1 Overall Assessment

1.1.1 Completeness

The VOC data reported in these sample sets are considered usable for supporting project objectives. 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 sets is 100%.

1.1.2 Analysis Anomaly

Multiple results were flagged J0 to indicate the recoveries of the specified compound(s) in the continuing calibration verification (CCV) standards were outside the laboratory specified acceptance criteria. Upon request, the laboratory provided the compounds and recoveries that were outside of the criteria.

L1157928: The recoveries of bromomethane and chloromethane were low and outside the laboratory specified acceptance criteria in the CCV in batch WG1327324. Since the chloromethane result in the CCV was within the validation specified acceptance criteria, no qualifications were applied to the chloromethane data, based on professional and technical judgment. However, the non-detect bromomethane (methyl bromide) results in the associated samples were UJ qualified as estimated less than the reporting limit (RL).

L1157939: The recovery of bromomethane was low and outside the laboratory specified acceptance criteria in the CCV in batch WG1326885. Therefore, the non-detect bromomethane results in the associated samples were UJ qualified as estimated less than the RL.

Sample	Analyte	Laboratory Result (ppm)	Laboratory Flag	Validation Result (ppm)	Validation Qualifier*	Reason Code**
CMW10DS-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9

Sample	Analyte	Laboratory Result (ppm)	Laboratory Flag	Validation Result (ppm)	Validation Qualifier*	Reason Code**
CMW17DS-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
CMW18DS-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
CMW18DS-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
CMW19DS-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
D17DG-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
D17DS-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
EW1-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
EW12-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
EW14-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
EW2-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
EW23-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
TS-C-EFF-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
TS-C-EFF-110419-DUP	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
TS-C-INF-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
VMWA-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
VMWB-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
VMWC-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
VMWD-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
VMWE-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
VMWF-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
VMWG-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
VMWH-110419	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9
TRIP BLANK LOT#414	Methyl Bromide	0.000157	U,J0	0.000157	UJ	9

ppm-parts per million
J0-laboratory flag defined as the identification of the analyte is acceptable, but the reported concentration is an estimate. The calibration met method 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

1.2 Holding Time

The holding time for the VOC analysis of a preserved water 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 WG1380372, WG1381136, WG1378829, and WG1380768). VOCs were not detected in the method blanks above the method detection limits (MDLs), with the following exceptions.

L1157928: Cis-1,2-dichloroethene was detected in the method blank in batch WG1378829 at an estimated concentration greater than the MDL and less than the RL. No qualifications were applied to the data where cis-1,2-dichloroethene was either not detected or detected at a concentration greater than the RL. However, the cis-1,2-dichloroethene estimated concentrations in samples EW1-110419, EW14-110419, EW2-110419, VMWA-110419, VMWC-110419, VMWD-110419, VMWE-110419, VMWF-110419, and VMWH-110419 were U qualified as not detected at the RL based on technical and professional judgment.

L1127014: Acetone was detected in the method blank in batch WG1381136 at an estimated concentration greater than the MDL and less than the RL. Since acetone was not detected in the associated samples, no qualifications were applied to the data.

Sample	Analyte	Laboratory Result (ppm)	Laboratory Flag	Validation Result (ppm)	Validation Qualifier	Reason Code
EW1-110419	cis-1,2-Dichloroethene	0.000948	B	0	U	3
EW14-110419	cis-1,2-Dichloroethene	0.00115	B	0	U	3
EW2-110419	cis-1,2-Dichloroethene	0.00165	B	0	U	3
VMWA-110419	cis-1,2-Dichloroethene	0.000805	B	0	U	3
VMWC-110419	cis-1,2-Dichloroethene	0.00247	B	0	U	3
VMWD-110419	cis-1,2-Dichloroethene	0.000704	B	0	U	3
VMWE-110419	cis-1,2-Dichloroethene	0.00174	B	0	U	3
VMWF-110419	cis-1,2-Dichloroethene	0.00142	B	0	U	3
VMWH-110419	cis-1,2-Dichloroethene	0.000629	B	0	U	3

ppm-parts per million
B-laboratory flag indicating analyte was detected in both the sample and associated method blank

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

MS/MSD pairs were not reported with the data.

1.5 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Three LCSs and one LCS/LCS duplicate (LCSD) pair 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 Field Duplicate

One field duplicate sample was collected with the sample set, TS-C-EFF-110419-DUP. Acceptable precision (RPD $\leq$30%) was demonstrated between the field duplicates and the original sample, TS-C-EFF-110419.

1.8 Trip Blank

One trip blank, TRIP BLANK LOT#414, accompanied the sample shipments. VOCs were not detected in the trip blank above the RLs.

1.9 Sensitivity

The sample results were reported to the RLs. No elevated non-detect results were reported.

1.10 Electronic Data Deliverable (EDD) Review

Results and sample IDs in the EDDs 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 data were reported in units of parts per million (ppm) in the EDDs, while the sample data were reported in units of parts per billion (or microgram per liter, µg/L) in the level II reports. This did not affect the quality of the data. No other discrepancies were identified between the level II reports and the EDDs.

2.0 SELECTED VOLATILE ORGANIC COMPOUNDS

The air samples were analyzed for selected VOCs per EPA method TO-15/EPA method TO-15 modified (1,1-dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride).

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
- ✓ Laboratory Control Sample
- ✓ Laboratory Duplicate
- ✓ Surrogates
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverable Review

2.1 Overall Assessment

The VOC data reported in the sample sets are considered usable for supporting project objectives. 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 sets is 100%.

2.2 Holding Time

The holding time for the VOC analysis of an air sample collected in a SUMMA® 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). One method blank was reported (batch P191023). VOCs were not detected in the method blank 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). One LCS was reported. The recovery results were within the laboratory specified acceptance criteria.

2.5 Laboratory Duplicate

A laboratory duplicate was not reported with the air samples.

2.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

2.7 Field Duplicate

A field duplicate was not collected with the air samples.

2.8 Sensitivity

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

2.9 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. It was noted that the samples were reported to the MRLs in the level II reports; both the MRLs and the MDLs were listed in the EDDs. It was also noted that the data were reported in micrograms per cubic meter ($\mu g/m^3$) in the EDDs, while the sample data were reported in both $\mu g/m^3$ and parts per billion by volume (ppbv) in the level II reports. This did not affect the quality of the data. No other 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	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 and RPD outside limits (LCS/LCSD)
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

Geosyntec consultants

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Memorandum

Date:	24 January 2020
To:	Cindy Bartlett, RG, LG
	Geosyntec Consultants, Portland, Oregon
From:	Matthew Richardson
CC:	J. Caprio
Subject:	**Stage 2A Data Validations - Level II Data Deliverables –ALS Environmental Service Request Numbers P1907399 and 1911442.**

SITE: Cascade Corp., Fairview Oregon; Job No: PNG0564S19

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of eight air samples collected on November 5, 2019 and December 3, 2019 as part of the site investigation activities for the Cascade Corp., Fairview Oregon sampling event.

The samples were analyzed by ALS Environmental, Cincinnati, Ohio for the following analytical test:

- United States Environmental Protection Agency (US EPA) Method TO-15 – Volatile Organic Compounds (VOCs)

The sample, SVE-EFF-120319, was analyzed by ALS Environmental, Simi Valley, California for the following analytical test:

- US EPA Method TO-15 Modified – 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 USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, January 2017 (EPA-540-R-2017-002) and the pertinent methods referenced in the data package and professional and technical judgment.

The following samples were analyzed in the data sets:

Laboratory ID	Client ID
P1907399-001	SVE-EFF-120319
1911442-01	SVE-EFF-110519
1911442-02	VW-17D-95.5-110519
1911442-03	VMWC-110519

Laboratory ID	Client ID
1911442-04	VMWE-110519
1911442-05	VMWF-110519
1911442-06	VMWG-110519
1911442-07	VMWH-110519

The laboratory did not report the initial canister pressures upon receipt in laboratory report 1911442. No qualifications were applied to the data. However, the data user should be aware of the implications of the undocumented canister pressures.

1.0 VOLATILE ORGANIC COMPOUNDS

The samples in laboratory report 1911442 were analyzed for the full list of VOCS per US EPA method TO-15 and sample SVE-EFF-120319, was analyzed for selected VOCs per US EPA method TO-15/ US EPA method TO-15 modified (1,1-dichloroethene, cis-1,2-dichloroethene, trichloroethene, tetrachloroethene, and vinyl chloride).

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
✓ Laboratory Control Sample
✓ Laboratory Duplicate
✓ Surrogates
✓ Field Duplicate
✓ Sensitivity
⊗ Electronic Data Deliverable Review

1.1 Overall Assessment

1.1.1 Completeness

The VOC data reported in the sample sets are considered usable for supporting project objectives. 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 sets is 100%.

1.1.2 Analysis Anomaly

The acetone concentration in sample VMWE-110519 was flagged E by the laboratory to indicate the concentration exceeded the calibration range. Therefore, the acetone concentration in sample VMWE-110519 was J qualified as estimated. The data user should be advised the parts per billion by volume (ppbv) acetone result in sample VMWE-110519 is considered to be an estimated concentration as well.

Sample	Analyte	Laboratory Result ($\mu g/m^3$)	Laboratory Flag	Validation Result ($\mu g/m^3$)	Validation Qualifier*	Reason Code**
VMWE-110519	Acetone	72	NA	72	J	10

µg/m3-microgram per cubic meter
NA-not applicable
* 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

1.2 Holding Time

The holding time for the VOC analysis of an air sample collected in a SUMMA® canister is 30 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 P191220, P191221, R172423 and R172466). VOCs were not detected in the method blanks above the method reporting limits (MRLs).

1.4 Laboratory Control Sample (LCS)

LCSs were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Four LCSs were reported. The recovery results were within the laboratory specified acceptance criteria.

1.5 Laboratory Duplicate

A laboratory duplicate was not reported with the air samples.

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Field Duplicate

A field duplicate was not collected with the air samples.

1.8 Sensitivity

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

1.9 Electronic Data Deliverable Review

Results and sample IDs in the EDD were reviewed against the information provided by the associated level II reports at a minimum of 20% as part of the data validation process. It was noted that the samples were reported to the MRLs in the level II reports; both the MRLs and the MDLs were listed in the EDDs. The EDD did not include the laboratory qualifiers used in the level II reports. It was also noted that the data were reported in micrograms per cubic meter ($\mu g/m^3$) in the EDDs, while the sample data were reported in both $\mu g/m^3$ and parts per billion by volume (ppbv) in the level II reports. This did not affect the quality of the data. No other 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	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 and RPD outside limits (LCS/LCSD)
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