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ANNUAL PERFORMANCE REPORT
1 OCTOBER 2014 – 31 DECEMBER 2015

TROUTDALE SANDSTONE AQUIFER REMEDY

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Annual Performance Report
1 October 2014 – 31 December 2015

Troutdale Sandstone Aquifer Remedy

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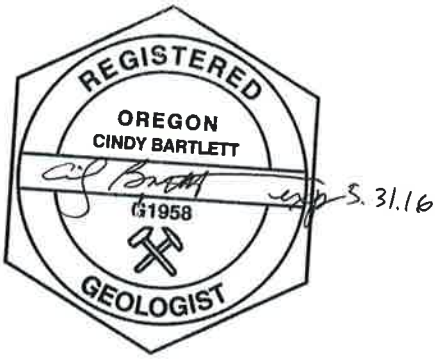

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1.0 INTRODUCTION

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, Troutdale Sandstone Aquifer (TSA) remedy. Data presented in this Annual Performance Report were collected during the period of 1 October 2014 through 31 December 2015 as part of the joint remedy being implemented under the Department of Environmental Quality's (DEQ's) Consent Order No. WMCSR-NWR-96-08 (DEQ, 1997).

1.1 Purpose of Report

The reporting period for the TSA remedy was modified from semi-annual to annual, and this Annual Performance Report presents data from the end of the last semi-annual reporting period, October 2014, through the calendar year 2015. This Annual Performance Report provides an evaluation of TSA remedy performance, including:

- A summary of the remediation system operation, maintenance, and performance monitoring data, and
- An assessment of aquifer restoration progress.

Data presented and evaluated in this report includes water level, extraction rate, discharge compliance, and water quality data. Laboratory reports for samples collected during this reporting period are contained on a compact disc provided with this report.

The project area and site are shown on Figure 1-1. The Lower TSA restoration zones (Zones A, B, C, and D), the TSA remedy network of extraction wells and monitoring wells, and the former and current TSA remedy extraction system layouts are shown on Figure 1-2.

In January 2014, the DEQ approved discontinuation of water-quality monitoring at Sand and Gravel Aquifer (SGA) monitoring wells BOP-44(usg), PWB-1(usg), and EMC-2(usg). The locations of these SGA wells are included on Figure 1-2. SGA groundwater elevation data will continue to be collected on a monthly basis for the SGA at one well, BOP-44(usg), as part of the Portland Water Bureau (PWB) contingency plan.

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 changes in sampling frequency are summarized in Table 2-1. The current groundwater monitoring schedule is summarized in Table 2-2, and 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 *Semiannual Performance Report: 1 April 2014 through 30 September 2014, Troutdale Sandstone Aquifer Remedy* (Geosyntec, Landau Associates, and SSPA, 2014), as well as other work plans for EW-16 Cycling/Pilot Shutdown (Geosyntec, 2014a), Soil Vapor Extraction (SVE) (Geosyntec, 2014c), and PWB Contingency Monitoring (Landau Associates, 2015a). These changes are described below and summarized in the monitoring schedule presented in Table 2-2.

- Two extraction wells, EW-4 and EW-18, and two monitoring wells, BOP-41(ds) and BOP-41(dg), were decommissioned in November and December 2015.

- Water quality monitoring ceased at monitoring wells BOP-70(ds-215) and BOP-71(ds), and the wells were selected for PWB contingency monitoring. These two wells were subsequently removed from the PWB monitoring program when the contingency monitoring plan was revised (discussed below).

2.2 Portland Water Bureau Well Field

The PWB Contingency Monitoring Plan was revised in July 2015 (Landau Associations, 2015a), and revisions included moving the contingency monitoring wells southward and closer to the leading edge of the dissolved volatile organic compound (VOC) plume. Both DEQ and PWB reviewed and approved the PWB contingency Monitoring Plan (DEQ 2015b, PWB 2015). Two SGA wells, PWB-1(usg) and EMC-2(usg), two Upper TSA wells, BOP-70(ds) and BOP-71(ds), and one Lower TSA well PWB-1(lts) were removed from the monitoring plan. As part of the revision, transducers were installed in three Lower TSA wells: BOP-23(dg), MW-36(dg), BOP-60(dg).

Current PWB monitoring is being conducted in a total of 11 wells, including 4 Upper TSA wells, BOP-20(ds), BOP-21(ds), BOP-22R(ds), and BOP-44(ds); 6 Lower TSA wells, BOP-20(dg), BOP-23(dg), BOP-44(dg), BOP-60(dg), EMC-2(dg), and MW-36(dg), and 1 SGA well, BOP-44(usg).

PWB operated its Columbia South Shore wellfield from 16 July through 4 November 2015, for 111 days, and pumped approximately 5.7 billion gallons. PWB reported the highest groundwater extraction rates were from operation of wells screened in the Blue Lake Aquifer and SGA, with a lesser amount of groundwater extraction from wells screened in the TSA.

Continuous water level monitoring was conducted at the 11 TSA remedy monitoring wells using pressure transducers. Water quality sampling was completed in October 2015, after the well field had been pumping over 90 days. This sampling event coincided with the November quarterly groundwater monitoring event. Water levels and VOC results are summarized in Appendices B and C, respectively. The PWB Contingency Monitoring Plan also requires water quality sampling approximately 30 days after shutdown of the wellfield; however, DEQ concurred (DEQ, 2015d) that the 90-day sampling event and collection of remedy-wide water levels fulfilled the intent of the plan for both the 30-day progress monitoring and the 30-day post pumping monitoring.

A decrease in the groundwater elevations in SGA wells was observed almost immediately in response to the PWB pumping (groundwater elevations for extraction wells are provided in Appendix A and for monitoring wells in Appendix B). A groundwater elevation decrease of approximately 10.5 ft was observed in Lower TSA wells located along the eastern portion of the site (e.g., EW-23) compared to approximately 20.75 ft decrease along the western portion [e.g., BOP-22(dg)]. Groundwater elevations within the Upper TSA decreased between 2 and 16 ft throughout the site during the PWB pumping event. Declines in water levels across the site were also exacerbated by regional drought conditions.

Groundwater VOC results from the 90-day contingency monitoring event indicate that VOCs do not extend beyond the TSA mound area nor did concentrations within the mound area markedly increase above levels normally detected as a result of the PWB pumping. Groundwater VOC results are provided in Appendix C. These results indicate that the revised PWB Contingency Monitoring well network was sufficient for monitoring wellfield pumping.

3.0 EXTRACTION AND TREATMENT SYSTEMS

This section summarizes the operation and performance of the groundwater extraction remedy. The Central Treatment System (CTS) is the only extraction and treatment system operating for the remedy. The CTS operates to remove VOC mass and maintain ongoing hydraulic plume control for the TSA. The location of the CTS compound and the currently operating five Lower TSA extraction wells are shown on Figure 1-2. Monitoring well construction details and location coordinates for monitoring and extraction wells are summarized in Table 3-1.

3.1 CTS Operational Summary

The CTS and Lower TSA extraction wells EW-1, EW-2, EW-14, and EW-23 operated nearly continuously during the fifteen-month reporting period. EW-16 only operated for one month (October 2014) as part of the pump cycling/pilot shutdown. Five unplanned temporary well shutdowns occurred during the reporting period, as well as routinely-scheduled shut downs for sonar cleaning, as follows:

- 30 September to 1 October 2014: Sonar cleaning of EW-2.
- 13 November to 14 December 2014: Programmable Logic Controller (PLC) system failure and data lost for one month (EW-1, EW-2, EW-14, and EW-23). Failure due to transformer failure (fire) on power line feed from main line.
- 17 January to 26 January 2015: PLC system failure due to power surges and data lost for 9 days (EW-1, EW-2, EW-14, and EW-23).
- 16 February to 23 February 2015: PLC system failure and data lost for one week (EW-1, EW-2, EW-14, and EW-23).
- 23 April 2015: Sonar cleaning of EW-1.
- 29 August to 31 August 2015: PLC system failure and data loss (EW-1, EW-2, EW-14, and EW-23). High winds caused PLC failure.
- 4 December to 10 December 2015: Sonar cleaning of EW-1 and EW-2. Pump reinstallation and restart delayed 5 days due to high winds.
- 10 December to 14 December 2015: PLC system failure and data lost (EW-1, EW-2, EW-14, and EW-23).

Pilot shutdown of EW-16 was approved by DEQ (DEQ, 2014b) and commenced in November 2014. Water quality evaluation and pump cycling was initiated on a quarterly basis at EW-16 in November 2014. TCE concentrations have remained below the 5 micrograms per liter (µg/L)

maximum contaminant limit (MCL) threshold for the November 2014 through November 2015 quarterly sampling events. As a result the pump has not been restarted after the initial shutdown. Quarterly sampling of EW-16 will continue through August 2016.

Upper TSA extraction well EW-3 and Lower TSA extraction well EW-13 remain in use as monitoring wells. Extraction well EW-12 remained in pilot shutdown mode (monitoring only) during the reporting period. Decommissioning of EW-4/MW-16dg and EW-18 occurred in November of 2015, as summarized in Section 3.3 of this report.

3.2 Groundwater Extraction Rates

Current operating extraction wells include: EW-1, EW-2, and EW-14, located in the mound area near the CTS; EW-16 located in the eastern treatment area; and EW-23 located on the Boeing property in the western treatment area. Extraction well construction data are presented in Table 3-1.

Daily flow data from each well is recorded by the automated PLC system. Data from the PLC is 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.

During the reporting period, average extraction rates decreased steadily in EW-1 from about 44 gallons per minute (gpm) in October 2014 to 30 gpm at the end of April 2015. Due to the declining flows, sonar cleaning was conducted in April 2015. Following the sonar cleaning, EW-1 flow increased to 67 gpm although again slowly decreased to 27 gpm by November 2015. As a result, sonar cleaning of EW-1 was conducted in December 2015.

EW-2 flows decreased from approximately 33 gpm at the beginning of October 2014 to approximately 19 gpm by the end of November 2015. As a result, EW-2 was sonar cleaned in December 2015, and the flow was up to approximately 35 gpm following the sonar cleaning.

EW-14 decreased from about 25 gpm at the start of October 2014 to 19 gpm in December 2015. EW-23 water levels declined during the summer-autumn 2015 and flows remained relatively constant between 25 to 30 gpm from October 2014 to December 2015.

Flow rates at EW-16 were inconsequential as the EW-16 system was only run for the month of October 2014 and the first week of November before being shutoff for pump cycling/pilot shutdown.

Flow rate and water level data for extraction wells are provided in Appendix A. Average monthly extraction well flow rates over the most recent 5-year period are shown on Figures A-1 through A-5. The total average monthly flows for each of the wells are shown on Figure A-6. Significant repair/cleaning events for the operating TSA extraction wells also are noted on

Figures A-1 through A-5. Total and average flow data for the 15-month reporting period also are summarized in Table A-1.

3.3 Well Decommissioning

Two extraction wells, EW-4/MW-16dg and EW-18, and two monitoring wells, BOP-41(ds) and BOP-41(dg), were decommissioned in November and early December 2015. The two former extraction wells (EW-4 and EW-18) were pilot shutdown in October 2003 and November 2009, respectively. The two extraction wells subsequently were removed from the monitoring program due to TCE concentrations being consistently below the MCL (5 µg/L). Monitoring wells BOP-41(ds,dg) were selected for decommissioning because the wells were located a substantial distance from the dissolved VOC plume and had been removed from the monitoring program.

The four wells were decommissioned by overdrilling in accordance to the DEQ-approved work plan (Landau Associates, 2015b; DEQ, 2015c). Well decommissioning activities were conducted by Oregon State licensed drillers and observed by representatives from Geosyntec [(EW-4/MW-16dg) and EW-18] and Landau Associates [BOP-41(ds,dg)]. Original boring logs and decommissioning logs are provided in Appendix D for the four wells.

Decontamination water and water removed from the wells during decommissioning was routed to the respective treatment systems at the Boeing and Cascade sites. IDW from the monitoring wells was combined with IDW from two Boeing Portland Troutdale Gravel Aquifer (TGA) well decommissioning activities. Composite disposal sample results will be utilized for disposal characterization through Boeing's IDW disposal process. IDW sample results for the two extraction wells are summarized in Table C-1 and solids and liquid/sludge IDW from these wells was collected in roll-off boxes and taken off-site by WasteExpress for permitted disposal at the Waste Management facility in Hillsboro, Oregon. Disposal receipts are provided in Appendix D.

3.4 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 on a quarterly basis. Permits to discharge treated groundwater effluent from the CTS are presented in Attachment C to TSA Remedy Consent Order No. WMCSR-NWR-96-08 (DEQ, 1997).

CTS data for the reporting period are as follows:

- The average flow during the 15-month period October 2014 through December 2015 was 127 gpm (Table A-1);
- Effluent pH ranged from 7.2 to 7.8 standard units (SU) and remained within the effluent limits of 6 to 9 SUs;

- Effluent temperature ranged from 52 to 65 degrees Fahrenheit (F); and
- VOCs were not detected in effluent samples.

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).

4.0 SOIL VAPOR EXTRACTION

An SVE Pilot Study conducted at the site in July 2014 determined that SVE is effective in removing VOCs from the TSA (Geosyntec, 2014b). A work plan for operation of a longer-term SVE system was developed (Geosyntec, 2014c). DEQ approved the work plan on 24 December 2014 (DEQ, 2014d). Operation of the SVE system was initiated in April 2015 to extract vapor from existing vapor monitoring wells VW-17d-42.4, -75, and -95.5. SVE data are provided in Appendix E.

4.1 SVE System Operation

The SVE system consists of a 15 horsepower TurboTron regenerative blower and a knock-out tank situated on a concrete pad within the chain-link fence that surrounds the CTS. The system is connected to the vapor wells by aboveground PVC piping. A PVC exhaust stack directly discharges to the atmosphere at a height of approximately 8 feet. In November 2015, a small structure was constructed over the blower and insulation placed around the piping to provide protection for the system through the winter.

The SVE system was started on 16 April 2015 and has been extracting soil vapor at an average rate of 163 standard cubic feet per minute (scfm) through November 2015, when the extraction flow rate was increased to approximately 226 scfm to enhance vapor extraction. The SVE system has operated almost continuously since the startup, with only brief shutdowns in late April 2015 to fix wellhead leaks and a power outage in November 2015. Operating conditions were initially based on the results of the pilot study. Soil vapor extraction data collected since the startup of the system, including flow rates, vapor concentrations (field and laboratory), and estimated mass extracted, are summarized in Appendix E, Tables E-1 and E-2 and in Figures E-1, E-2, and E-3.

4.2 SVE System Monitoring

Baseline VOC samples were collected from the three extraction wells and the SVE system outlet after the first week of operation. Routine SVE system monitoring consists of the following parameters and schedule:

- Weekly Sampling:
    - SVE system temperature, pressure, and flow;
    - Extraction well temperature, pressure, and flow; and
    - System outlet field vapor sampling for VOCs (photoionization detector [PID]).
- Monthly Sampling:
    - System outlet laboratory vapor sampling for VOCs (summa canister).

- Quarterly Sampling:
    - Extraction well laboratory sampling for VOCs (summa canisters).

Extracted vapor concentrations are measured at the effluent riser pipe using a PID and in evacuated 1.0-liter summa canisters for laboratory analysis. Summa canisters are submitted for analytical testing of VOCs by EPA Method TO-15. VOC results from PID measurements and laboratory testing are summarized in Tables E-1 and E-2 and Figure E-1.

4.3 SVE System Mass Removal

Approximately 15 pounds of VOCs have been removed through December 2015, based on laboratory data[1]. VOC mass removal from the SVE system in the next 4-months is estimated to be on the order of 4 to 6 pounds.

A breakdown of VOC mass removal from the three vapor wells is estimated to be approximately 5% from VW-17D-42.5, 26% from VW-17D-75, and 68% from VW-17D-95.5. The higher mass removal from the deepest well is likely indicative of a groundwater source; however, TCE mass could be from one or more potential sources:

- The vadose zone above the former groundwater table;
- The smear zone where dewatering occurred (originally contaminated by groundwater); and/or
- Volatilization from existing contaminated groundwater.

Monthly groundwater sampling at monitoring well MW-17ds, which is located adjacent to the vapor wells, was commenced in November 2015 to evaluate the potential effect of SVE mass removal on groundwater concentrations. MW-17ds is screened from elevation 24 to 14 feet MSL, at a depth just below the deepest vapor monitoring well (VW-17D-95.5 is screened from elevation 44.5 to 24.5 feet MSL). Groundwater elevations and TCE concentrations at MW-17ds are shown on Figure C-1.

Operation of the SVE system will continue through at least April 2016. In addition to the vapor monitoring, monthly groundwater monitoring of MW-17ds will be collected to evaluate possible effects of the SVE operation on shallow groundwater quality. Further evaluation of SVE mass removal will be discussed in future reports (i.e. 2016 Annual Report).

[1] VOCs mass removal rates are estimated using both the PID and laboratory data (Figure E-3). Due to low concentrations detected using the field PID meter (1-2 ppm), the laboratory data is a more reliable and a more accurate representation of mass removal with the SVE system.

5.0 REMEDY PERFORMANCE SUMMARY

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

5.1 Groundwater Elevations

Groundwater elevations are measured in the five operating Lower TSA extractions wells and seven Upper and Lower TSA monitoring wells during the quarterly (November and May) monitoring events, and 43 Upper and Lower TSA monitoring wells during the semi-annual (February) and annual (August) monitoring events. The monitoring schedule for measuring groundwater levels is included in Table 2-2. Additional groundwater elevations were collected in 2015 as part of PWB contingency plan monitoring (as discussed in Section 2.2).

Depth to groundwater is measured using a portable electric tape meter in the monitoring wells, along with pressure transducers located in 11 wells for PWB contingency plan monitoring (4 Upper TSA wells, 6 Lower TSA wells, and 1 SGA well). Water level data are downloaded monthly from the pressure transducers. Groundwater depths and groundwater elevations are summarized in Table B-1. Water level hydrographs for the 11 wells with pressure transducers, for the 15-month period from October 2014 through December 2015, are also included in Appendix B on Figures B-2 through B-9. Precipitation during the last 12 months (December 2014 – December 2015) was approximately 39.81 inches (Appendix B, Figure B-1; NOAA, 2015). Normal annual precipitation at the Portland airport is about 36.0 inches. During the last 15 months (October 2014 – December 2015), total precipitation was approximately 54.8 inches (NOAA, 2015). May through October 2015 were drier than previous years, which may have contributed to general decreases in Upper TSA water levels during this timeframe.

5.1.1 Upper TSA Water Levels and Flow Direction

Groundwater levels in the Upper TSA are shown on Figure 4-1a (February) and 4-2a (August). Groundwater flow in the northern portion of the site is toward the east in February, but to the west in August, indicating influence from PWB pumping.

5.1.2 Lower TSA Water Levels and Flow Direction

Groundwater levels in Lower TSA monitoring wells are shown on Figures 4-1b (February) and 4-2b (August) and indicate inward flow towards the extraction wells EW-1, EW-2, EW-14, and EW-23. Pumping at extraction well EW-16 was ceased in November 2014 as part of the pump cycling trial. Groundwater elevations are variable with higher water levels measured at CMW-14R(ds) and EW-15 (Figure 4-2b); the reason for the groundwater mound at EW-15 is unknown. Groundwater flow directions in the vicinity of the mound do not typically vary significantly from

wet to dry season in the Lower TSA and are strongly influenced by the operating extraction wells. Lower TSA groundwater flow outside of the influence of the remedy pumping is generally northward, although in August 2015 flows were westward due to PWB pumping.

5.2 Hydraulic Capture

Groundwater levels near the TSA mound area indicate that inward horizontal gradients towards the extraction wells continue due to ongoing remedy pumping. Groundwater elevation data are presented in Appendix B. Groundwater contours for the comprehensive semiannual water level measurement event (February 2015) and the annual event (August 2015) are provided in Figures 4-1a, 4-1b, 4-2a, and 4-2b. Inward hydraulic gradients toward the extraction wells are indicative of hydraulic capture and demonstrate the effectiveness of Lower TSA extraction wells EW-1, EW-2, and EW-14 in achieving and maintaining capture. Hydraulic capture is also achieved in the western portion of the site by the operation of EW-23. These extraction wells capture groundwater within areas of the site where TCE concentrations remain above the cleanup level.

5.3 Water Quality

Analytical results for groundwater samples collected during the reporting period are summarized in Appendix C, Table C-1. Plots of time versus TCE concentrations for monitoring wells in the mound area and the five operating extraction wells from the early 1990s through December 2015 are presented in Figures C-1 through C-9. TCE concentration contours for the semiannual event (February 2015) and the annual event (August 2015) are shown on Figures 5-1a, 5-1b, 5-2a, and 5-2b for the Upper and Lower TSA wells. TCE concentrations from the samples collected during the quarterly events are provided in Appendix C.

5.3.1 Upper TSA

TCE concentrations in the mound area persist near an area where the Cascade TGA plume historically discharged into the TSA. TCE concentrations during the monitoring period (October 2014 through December 2015 sampling events) ranged from 37.5 to 52 µg/L in water table well MW-17(ds) (Figure C-1), 54.3 to 79.2 µg/L at MW-18(ds) (Figure C-7), and 20 to 23 µg/L at MW-10(ds) (Figure C-6). Groundwater in the vicinity of these three wells is captured by nearby Lower TSA extraction wells EW-2 and EW-14.

In the Upper TSA near the western extent of the TSA mound area, TCE concentrations remain below the MCL of 5.0 µg/L. TCE concentrations at BOP-13(ds), located in the direct vicinity of the mound area, was 3.7 µg/L during this reporting period (Figure C-2). At locations further west and northwest of the TSA mound area, TCE concentrations range from non-detect at the laboratory reporting limit to 8.7 µg/L at BOP-61(ds), as shown on Figure 5-2a. South of the mound area at well MW-19(ds), TCE concentrations ranged from 1.1 to 6.66 µg/L.

In the northern portion of the site, Zone A, PWB contingency plan monitoring has been relocated to a well positioned closer to the Upper TSA mound area. VOC concentrations remain below detection limits in the Upper TSA monitoring wells since the mid-2000s.

5.3.2 Lower TSA

In Lower TSA Zone B, the western portion of the remediation area, TCE concentrations were below the MCL during this reporting period with the exception of monitoring well BOP-31(dg), where TCE concentrations ranged from 4.6 to 5.2 µg/L. TCE concentrations at BOP-31(dg) have remained near the 5.0 µg/L MCL for the last 5 years (Figure C-4). TCE concentrations at extraction well EW-23 decreased from 4.5 µg/L in February 2015 to 1.9 µg/L in August 2015.

In Lower TSA Zone C, the central portion of the remediation area, TCE concentrations were as follows during the October 2014 through November 2015 sampling events: below the MCL in extraction well EW-1 (ranging from 2.6 to 3.74 µg/L), and above the MCL at extraction wells EW-2 (between 10 and 12 µg/L, respectively) and EW-14 (between 6.5 and 8.01 µg/L, respectively).

In Lower TSA monitoring wells EW-8, EW-12, and EW-13, which are non-pumping extraction wells converted to monitoring use, TCE concentrations remained below the MCL during this reporting period. TCE concentrations were below the reporting limit at EW-8.

The highest TCE concentration in the Lower TSA Zone C continued to occur in mound area well D-17(ds). Well D-17(ds) is screened at the top of the Lower TSA across the water table. TCE concentrations ranged from 27 to 37.7 µg/L at D-17(ds) during this reporting period (Figure C-8).

In Lower TSA Zone D, the eastern portion of the remediation area, TCE concentrations remained below the MCL in monitoring wells MW-26(dg), where TCE concentrations ranged from 2.3 to 3.49 µg/L between the November 2014 and November 2015 sampling events.

Similar to the Upper TSA, the Lower TSA in Zone A in the northern portion of the site is monitored as part of the PWB contingency monitoring plan. Wells used for contingency measurement of water levels have been relocated to wells positioned closer to the Upper TSA mound area. VOC concentrations in these Lower TSA wells have remained below detection limits since the mid-2000s, with the exception of BOP-44(dg), where VOCs have been below laboratory reporting limits since 2013.

6.0 PERFORMANCE SUMMARY

Significant remedy performance findings are summarized below.

- Groundwater flow directions in the Upper and Lower TSA indicate ongoing inward and downward flow towards the operating extraction wells. The 15-month average flow rate from the four operating extraction wells (EW-16 was only running for one month) was 121 gpm. This rate is less than the average rate during the previous reporting period (134 gpm). Extraction rates at EW-1 declined below optimal levels 6 months after the previous sonar cleaning (April 2015); therefore, an additional sonar cleaning was completed in early December 2015. Flow rates at extraction well EW-2 increased substantially after the December 2015 sonar cleaning; however, previous trends suggest that the well will need additional sonar cleaning in approximately 6 months to one year. Flow rates at EW-14 increased substantially after well maintenance and cleaning activities in July 2013, and rates have declined since then but remain above the target pumping rate.

- Upper TSA groundwater quality: TCE concentrations continued to be above the MCL in the mound area wells MW-10ds (23 µg/L), MW-17ds (52 µg/L), and MW-18ds (77.5 µg/L) during the November 2015 event. TCE concentrations in wells located outside of the mound area are below the MCL, with the exception of wells BOP-61(ds) (8.7 µg/L) and MW-19(ds) (6.66 µg/L).

- Lower TSA groundwater quality: The highest TCE concentrations continue to be observed in the vicinity of the mound area (Zone C) near wells D-17(ds) (37.7 µg/L) and D-17(dg) (8.97 µg/L). In Zones B and D, TCE concentrations were below the MCL during the reporting period. TCE concentrations for Lower TSA extraction wells remained generally stable with the following maximum concentrations during this reporting period: EW-1 (3.74 µg/L), EW-2 (12 µg/L), EW-14 (8.01 µg/L), and EW-23 (4.5 µg/L).

- The dissolved VOC plume continues to be hydraulically captured by remedy operation (Figures 5-1(a, b) and 5-2 (a, b)).

- An SVE system has been operating since April 2015, and has removed an estimated 15 pounds of VOC mass from the unsaturated zone near the mound area. The system is anticipated to operate through at least April 2016 at which time an evaluation will be conducted to determine if additional operation time is warranted. Data evaluation is ongoing to determine the source of the VOCs being removed by the system, including monthly sampling of monitoring well MW-17ds located adjacent to the SVE system.

- During the 111-day pumping of the PWB Columbia South Shore well field (16 July through 4 November 2015), TSA hydraulic plume capture was maintained by the remedy

extraction system. Groundwater elevations declined in SGA and Lower TSA wells, and to a lesser extent in Upper TSA wells. Groundwater VOC results from the 90-day contingency monitoring event indicated that VOCs did not expand beyond the TSA mound area nor did concentrations substantially increase above levels normally detected.

6.1 Mass Removal

TCE annual mass removal estimates are based on influent TCE concentrations and groundwater flow for the operating extraction wells, and assume that the TCE is completely removed during groundwater treatment. During 2015, approximately 2.98 pounds (lbs) of TCE mass were removed through remedy extraction, reflecting a slight decline from the 3.36 lbs estimated to have been removed during the prior year (2014). An estimated total of 487 lbs of TCE have been removed from the TSA and SGA since 1996. TCE annual mass removal estimates for the TSA remedy are summarized in Appendix G, Table G-1 and Figure G-1, and TCE mass removal estimates for each extraction well are summarized in Appendix G, Table G-2 and Figure G-2.

6.2 Restoration Progress

Approximately three pounds of VOC mass was removed from the extraction system during 2015. Performance data indicates that the existing pump and treat remedy has been effective in areas of the remedy; however, progress toward restoration in the mound area (Zone C) has been slow and restoration will not be achieved by 2018, which will be the 20th year of remedy operation. A design criterion for the remedy was a 20-year restoration time frame. The Record of Decision states that if restoration is not achieved within this time frame, that groundwater pump and treat would continue until restoration is complete. It is anticipated that operation of the pump and treat system will continue beyond 2018 until restoration is complete.

6.3 Closure by Restoration Zone

The following summarizes the status of closure by restoration zone:

- Restoration has been achieved in Zone A for the Upper TSA, Lower TSA, and the SGA. Currently 6 Upper TSA wells [BOP-44(ds), BOP-70(ds), BOP-71(ds), D-16(ds), D-18(ds), and PWB-1(uts)], 3 Lower TSA wells [BOP-44(dg), MW-36(dg), and PWB-1(lts)], and 1 SGA well [BOP-44(usg)] are monitored as part of either the remedy monitoring program or the PWB contingency monitoring plan. Groundwater quality data continues to indicate that TCE concentrations in Zone A are below the MCL. Monitoring and groundwater elevation data are being collected for the SGA at well BOP-44(usg) as part of the PWB contingency monitoring plan. Wells used for monitoring water levels and VOCs as part of the PWB contingency monitoring plan were relocated to wells positioned closer to the leading edge of the dissolved VOC plume.

- Restoration in Zone B is complete except for a small area near wells EW-23, BOP-31(dg) and BOP-61(ds).

- Restoration in Zone C continues, as this area of the site contains the highest TCE concentrations. TCE concentrations in the mound area continue to decrease; however, this area of the remediation area has been slower to respond to remediation actions. The Record of Decision states that if restoration is not achieved within this time frame, that groundwater pump and treat would continue until restoration is complete.

- Restoration in Zone D is almost complete as current TCE concentrations are below the MCL. Continued monitoring for stabilization of conditions shall be conducted for the near future.

7.0 RECOMMENDATIONS AND FUTURE PLANNED ACTIVITIES

Water-quality restoration has been achieved in the SGA, in the Upper and Lower TSA north of Sandy Boulevard (Zone A), and in the western portion of the remedy area in the Upper and Lower TSA (Zone B), with a minor exception near the Zone C boundary. Restoration progress in the eastern portions (Zone D) of the remedy area continues with groundwater concentrations near the MCL. An SVE system was operated during the last nine months of last years, and is planned to be operated at least until April 2016, to expedite restoration progress. The following recommendations are proposed to improve the monitoring programs and optimize the remedy treatment and performance.

7.1 Extraction Well Operation

Continued pumping of operating extraction wells EW-1, EW-2, EW-14, and EW-23 is recommended to maintain hydraulic capture, with continued pumping at the current rates. Increased sonar cleaning (i.e. twice per year) may be necessary at extraction wells EW-1 and EW-2 to optimize water flow through this portion of the site. In addition, cycled pump operations (pilot shutdown) at EW-16 continues through 2016. Continued maintenance and scheduled cleaning of the wells will be conducted as needed to meet target extraction pump rates.

- Extraction well EW-1 has a target pumping rate of 50 gpm, with the last sonar well cleaning occurring in December 2015. Additional sonar cleaning occurred in April of 2015, following the April sonar cleaning the extraction rate declined and remained below the target pump rate from July 2015 through November 2015. Sonar cleaning of EW-1 is tentatively scheduled for early summer 2016. The monthly average extraction rates ranged from 27 gpm in November 2015 to 67 gpm in May 2015.

- Extraction well EW-2 has a target pumping rate of 25 gpm or greater. Over the last 12 months, the pumping rate has gradually decreased from 34 to 18 gpm. The last sonar cleaning at EW-2 was in December 2015 and the flow rate increased to 35 gpm. Based on this observed extraction rate trend, we anticipate a sonar cleaning event will likely be necessary in the next year.

- At EW-14, the extraction rate over the last 12 months has ranged from 21 to 25 gpm, which is greater than the target pumping rate of 20 gpm. The last sonar cleaning at EW-14 was conducted in June 2013, and while flow rates increased immediately following cleaning, the rate has declined steadily. A sonar cleaning event will likely be necessary in the next year.

- Extraction well EW-16 was primarily off for the reporting cycle since TCE concentrations remain below detection limits. When operating, the target pumping rate at

EW-16 is 15 gpm, and average flow rates were 24 gpm, above the target rate in October 2014.

- Pumping rates at EW-23 ranged from 23 to 33 gpm during the last 15 months, with an average of 30 gpm. The target flow rate for EW-23 is 30 gpm.

7.2 SVE system

The current SVE system has extracted 15 pounds of VOCs between system startup in April 2015 and 31 December 2015. The SVE system will continue to operate through April 2016 to allow for a 1 year operating cycle to evaluate data and develop recommendations. Vapor and groundwater data are being evaluated, and the system may be operated for an additional time period or potentially expanded to remove more mass.

7.3 Monitoring Program and Schedule Modifications

Monitoring program modifications are recommended for wells in Zone A, which align with revisions to the PWB contingency monitoring plan. These wells have met the criteria for well decommissioning (Table 2-1) and are no longer needed for PWB contingency monitoring. We recommend the following:

- Decommission monitoring wells Upper TSA BOP-70(ds) and BOP-71(ds) and SGA wells PWB-1(usg) and EMC-2(usg). The wells are located north of Sandy Boulevard and have previously been removed from the groundwater monitoring program. The two Upper TSA wells [BOP-70(ds) and BOP-71(ds)] were removed from the monitoring program because the wells are considered redundant with other wells located downgradient and closer to the leading edge of the dissolved VOC plume. The two SGA wells [PWB-1(usg) and EMC-2(usg)] were removed from the monitoring program in August 2013 due to TCE concentrations consistently being below the laboratory reporting limits. These four wells will either be decommissioned, or if possible, transferred to the City for their use.

- Discontinue monitoring at Upper TSA wells D-16(ds) and D-18(ds). TCE concentrations at these two downgradient wells have consistently been below or near the laboratory reporting limit since the wells were included in the groundwater monitoring program [1992 for D-16(ds) and 1995 for D-18(ds)].

- Reduce water level measurement at PWB-1(lts) from semiannual to annual and water quality sampling from annual to biennial.

- Reduce water level monitoring at wells BOP-44(ds) and BOP-44(dg) from semiannual to annual, and reduce water quality sampling at BOP-44(ds) from annual to biennial.

- Decommission well BOP-22(dg). The well is located within close proximity to the Boeing site to provide groundwater quality for the Lower TSA along the western portion of the remedy area. TCE concentrations in BOP-22(dg) has consistently been below the laboratory reporting limit since 1991.

- Reduce water quality monitoring at Upper TSA wells BOP-65(ds) and EW-3 from semiannual to annual. VOCs have been below the MCLs since 2011 at BOP-65(ds) and since 2007 for EW-3. Water level measurement frequencies will not change and will be collected semiannually.

- Cease water quality monitoring at Lower TSA well PMX-196. VOCs have not been detected in this well since 1996, and the well is no longer needed for collection of water levels or PWB monitoring, since other wells located closer to the extraction wells serve the same purpose. PMX-196 is a private well.

- Reduce water quality monitoring at EW-11, EW-15, and BOP-60R(ds) from annual to biennial. VOCs have been below the MCLs at EW-11 since 2009 and at BOP-60R(ds) since 2011. VOCs have not been detected at EW-15 since 2010. Water levels will be measured annually.

- Reduce water level monitoring and water quality sampling at MW-36(dg) from semiannual to biennial. VOCs have been below reporting limits at MW-36(dg) since 2002. MW-36(dg) is part of the PWB contingency monitoring plan.

- Reduce water quality monitoring at Lower TSA well EW-13 from semiannual to annual. VOCs have been below the MCL since 2010. Water level measurement will not change and will be collected semiannually.

8.0 REFERENCES

Geosyntec Consultants, 2014a. TSA Remedy: EW-16 Cycle Operation Proposal, 30 October 2014.

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Oregon Department of Environmental Quality (DEQ), 1997. TSA Remedy Order on Consent, WMCSR-NWR-96-08, 14 February 1997.

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Oregon Department of Environmental Quality (DEQ), 2015b. Email from B. Williams, 2015 Monitoring and Contingency Plan for PWB Pumping Events. 10 August 2015.

Oregon Department of Environmental Quality (DEQ), 2015c. Email from B. Williams, RE: TSA Well Decommissioning Work Plan. 7 October 2015.

Oregon Department of Environmental Quality (DEQ), 2015d. Phone conversation, B. Williams, C. Kimmel from Landau Associates. RE: Elimination of end of PWB pumping water quality monitoring. 18 November 2015.

Portland Water Bureau (PWB), 2015. Email from D. Wise, 2015 Monitoring and Contingency Plan for PWB Pumping Events. 12 August 2015.

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 during the confirmation sampling round that will be performed 2 years after a well has been removed from the remedy monitoring schedule; if TCE is detected at or above the MCL during the confirmation sampling round, additional monitoring may be required.*

[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 October 2014 through 31 December 2015
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 (on)	Lower TSA	Monthly	Quarterly	Cascade
EW-2 (on)	Lower TSA	Monthly	Quarterly	Cascade
EW-14 (on)	Lower TSA	Monthly	Quarterly	Cascade
EW-16 (pilot shutdown)	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	Semiannually	Annually	Boeing
BOP-20(ds)	Upper TSA	Semiannually PWB Monitoring	Annually PWB Monitoring	Boeing
BOP-20(dg)	Lower TSA	Semiannually PWB Monitoring	Annually PWB Monitoring	Boeing
BOP-21(ds)	Upper TSA	Semiannually PWB Monitoring	Annually PWB Monitoring	Boeing
BOP-22R(ds)	Upper TSA	Annually PWB Monitoring	Annually PWB Monitoring	Boeing
BOP-22(dg)	Lower TSA	Decommission	Decommission	Boeing
BOP-23(dg)	Lower TSA	Semiannually PWB Monitoring	Annually PWB Monitoring	Boeing
BOP-31(ds)	Upper TSA	Quarterly	Quarterly	Boeing
BOP-31(dg)	Lower TSA	Semiannually	Semiannually	Boeing
BOP-42(ds)	Upper TSA	Semiannually	Annually	Boeing
BOP-42(dg)	Lower TSA	Semiannually	Annually	Boeing
BOP-44(ds)	Upper TSA	Annually PWB Monitoring	Once per 2 Yrs	Cascade
BOP-44(dg)	Lower TSA	Annually PWB Monitoring	Once per 2 Yrs	Cascade
BOP-60R(ds)	Upper TSA	Annually	Once per 2 Yrs	Boeing
BOP-60(dg)	Lower TSA	Semiannually PWB Monitoring	Annually PWB Monitoring	Boeing
BOP-61(ds)	Upper TSA	Semiannually	Semiannually	Boeing
BOP-61(dg)	Lower TSA	Semiannually	Semiannually	Boeing
BOP-62(ds)	Upper TSA	Semiannually	Annually	Boeing
BOP-65(ds)	Upper TSA	Semiannually	Annually	Boeing
BOP-66(ds)	Upper TSA	Semiannually	Semiannually	Boeing
BOP-70(ds-215)	Upper TSA	Decommission	Decommission	Cascade
BOP-71(ds)	Upper TSA	Decommission	Decommission	Cascade
D-16(ds)	Upper TSA	Discontinue	Discontinue	Cascade
D-17(ds)	Lower TSA	Quarterly	Quarterly	Cascade
D-17(dg)	Lower TSA	Semiannually	Semiannually	Cascade
D-18(ds)	Upper TSA	Discontinue	Discontinue	Cascade
DEQ-1(dg)	Lower TSA	Semiannually	–	Cascade

Table 2-2
Performance Monitoring Schedule - 1 October 2014 through 31 December 2015
TSA Remedy - East Multnomah County

Well	Aquifer	Water Level Measurements	Water Quality Sampling	Responsibility
DEQ-5(ds)	Upper TSA	Semiannually	—	Cascade
DEQ-5(dg)	Lower TSA	Semiannually	—	Cascade
EMC-2(dg)	Lower TSA	PWB Monitoring	—	Cascade
EW-3 (monitoring only)	Upper TSA	Semiannually	Annually	Boeing
EW-8 (monitoring only)	Lower TSA	Semiannually	Semiannually	Cascade
EW-11 (monitoring only)	Lower TSA	Annually	Once per 2 Yrs	Cascade
EW-12 (monitoring only)	Lower TSA	Semiannually	Quarterly	Cascade
EW-13 (monitoring only)	Lower TSA	Semiannually	Annually	Boeing
EW-15 (monitoring only)	Lower TSA	Annually	Once per 2 Yrs	Cascade
MW-3	TSA	Semiannually	—	Cascade
MW-8(dg)	Lower TSA	Semiannually	Once per 2 Yrs	Cascade
MW-10(ds)	Upper TSA	Quarterly	Quarterly	Cascade
MW-10(dg)	Lower TSA	Semiannually	Annually	Cascade
MW-14R(ds)	Lower TSA	Semiannually	Quarterly	Cascade
MW-17(ds)	Upper TSA	Quarterly	Quarterly	Cascade
MW-18(ds)	Upper TSA	Quarterly	Quarterly	Cascade
MW-19(ds)	Upper TSA	Quarterly	Quarterly	Cascade
MW-20(ds)	Upper TSA	Semiannually	Annually	Cascade
MW-22(dg)	Lower TSA	Semiannually	Once per 2 Yrs	Cascade
MW-24(dg)/EW-5	Lower TSA	Semiannually	Semiannually	Cascade
MW-25(dg)	Lower TSA	Semiannually	Semiannually	Cascade
MW-26(dg)	Lower TSA	Semiannually	Quarterly	Cascade
MW-36(dg)	Lower TSA	PWB Monitoring	PWB Monitoring	Cascade
PMX-167 [W. Interlachen]	Upper TSA	Semiannually	—	Cascade
PMX-196 [Andrews]	Lower TSA	Discontinue	Discontinue	Cascade
PMX-208(dg) [Simpson]	Lower TSA	Semiannually	—	Cascade
PWB-1(uts)	Upper TSA	Semiannually	Once per 2 Yrs	Cascade
PWB-1(lts)	Lower TSA	Annually	Once per 2 Yrs	Cascade
PWB-2(lts)	Lower TSA	Semiannually	—	Cascade
RPW-1(ds)	Upper TSA	Semiannually	—	Cascade
SGA Monitoring Wells				
BOP-44(usg)	Upper SGA	PWB Monitoring	--	Cascade
EMC-2(usg)	Upper SGA	Decommission	Decommission	Cascade
PWB-1(usg)	SGA	Decommission	Decommission	Cascade

NOTES:

[a]Annual monitoring performed in August; semiannual in February and August; quarterly in February, May, August, and November. Two-year monitoring was performed in August 2015 and is scheduled August 2017.

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

Table 2-3
Significant Remedy Documents – 1 October 2014 through 31 December 2015
TSA Remedy – East Multnomah County

Date	Document Type	Author	Title	Comments
10/30/14	Technical Memorandum	Geosyntec Consultants	TSA Remedy: EW-16 Cycle Operation Proposal	Proposal to cycle EW-16 off/on based on November 2014 quarterly monitoring results, with quarterly re-evaluation.
10/30/14	Technical Memorandum	Geosyntec Consultants	TSA Soil Vapor Extraction Pilot Test Results	Presents results of SVE pilot study conducted at existing wells.
11/03/14	Email	DEQ	Email RE: Cascade TSA Remedy, EW-16 Letter	Approval of EW-16 Cycle Operation Proposal.
11/06/14	Email	DEQ	Email RE: TSA Semi-Annual Performance Report for Spring 2014.	Approval of Spring TSA Semi-Annual Report.

Table 2-3
Significant Remedy Documents – 1 October 2014 through 31 December 2015
TSA Remedy – East Multnomah County

Date	Document Type	Author	Title	Comments
11/25/14	Report	Geosyntec Consultants, Landau Associates, and SSPA	TSA Fall Semi-Annual Performance Report	2014 Semi-Annual Performance Report, 1 April 2014 - 30 September 2014. Recommendations included: • Decommission wells BOP-41(ds) and BOP-41(dg). • Cease water quality monitoring at BOP-70(ds-215) and BOP-71(ds) (keep for PWB contingency monitoring). • Change from semiannual reporting to a single annual report.
12/03/14	Work Plan	Geosyntec Consultants	Cascade TSA SVE Work Plan and SVE Pilot Study Tech Memo	Work Plan for SVE operation and report of SVE Pilot Testing at existing vapor and monitoring wells to evaluate VOCs in Upper TSA.
12/24/14	Email	DEQ	Email RE: Cascade TSA SVE Work Plan and SVE Pilot Study Tech Memo (12/03/14)	DEQ approval of TSA SVE Work Plan.
01/21/15	Email	DEQ	Email RE: TSA Fall Semi-Annual Performance Report (11/26/14)	DEQ approval of December 2014 Semi-Annual Performance Report, 1 April 2014 - 30 September 2014.

Table 2-3
Significant Remedy Documents – 1 October 2014 through 31 December 2015
TSA Remedy – East Multnomah County

Date	Document Type	Author	Title	Comments
03/25/15	Email	DEQ	Email RE: Cascade SVE Modeling Inputs	DEQ recommendations for SVE air discharge monitoring (to be based on observed/measured significant changes).
7/21/15	Technical Memorandum-Work Plan	Landau Associates	2015 Monitoring and Contingency Plan for PWB Pumping Events	Work Plan for revision to the PWB Contingency Monitoring. The plan moves the monitoring threshold inward. SGA wells PWB-1(usg) and EMC-2(usg), upper TSA wells BOP-70(ds) and BOP-71(ds), and lower TSA well PWB-1(lts) were removed from the monitoring plan. Transducers moved to 3 Lower TSA wells: BOP-23(dg), MW-36(dg), BOP-60(dg). PWB monitoring is being conducted in a total of 4 Upper TSA wells, BOP-20(ds), BOP-21(ds), BOP-22R(ds), and BOP-44(ds); 6 Lower TSA wells, BOP-20(dg), BOP-23(dg), BOP-44(dg), BOP-60(dg), EMC-2(dg), and MW-36(dg), and 1 SGA well, BOP-44(usg).
7/27/15	Technical Memorandum	Geosyntec Consultants	Results of CU1 Subsurface Exploration Memorandum	Presents results of CU1 drilling and sampling completed in June 2014.

Table 2-3
Significant Remedy Documents – 1 October 2014 through 31 December 2015
TSA Remedy – East Multnomah County

Date	Document Type	Author	Title	Comments
08/10/15 08/12/15	Emails	DEQ PWB	Emails RE: 2015 Monitoring and Contingency Plan for PWB Pumping Events (7/21/15)	DEQ and PWB approval of revised PWB Contingency Monitoring Plan.
8/26/15	Email	DEQ	Email RE: Results of CU1 Subsurface Exploration Memorandum	DEQ approval/agreement with conclusions, CU1 drilling and sampling.
9/18/15	Technical Memorandum-Work Plan	Landau Associates	TSA Well Decommissioning Work Plan	Work plan for decommissioning two TSA groundwater monitoring wells BOP-41(ds,dg), and two former extractions wells EW-4/MW-16 and EW-18.
10/07/15	Email	DEQ	Email RE: TSA Well Decommissioning Work Plan (9/18/15)	DEQ approval of TSA well decommissioning work plan.

Table 3-1
Well Construction Data - 1 October 2014 through 31 December 2015
TSA Remedy - East Multnomah County

				Elevations, ft MSL				
Well	**Aquifer Screened**	**X Coordinate**	**Y Coordinate**	**Ground Surface**	**Measuring Point**	**Top of Screen**	**Bottom of Screen**	**Depth of Boring (ft)**
Extraction Wells								
EW-1	Lower TSA	1,497,771.2	689,549.0	124.1	124.04	-27.8	-57.8	183
EW-2	Lower TSA	1,498,903.1	689,252.5	126.2	126.01	-6.8	-46.8	179
EW-14	Lower TSA	1,498,163.8	689,374.1	128.4	127.63	-21.9	-51.9	230
EW-16	Lower TSA	1,500,635.3	689,710.0	84.2	83.71	-40.3	-80.3	198
EW-23	Lower TSA	1,497,018.0	690,569.1	83.8	83.93	-26.2	-66.2	157
Monitoring Wells & Former Extraction Wells Approved for Monitoring Use								
BOP-13(ds)	Upper TSA	1,497,672.4	689,432.8	126.7	128.94	9.0	-1.0	132
BOP-13(dg)	Lower TSA	1,497,677.0	689,419.8	127.5	128.71	-41.0	-61.0	193
BOP-20(ds)	Upper TSA	1,496,606.5	691,086.0	78.2	77.45	9.0	-11.0	97
BOP-20(dg)	Lower TSA	1,496,592.5	691,087.0	78.1	77.32	-105.0	-125.0	209
BOP-21(ds)	Upper TSA	1,495,803.0	691,149.4	77.1	78.02	-88.0	-108.0	192
BOP-22R(ds)	Upper TSA	1,495,261.6	691,063.9	84.2	82.91	-158.8	-178.8	310
BOP-22(dg)	Lower TSA	1,495,260.1	691,137.8	81.3	81.05	-239.0	-259.0	338
BOP-23(dg)	Lower TSA	1,497,737.8	690,876.6	75.2	76.96	-26.0	-46.0	125
BOP-31(ds)	Upper TSA	1,497,533.3	690,135.0	97.1	99.04	17.0	7.0	91
BOP-31(dg)	Lower TSA	1,497,534.8	690,149.5	96.5	98.51	-34.0	-54.0	154
BOP-41(ds)	Upper TSA	1,495,162.9	689,871.4	135.7	136.74	-107.0	-127.0	262
BOP-41(dg)	Lower TSA	1,495,164.9	689,889.2	135.2	136.45	-230.0	-250.0	388
BOP-42(ds)	Upper TSA	1,496,462.1	689,632.7	129.3	130.74	-8.0	-28.0	159
BOP-42(dg)	Lower TSA	1,496,447.9	689,633.3	129.5	130.71	-92.0	-112.0	243
BOP-44(ds)	Upper TSA	1,497,206.5	691,983.0	32.5	35.24	-23.0	-43.0	76
BOP-44(dg)	Lower TSA	1,497,225.2	691,983.0	32.6	35.15	-104.0	-124.0	166
BOP-60R(ds)	Upper TSA	1,495,937.7	690,547.9	83.2	82.80	-71.8	-81.8	165
BOP-60(dg)	Lower TSA	1,495,915.9	690,414.3	93.8	93.59	-165.0	-185.0	280
BOP-61(ds)	Upper TSA	1,496,851.9	690,285.1	96.3	94.64	6.0	-4.0	100
BOP-61(dg)	Lower TSA	1,496,843.6	690,290.5	96.2	94.43	-60.0	-70.0	171
BOP-62(ds)	Upper TSA	1,496,066.6	690,031.6	112.1	112.29	-42.0	-51.9	166
BOP-65(ds)	Upper TSA	1,496,445.1	690,159.4	104.4	104.22	2.0	-8.0	113
BOP-66(ds)	Upper TSA	1,496,881.8	690,155.8	103.3	102.97	13.0	3.0	102
BOP-70(ds-215)	Upper TSA	1,495,082.9	691,532.8	65.5	65.15	-144.6	-154.6	285
BOP-71(ds)	Upper TSA	1,494,310.3	691,381.3	85.6	87.88	-185.0	-205.0	308
D-16(ds)	Upper TSA	1,497,497.5	693,117.3	15.4	16.91	-114.0	-134.0	152

Table 3-1
Well Construction Data - 1 October 2014 through 31 December 2015
TSA Remedy - East Multnomah County

				Elevations, ft MSL				
Well	**Aquifer Screened**	**X Coordinate**	**Y Coordinate**	**Ground Surface**	**Measuring Point**	**Top of Screen**	**Bottom of Screen**	**Depth of Boring (ft)**
D-16(dg)	Lower TSA	1,497,511.9	693,134.8	15.1	16.84	-206.0	-226.0	247
D-17(ds)	Lower TSA	1,498,097.3	689,575.1	121.9	123.28	12.0	2.0	121
D-17(dg)	Lower TSA	1,498,080.6	689,576.6	121.8	124.61	-30.0	-50.0	178
D-18(ds)	Upper TSA	1,495,386.1	692,820.3	18.1	18.01	-153.0	-163.0	179
D-18(dg)	Lower TSA	1,495,375.5	692,825.6	18.3	18.13	-237.0	-257.0	301
DEQ-1(dg)	Lower TSA	1,500,184.6	688,240.0	151.0	150.58	-53.0	-73.0	235
DEQ-5(ds)	Upper TSA	1,496,861.6	688,831.7	155.9	155.68	19.9	0.0	160
DEQ-5(dg)	Lower TSA	1,496,871.4	688,830.8	155.9	155.95	-58.0	-78.0	240
EW-3	Upper TSA	1,495,948.5	690,357.7	97.1	94.26	-77.9	-102.9	205
EW-8	Lower TSA	1,497,733.0	690,480.3	77.3	77.16	6.8	-33.2	163
EW-11	Lower TSA	1,500,302.8	689,236.9	115.4	114.73	-22.8	-62.8	235
EW-12	Lower TSA	1,497,744.0	690,037.2	94.4	94.14	-16.1	-46.1	197
EW-13	Lower TSA	1,496,697.5	690,134.4	104.5	103.59	-33.5	-73.5	234
EW-15	Lower TSA	1,499,970.7	689,249.7	116.7	116.21	-27.3	-57.3	186
EW-18	Lower TSA	1,498,965.7	689,596.5	106.3	104.50	-13.3	-43.3	159
EMC-2(dg)	Lower TSA	1,499,225.7	692,052.5	44.8	43.51	-75.0	-85.0	140
MW-3	Upper & Lower TSA	1,498,553.4	688,459.8	148.1	147.69	25.0	-53.0	209
MW-8(dg)	Lower TSA	1,498,286.8	689,072.7	137.0	136.21	-41.0	-56.0	199
MW-10(ds)	Upper TSA	1,498,811.1	688,966.5	135.2	134.54	21.0	6.0	135
MW-10(dg)	Lower TSA	1,498,800.6	688,968.3	135.3	135.05	-53.0	-68.0	210
MW-14R(ds)	Lower TSA	1,499,064.0	689,911.0	83.9	83.48	29.0	9.0	76
MW-17(ds)	Upper TSA	1,498,758.3	689,471.1	120.0	121.89	24.0	14.0	110
MW-18(ds)	Upper TSA	1,499,100.4	689,311.7	118.2	117.66	16.0	6.0	118
MW-19(ds)	Upper TSA	1,498,508.3	688,687.2	144.3	144.08	10.0	0.0	170
MW-20(ds)	Upper TSA	1,497,894.7	689,034.5	150.5	152.72	6.0	-4.0	158
MW-22(dg)	Lower TSA	1,499,756.6	689,895.1	82.1	81.65	-42.0	-52.0	142
MW-24(dg)/EW-5	Lower TSA	1,498,403.9	689,963.3	80.5	77.74	8.0	-42.1	127
MW-25(dg)	Lower TSA	1,498,008.4	690,067.2	75.7	75.28	-34.0	-44.0	131
MW-26(dg)	Lower TSA	1,501,401.0	689,348.0	106.3	108.98	-59.0	-69.0	238
MW-36(dg)	Lower TSA	1,499,600.9	690,836.8	79.1	78.84	-31.0	-41.0	162
PMX-167 [W. Interlachen]	Upper TSA	1,499,941.3	693,617.5	45.0	44.84	--- Not Available ---		50
PMX-196 [Andrews]	Lower TSA	1,500,927.4	689,964.2	88.3	89.27	18.0	-2.0	110
PMX-208(dg) [Simpson]	Lower TSA	1,499,450.8	690,374.5	80.2	81.14	-15.0	-35.0	115
PWB-1(uts)	Upper TSA	1,498,555.2	692,656.5	13.9	15.98	-51.0	-71.0	86

Table 3-1
Well Construction Data - 1 October 2014 through 31 December 2015
TSA Remedy - East Multnomah County

				Elevations, ft MSL				
Well	**Aquifer Screened**	**X Coordinate**	**Y Coordinate**	**Ground Surface**	**Measuring Point**	**Top of Screen**	**Bottom of Screen**	**Depth of Boring (ft)**
PWB-1(lts)	Lower TSA	1,498,563.4	692,649.2	14.0	16.48	-98.0	-118.0	134
PWB-2(lts)	Lower TSA	1,499,982.2	693,633.6	45.1	44.32	-20.0	-40.0	90
RPW-1(ds)	Upper TSA	1,498,538.9	693,219.5	10.9	15.90	-63.0	-103.0	119
VW-17d-42.5	Lower CU1 - Vapor	1,498,765.3	689,451.6	120.0	-------	*82.5*	*77.5*	45
VW-17d-75.0	Upper TSA - Vapor	1,498,757.5	689,453.0	120.0	-------	*65.0*	*45.0*	95
VW-75d-95.5	Upper TSA - Vapor	1,498,748.0	689,454.8	120.0	-------	*44.5*	*24.5*	130
BOP-44(usg)	SGA	1,497,207.4	691,933.2	24.6	34.25	-181.0	-191.0	219
EMC-2(usg)	SGA	1,499,258.5	691,965.1	52.9	47.15	-104.0	-114.0	175
PWB-1(usg)	SGA	1,498,550.0	692,646.6	13.7	16.59	-149.0	-169.0	183

NOTES:

1. BOP-44(usg) and EMC-2(dg) are monitored solely for PWB pumping events and are not included in the baseline remedy monitoring program.
2. EW-3 was approved for conversion from pilot shutdown status to monitoring well status, per DEQ's approval in an April 15, 2013 email.
3. EW-16 pilot shutdown (quarterly cycling) began in November 2014; approved by DEQ 11/2/14.
4. Monitoring wells indicated in red text are recommended for sampling frequency modifications (Table 2-2).

FIGURES

Project Location
TSA Remedy

East Multnomah County

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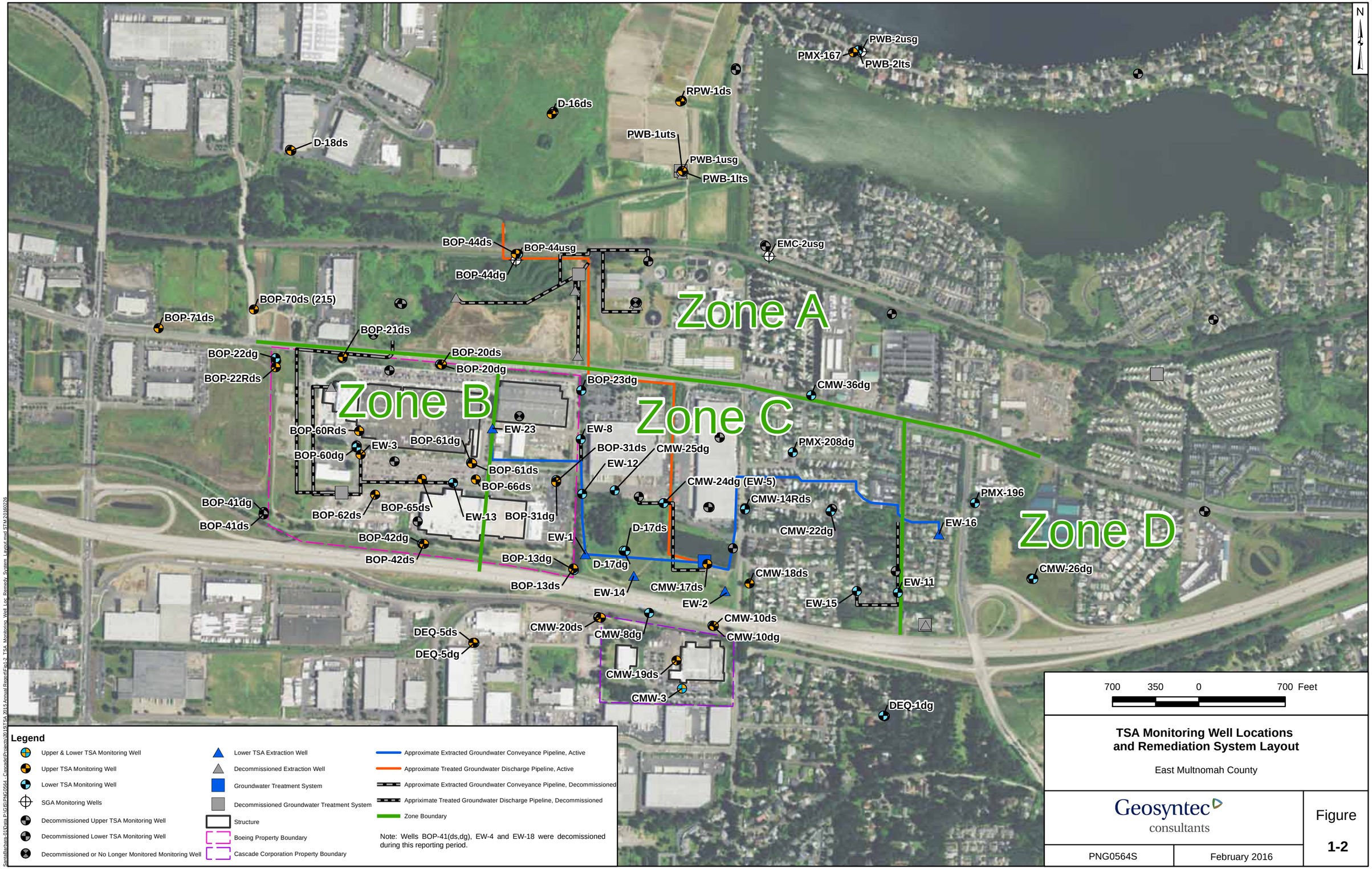
PNG0564S | February 2016

Figure **1-1**

S:\antaBarbara-01\Data P:\GIS\PNG\0564 - Cascade\Projects\2015\TSA 2015-02 Semi Annual Report\Fig1-1 Project Location.mxd STM 20160226



Legend

- Upper & Lower TSA Monitoring Well
- Upper TSA Monitoring Well
- Lower TSA Monitoring Well
- SGA Monitoring Wells
- Decommissioned Upper TSA Monitoring Well
- Decommissioned Lower TSA Monitoring Well
- Decommissioned or No Longer Monitored Monitoring Well
- Lower TSA Extraction Well
- Decommissioned Extraction Well
- Groundwater Treatment System
- Decommissioned Groundwater Treatment System
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary
- Approximate Extracted Groundwater Conveyance Pipeline, Active
- Approximate Treated Groundwater Discharge Pipeline, Active
- Approximate Extracted Groundwater Conveyance Pipeline, Decommissioned
- Appriximate Treated Groundwater Discharge Pipeline, Decommissioned
- Zone Boundary

Note: Wells BOP-41(ds,dg), EW-4 and EW-18 were decomissioned during this reporting period.

700 350 0 700 Feet

TSA Monitoring Well Locations and Remediation System Layout

East Multnomah County

Geosyntec consultants

PNG0564S	February 2016	Figure 1-2

PMX-167
38.23

RPW-1ds
12.87

D-16ds
12.97

D-18ds
13.68

PWB-1uts
10.71

BOP-44ds
12.59

BOP-22Rds
14.06

BOP-21ds
13.70

BOP-20ds
13.43

BOP-60Rds
13.76

BOP-61ds
11.34

EW-23

EW-3
11.38

BOP-65ds
13.47

BOP-66ds
12.94

BOP-31ds
12.78

BOP-62ds
13.45

BOP-42ds
13.69

BOP-13ds
9.90

EW-1

EW-14

CMW-17ds
19.18

CMW-18ds
15.03

EW-2

CMW-20ds
14.06

CMW-10ds
13.36

EW-16

DEQ-5ds
13.99

CMW-19ds
15.70

CMW-3
17.43

14 12 14 14 11 18 16 14 14 16

N

600 300 0 600 Feet

Legend

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

Notes

BOP-42ds = Monitoring Well Location ID
13.69 = Groundwater Elevation (ft. AMSL)

Upper TSA Groundwater Levels February 2015

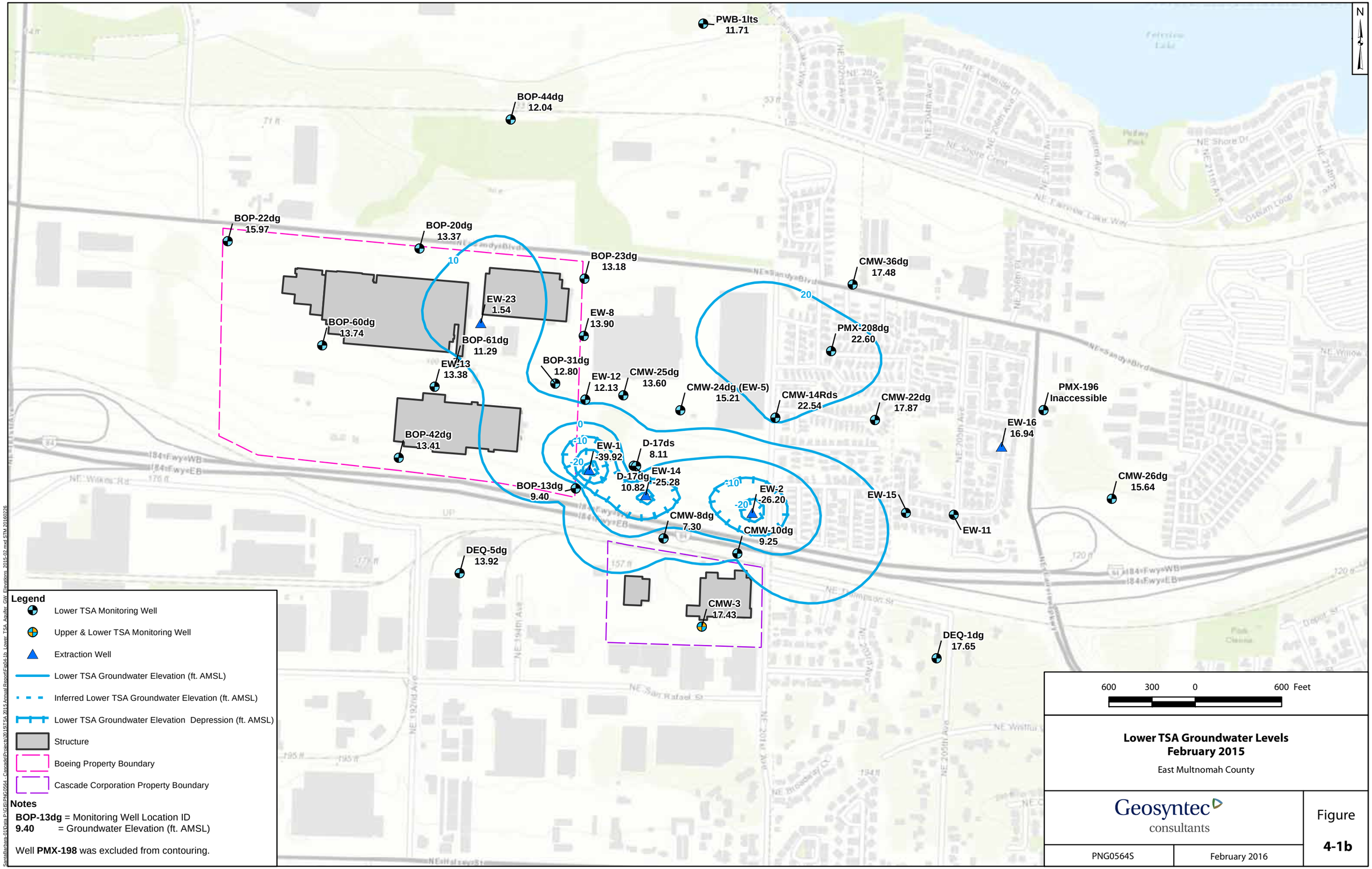
East Multnomah County

Geosyntec consultants

PNG0564S | February 2016

Figure **4-1a**

S:\SantaBarbara-01\Data P:\GIS\PNG\0564 - Cascade\Projects\2015TSA 2015 Annual Report\Fig04-1a Upper TSA Aquifer GW Elevations 2015-02.mxd STM 20160226


PWB-1lts
11.71
BOP-44dg
12.04
BOP-22dg
15.97
BOP-20dg
13.37
BOP-23dg
13.18
CMW-36dg
17.48
EW-23
1.54
EW-8
13.90
BOP-60dg
13.74
BOP-61dg
11.29
PMX-208dg
22.60
BOP-31dg
12.80
EW-13
13.38
EW-12
12.13
CMW-25dg
13.60
CMW-24dg (EW-5)
15.21
CMW-14Rds
22.54
CMW-22dg
17.87
PMX-196
Inaccessible
EW-16
16.94
BOP-42dg
13.41
EW-1
39.92
D-17ds
8.11
D-17dg
10.82
EW-14
25.28
CMW-26dg
15.64
BOP-13dg
9.40
EW-2
26.20
EW-15
EW-11
CMW-8dg
7.30
CMW-10dg
9.25
DEQ-5dg
13.92
CMW-3
17.43
DEQ-1dg
17.65
10
20
0
-10
-20
N
Legend
Lower TSA Monitoring Well
Upper & 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-13dg = Monitoring Well Location ID
9.40 = Groundwater Elevation (ft. AMSL)
Well PMX-198 was excluded from contouring.
600 300 0 600 Feet
Lower TSA Groundwater Levels
February 2015
East Multnomah County
Geosyntec consultants
PNG0564S
February 2016
Figure
4-1b
SantaBarbara-01\Data P:\GIS\PNG0564 - Cascade\Projects\2015\TSA 2015 Annual Report\Fig04-1b Lower TSA Aquifer GW Elevations 2015-02.mxd STM 20160226

PMX-167
10.89

RPW-1ds
11.12

D-16ds
8.84

D-18ds
8.36

PWB-1uts
9.52

BOP-44ds
9.51

BOP-21ds
9.01

BOP-20ds
9.40

BOP-22Rds
8.70

BOP-60Rds
9.12

EW-3
6.84

BOP-61ds
8.43

BOP-65ds
9.56

BOP-66ds
10.19

BOP-62ds
9.05

BOP-31ds
10.69

BOP-42ds
11.40

BOP-13ds
8.28

CMW-17ds
19.87

CMW-18ds
15.95

CMW-10ds
13.88

DEQ-5ds
12.94

CMW-19ds
15.87

CMW-3
17.31

N

600 300 0 600 Feet

Legend

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

Notes

BOP-41ds = Monitoring Well Location ID
16.48 = Groundwater Elevation (ft. AMSL)

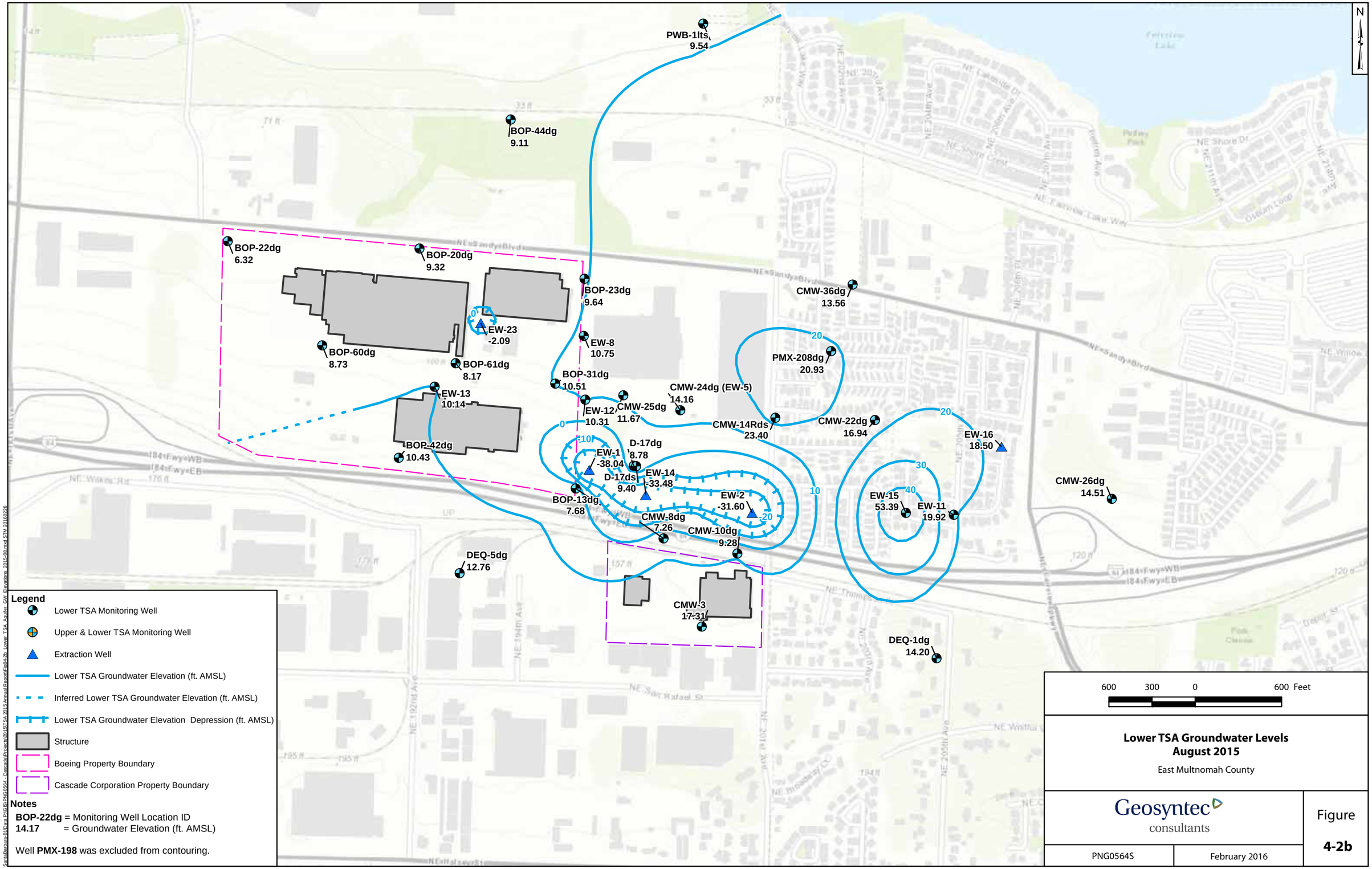
Upper TSA Groundwater Levels August 2015

East Multnomah County

Geosyntec consultants

PNG0564S | February 2016

Figure 4-2a



Legend

- Lower TSA Monitoring Well
- Upper & 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-22dg = Monitoring Well Location ID
14.17 = Groundwater Elevation (ft. AMSL)

Well **PMX-198** was excluded from contouring.

600 300 0 600 Feet

Lower TSA Groundwater Levels August 2015

East Multnomah County

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PNG0564S | February 2016

Figure **4-2b**

N

EW-3
< 0.20

BOP-65ds
1.3

5

BOP-61ds
8.7

BOP-66ds
3.6

BOP-31ds
< 0.20

BOP-13ds
3.0

CMW-17ds
52

55

CMW-18ds
57

45

35

25

CMW-10ds
22

CMW-19ds
5.4

15

5

Legend

- Upper TSA Monitoring Well
- Upper & Lower TSA Monitoring Well
- Continuous
- Inferred
- Unsaturated Area
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary

Notes

CMW-10ds = Monitoring Well Location ID
22 = 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 Trichloroethene Concentrations
February 2015
East Multnomah County

Geosyntec consultants

PNG0564S | February 2016

Figure **5-1a**

SantaBarbara-01\Data P:\GIS\PNG0564 - Cascade\Projects\2015TSA 2015 Annual Report\Fig\05-1a_Upper_TSA_Aquifer_TCE_Contours_2015-02.mxd STM 20160226

N

EW-23
4.5

EW-8
< 1.0(U)/<1.0(L)

BOP-61dg
5.1

5

BOP-31dg
5.2

5

EW-13
0.7

EW-12
4.1(U)/4.0(L)

CMW-25dg
< 1.0

CMW-24dg (EW-5)
< 1.0(U)/<1.0(L)

CMW-14Rds
< 1.0

EW-16
< 1.0

5

D-17dg
8.6

D-17ds
32

25

EW-1
2.6

EW-14
7.8

15

BOP-13dg
0.80

EW-2
12

EW-15
< 1.0(U)/<1.0(L)

EW-11
<1.0(U)/1.2(L)

CMW-26dg
3.3

CMW-8dg
< 1.0(a)

CMW-10dg
< 1.0(b)

Legend

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

Notes

D-17dg = Monitoring Well Location ID
6.4 = 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 Trichloroethene Concentrations
February 2015
East Multnomah County

Geosyntec consultants

PNG0564S | February 2016

Figure
5-1b

SantaBarbara-01\Data P:\GIS\PNG\0564 - Cascade\Projects\2015\TSA 2015 Annual Report\Fig05-1b Lower TSA Aquifer TCE Contours 2015-02.mxd SIM 20160226

D-16ds
< 1.0

D-18ds
< 1.0

PWB-1uts
< 1.0

BOP-44ds
< 1.0

BOP-22Rds
< 0.20

BOP-21ds
1.3

BOP-20ds
< 0.20

BOP-60Rds
0.40

BOP-61ds
5.1

EW-3
< 0.20

BOP-65ds
0.90

BOP-31ds
< 0.20

BOP-66ds
2.9

BOP-62ds
0.70

BOP-42ds
< 0.20

BOP-13ds
3.7

CMW-17ds
37

CMW-18ds
54

CMW-20ds
< 1.0

CMW-10ds
21

CMW-19ds
1.1

50
40
30
20
10
5

N

Legend

- Upper TSA Monitoring Well
- Upper & Lower TSA Monitoring Well
- Continuous
- Inferred
- Unsaturated Area
- Structure
- Boeing Property Boundary
- Cascade Corporation Property Boundary

Notes

CMW-10ds = Monitoring Well Location ID
22 = 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 Trichloroethene Concentrations
August 2015
East Multnomah County

Geosyntec consultants

PNG0564S | February 2016

Figure
5-2a

SantaBarbara-d1\Data P:\GIS\PNG\0564 - Cascade\Projects\2015\TSA 2015 Annual Report\Fig05-2a Upper TSA Aquifer TCE Contours 2015-08.mxd STM 20160226

N

PWB-1lts
1.6

BOP-44dg
< 1.0

BOP-22dg
< 0.20

BOP-20dg
1.0

BOP-23dg
0.70

CMW-36dg
< 1.0

EW-23
1.9

EW-8
< 1.0

BOP-60dg
1.5

BOP-61dg
5.8

5

EW-13
0.60

BOP-31dg
4.6

CMW-25dg
1.3

CMW-24dg
(EW-5)
< 1.0

EW-12
3.5

CMW-14Rds
< 1.0

CMW-22dg
1.4

BOP-42dg
1.3

EW-16
< 1.0

EW-1
3.5

D-17dg
9.0

D-17ds
27

20

10

5

BOP-13dg
0.80

EW-14
7.1

EW-2
10

CMW-26dg
3.0

EW-15
< 1.0

EW-11
1.2

CMW-8dg
< 1.0

CMW-10dg
< 1.0

Legend

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

Notes

D-17dg = Monitoring Well Location ID
6.4 = 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 Trichloroethene Concentrations
August 2015
East Multnomah County

Geosyntec consultants

PNG0564S | February 2016

Figure
5-2b

I:\SantaBarbara-01\Data P:\GIS\PNG0564 - Cascade\Projects\2015TSA 2015 Annual Report\Fig05-2b_Lower_TSA_Aquifer_TCE_Contours_2015-08.mxd $TM 20160226

APPENDIX A

Extraction Rate Profiles

Table A-1
TSA Extraction Rates October 2014 through December 2015 and
12-Month Averages through 30 December 2015
TSA Remedy - East Multnomah County

Zone	12-Mo. Avg.	10/2014	11/2014	12/2014	01/2015	02/2015	03/2015	04/2015	05/2015	06/2015	07/2015	08/2015	09/2015	10/2015	11/2015	12/2015
Zone B	**29**	**31**	**26**	**33**	**30**	**33**	**33**	**21**	**31**	**31**	**30**	**29**	**28**	**27**	**25**	**29**
EW-23	*29*	*31*	*26*	*33*	*30*	*33*	*33*	*21*	*31*	*31*	*30*	*29*	*28*	*27*	*25*	*29*
Zone C	**95**	**103**	**81**	**101**	**97**	**92**	**88**	**86**	**121**	**109**	**95**	**85**	**80**	**72**	**66**	**84**
EW-1	*40*	*44*	*31*	*42*	*38*	*34*	*30*	*30*	*67*	*59*	*48*	*40*	*36*	*32*	*27*	*43*
EW-2	*26*	*33*	*29*	*35*	*35*	*34*	*33*	*31*	*29*	*26*	*24*	*22*	*22*	*20*	*19*	*22*
EW-14	*23*	*25*	*21*	*25*	*25*	*24*	*25*	*25*	*25*	*23*	*23*	*23*	*22*	*21*	*21*	*19*
Zone D	**3**	**24**	**17**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
EW-16	*0*	*24*	*17*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Total Avg Flow TSA	**127**	**158**	**125**	**135**	**127**	**125**	**120**	**107**	**152**	**139**	**125**	**115**	**108**	**100**	**92**	**113**

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.

EW-16 pilot shutdown began in November 2014.

Table A-2
Discharge Monitoring Summary - Cental Treatment System
1 October 2014 through 30 December 2015
TSA Remedy - East Multnomah County

Parameter	Discharge Limitations[a]	Unit	Sample Date	System Discharge			Number of Exceedances	Sample Frequency
				Min	Avg	Max		
October 2014								
pH	6.0 – 9.0	su	—	7.50	7.65	7.80	0	Weekly
Temperature	—	ºF	—	60	62	63	—	Weekly
Flow	—	gpm	—	24	32	44	—	Daily
November 2014								
Trichloroethene	5.0	µg/L	11/3/2014	< 1.0	< 1.0	< 1.0	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	11/3/2014	< 1.0	< 1.0	< 1.0	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	11/3/2014	< 1.0	< 1.0	< 1.0	0	Quarterly
Tetrachloroethene	5.0	µg/L	11/3/2014	< 1.0	< 1.0	< 1.0	0	Quarterly
Vinyl Chloride	2.0	µg/L	11/3/2014	< 1.0	< 1.0	< 1.0	0	Quarterly
pH	6.0 – 9.0	su	—	7.60	7.67	7.70	0	Weekly
Temperature	—	ºF	—	—	57	—	—	Weekly
Flow	—	gpm	—	17	25	31	—	Daily
December 2014								
pH	6.0 – 9.0	su	—	7.60	7.66	7.70	0	Weekly
Temperature	—	ºF	—	—	55	—	—	Weekly
Flow[#]	—	gpm	—	25	34	42	—	Daily
January 2015								
pH	6.0 – 9.0	su	—	7.70	7.70	7.70	0	Weekly
Temperature	—	ºF	—	54	55	56	—	Weekly
Flow[#]	—	gpm	—	25	32	38	—	Daily
February 2015								
Trichloroethene	5.0	µg/L	2/2/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	2/2/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	2/2/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
Tetrachloroethene	5.0	µg/L	2/2/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
Vinyl Chloride	2.0	µg/L	2/2/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
pH	6.0 – 9.0	su	—	7.70	7.75	7.80	0	Weekly
Temperature	—	ºF	—	—	58	—	—	Weekly
Flow[#]	—	gpm	—	24	31	34	—	Daily
March 2015								
pH	6.0 – 9.0	su	—	7.20	7.56	7.70	0	Weekly
Temperature	—	ºF	—	—	60	—	—	Weekly
Flow[#]	—	gpm	—	25	30	33	—	Daily
April 2015								
pH	6.0 – 9.0	su	—	7.70	7.77	7.80	0	Weekly
Temperature	—	ºF	—	—	60	—	—	Weekly
Flow[#]	—	gpm	—	21	27	31	—	Daily
May 2015								
Trichloroethene	5.0	µg/L	5/5/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	5/5/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	5/5/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
Tetrachloroethene	5.0	µg/L	5/5/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
Vinyl Chloride	2.0	µg/L	5/5/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
pH	6.0 – 9.0	su	—	7.40	7.68	7.80	0	Weekly
Temperature	—	ºF	—	—	63	—	—	Weekly
Flow[#]	—	gpm	—	25	38	67	—	Daily

Table A-2
Discharge Monitoring Summary - Cental Treatment System
1 October 2014 through 30 December 2015
TSA Remedy - East Multnomah County

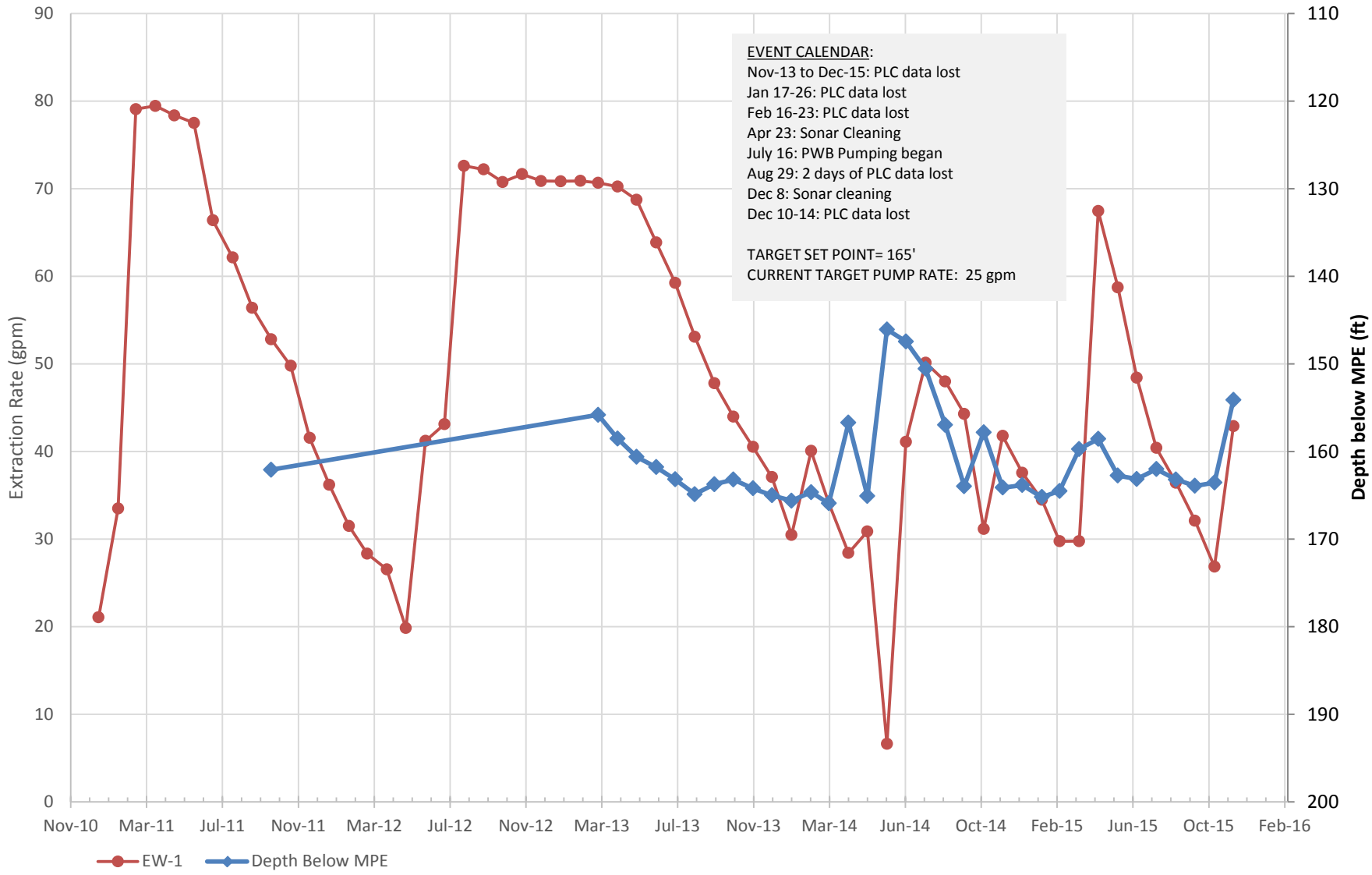
Parameter	Discharge Limitations[a]	Unit	Sample Date	System Discharge			Number of Exceedances	Sample Frequency
				Min	Avg	Max		
June 2015								
pH	6.0 – 9.0	su	—	7.40	7.58	7.80	0	Weekly
Temperature	—	ºF	—	—	64	—	—	Weekly
Flow[#]	—	gpm	—	23	35	59	—	Daily
July 2015								
pH	6.0 – 9.0	su	—	7.20	7.28	7.30	0	Weekly
Temperature	—	ºF	—	—	62	—	—	Weekly
Flow[#]	—	gpm	—	23	31	48	—	Daily
August 2015								
Trichloroethene	5.0	µg/L	8/3/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	8/3/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	8/3/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
Tetrachloroethene	5.0	µg/L	8/3/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
Vinyl Chloride	2.0	µg/L	8/3/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
pH	6.0 – 9.0	su	—	7.30	7.44	7.60	0	Weekly
Temperature	—	ºF	—	—	63	—	—	Weekly
Flow[#]	—	gpm	—	22	29	40	—	Daily
September 2015								
pH	6.0 – 9.0	su	—	7.30	7.53	7.60	0	Weekly
Temperature	—	ºF	—	—	63	—	—	Weekly
Flow	—	gpm	—	22	27	36	—	Daily
October 2015								
pH	6.0 – 9.0	su	—	7.30	7.33	7.40	0	Weekly
Temperature	—	ºF	—	—	61	—	—	Weekly
Flow[#]	—	gpm	—	20	25	32	—	Daily
November 2015								
Trichloroethene	5.0	µg/L	10/29/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
1,1-Dichloroethene	7.0	µg/L	10/29/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
cis-1,2-Dichloroethene	70	µg/L	10/29/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
Tetrachloroethene	5.0	µg/L	10/29/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
Vinyl Chloride	2.0	µg/L	10/29/2015	< 1.0	< 1.0	< 1.0	0	Quarterly
pH	6.0 – 9.0	su	—	7.30	7.40	7.50	0	Weekly
Temperature	—	ºF	—	—	59	—	—	Weekly
Flow[#]	—	gpm	—	19	23	27	—	Daily
December 2015								
pH	6.0 – 9.0	su	—	—	7.4	—	0	Weekly
Temperature	—	ºF	—	52	53	54	—	Weekly
Flow[#]	—	gpm	—	19	28	43	—	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 includes TS-C-Eff.

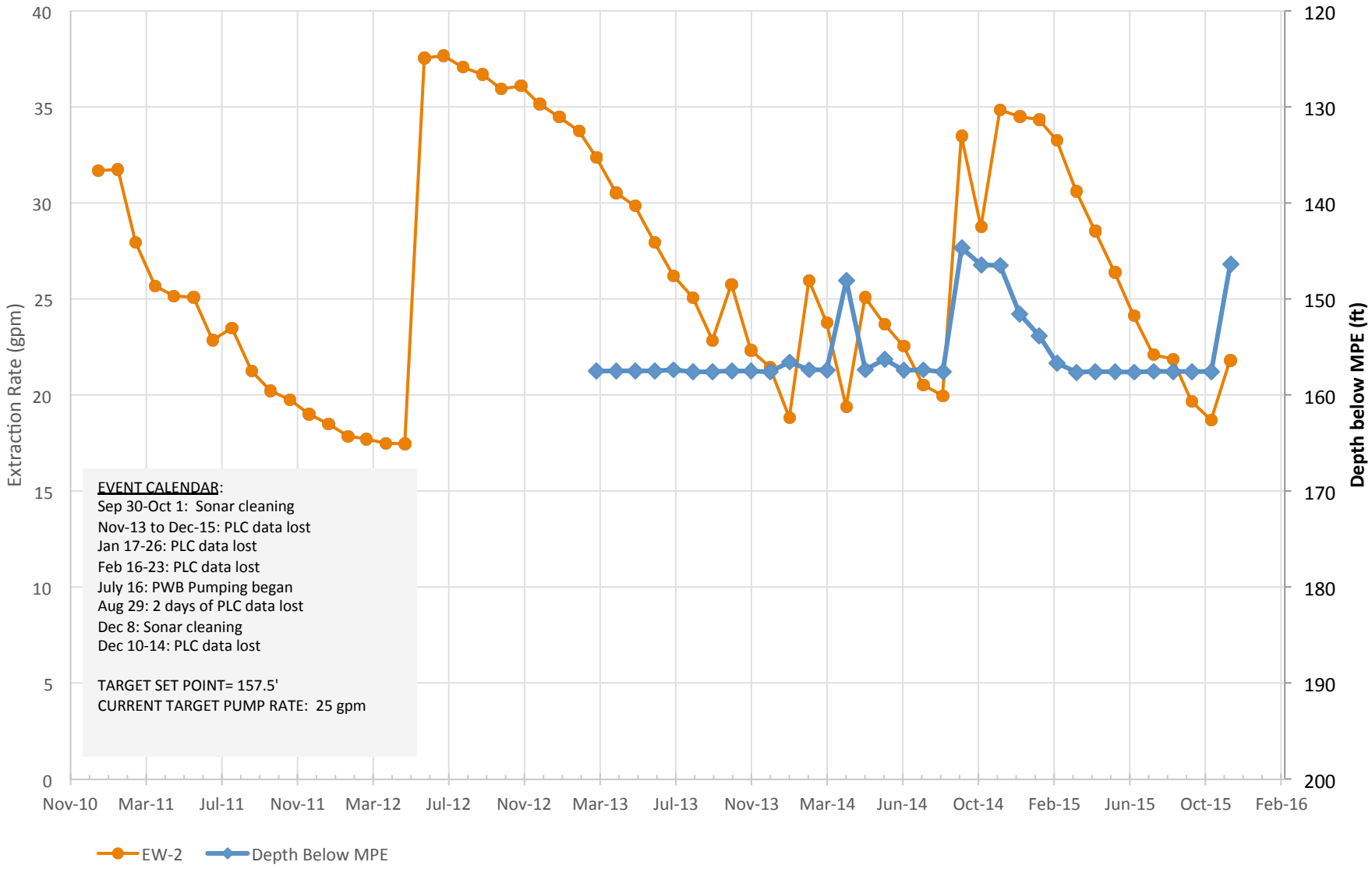
[#]Flow includes EW-1, EW-2, EW-14, and EW-23. EW-16 was cycled off in November 2014.

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



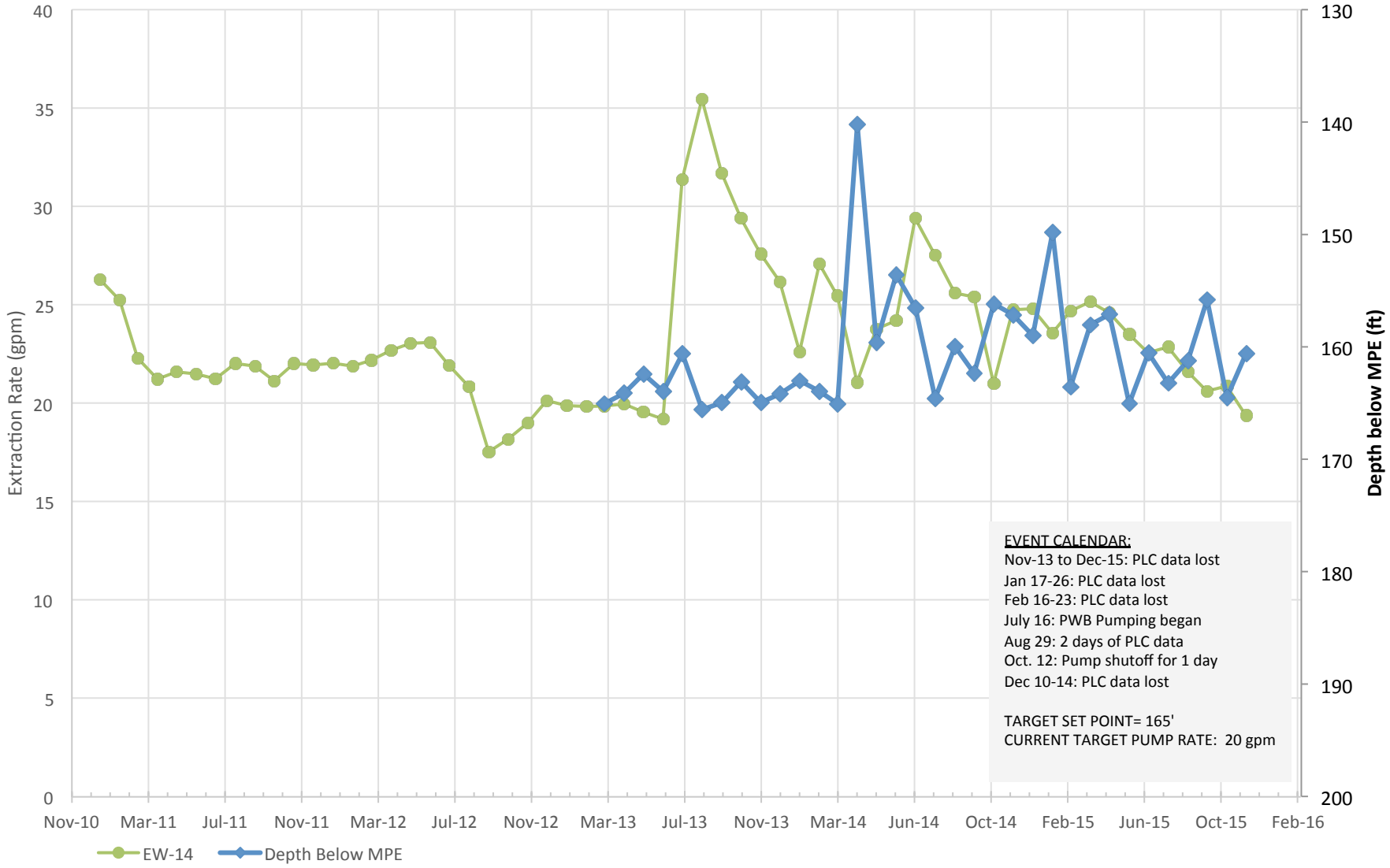
Geosyntec consultants

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



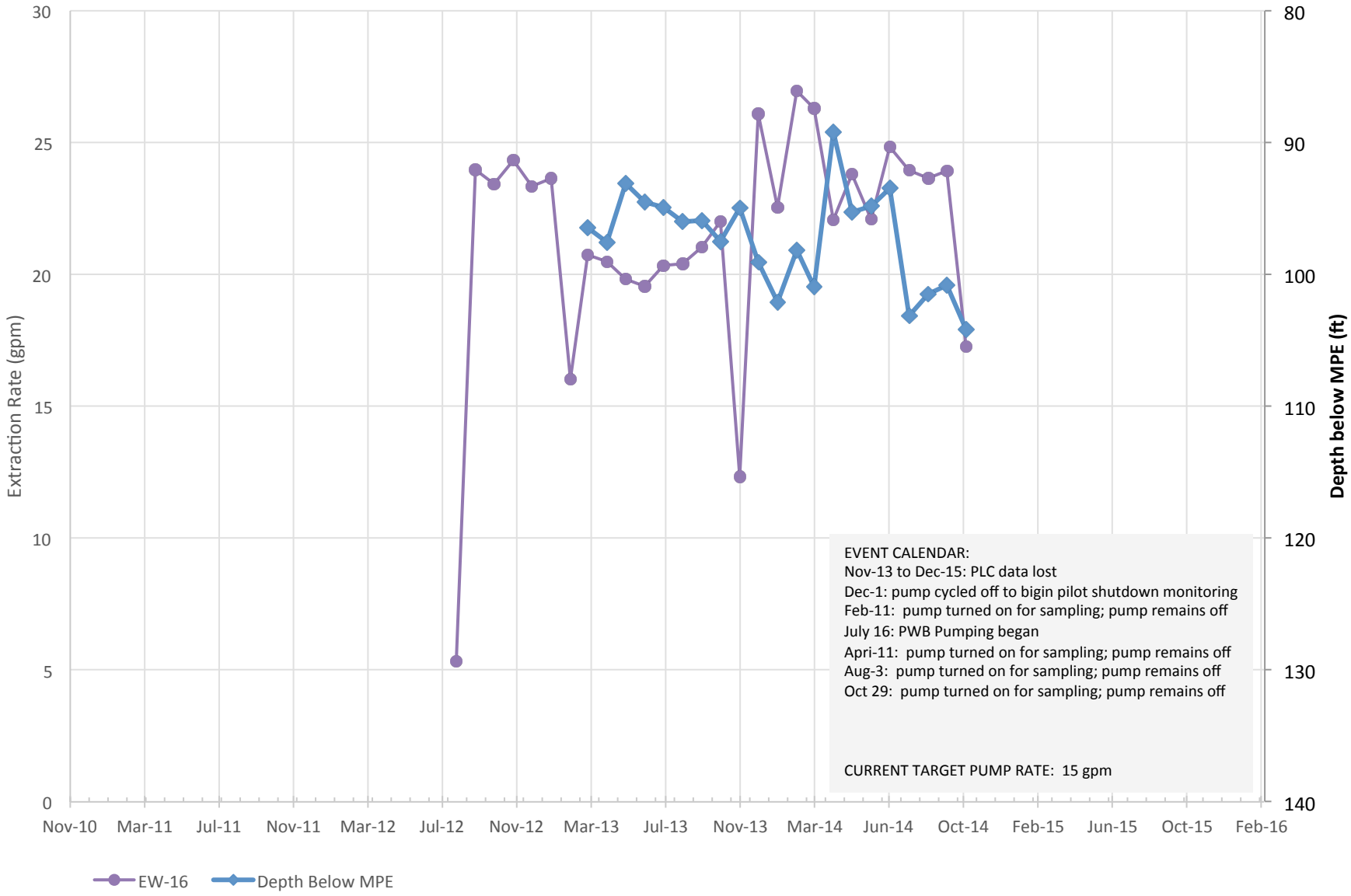
Geosyntec consultants

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



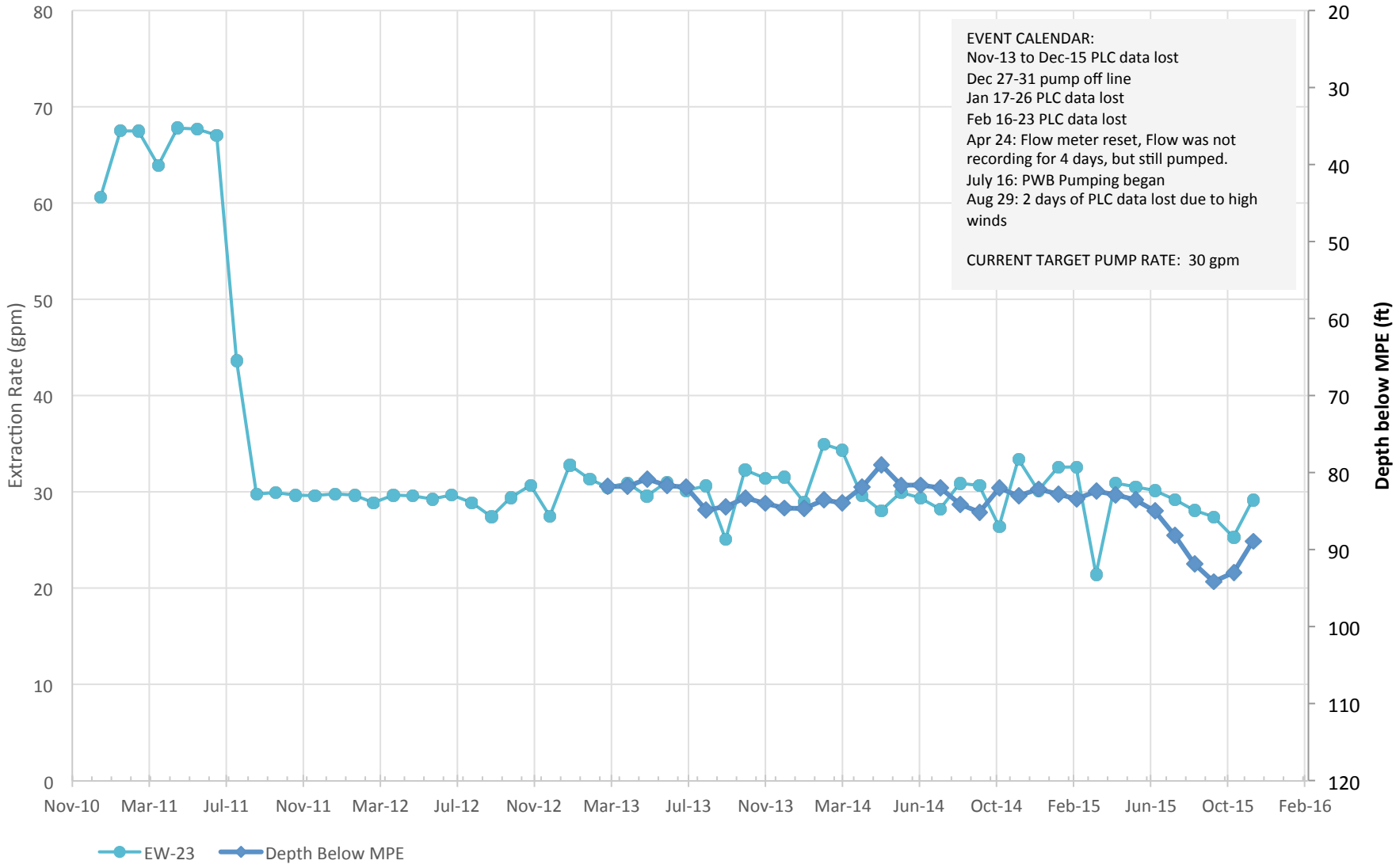
Geosyntec consultants

Cascade Corporation Gresham, Oregon	**EW-14 Monthly Average Extraction Rate** **TSA Remedy**	Figure A-3



Geosyntec consultants

Cascade Corporation Gresham, Oregon	**EW-16 Monthly Average Extraction Rate** **TSA Remedy**	Figure A-4



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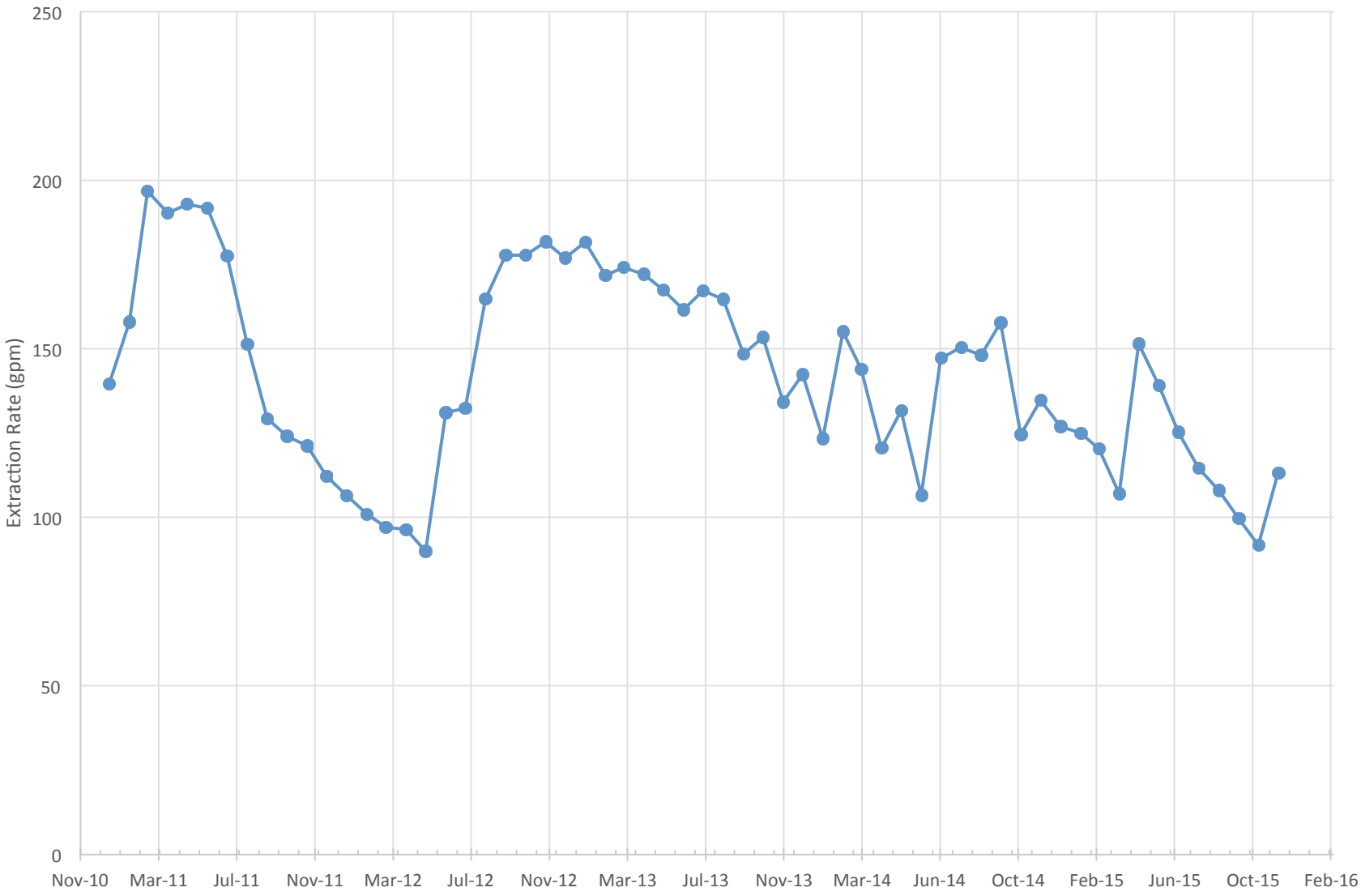
Cascade Corporation Gresham, Oregon	**EW-23 Monthly Average Extraction Rate** **TSA Remedy**	Figure A-5



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Cascade Corporation Gresham, Oregon	**Total Extraction Rate for Remedy Wells** **TSA Remedy**	Figure A-6

APPENDIX B

Groundwater Elevation Data

Table B-1
Groundwater Elevations - 1 October 2014 through 31 December 2015
TSA Remedy - Gresham, Oregon

Well ID	Date	Time	Top of Casing Elevation (ft, MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft. MSL)
Extraction Wells					
EW-1	10/06/2014	14:04	124.04	164.68	-40.64
EW-1	11/03/2014	9:46	124.04	153.18	-29.14
EW-1	11/03/2014	9:46	124.04	153.18	-29.14
EW-1	12/01/2014	12:27	124.04	163.28	-39.24
EW-1	01/05/2015	12:49	124.04	162.65	-38.61
EW-1	02/02/2015	9:09	124.04	163.96	-39.92
EW-1	02/02/2015	9:09	124.04	163.96	-39.92
EW-1	03/08/2015	9:09	124.04	165.7	-41.66
EW-1	04/14/2015	17:00	124.04	165.47	-41.43
EW-1	05/04/2015	10:54	124.04	155.24	-31.2
EW-1	05/05/2015	10:54	124.04	155.24	-31.2
EW-1	06/01/2015	11:34	124.04	160.04	-36
EW-1	07/06/2015	12:49	124.04	164.96	-40.92
EW-1	08/03/2015	10:12	124.04	162.86	-38.82
EW-1	08/04/2015	17:06	124.04	161.3	-37.26
EW-1	09/07/2015	13:59	124.04	164.06	-40.02
EW-1	10/29/2015	10:20	124.04	163.81	-39.77
EW-1	11/09/2015	10:10	124.04	163.46	-39.42
EW-1	12/14/2015	14:21	124.04	153.93	-29.89
EW-2	10/06/2014	13:58	126.01	144.26	-18.25
EW-2	11/03/2014	9:41	126.01	147.37	-21.36
EW-2	11/03/2014	9:41	126.01	147.37	-21.36
EW-2	12/01/2014	12:16	126.01	146.45	-20.44
EW-2	01/05/2015	12:31	126.01	151.21	-25.2
EW-2	02/02/2015	9:01	126.01	152.21	-26.2
EW-2	02/02/2015	9:10	126.01	152.21	-26.2
EW-2	03/08/2015	9:01	126.01	157.21	-31.2
EW-2	04/14/2015	16:56	126.01	157.53	-31.52
EW-2	05/04/2015	10:44	126.01	157.56	-31.55
EW-2	05/05/2015	10:44	126.01	157.56	-31.55
EW-2	06/01/2015	11:24	126.01	157.59	-31.58
EW-2	07/06/2015	12:40	126.01	157.56	-31.55
EW-2	08/03/2015	10:04	126.01	157.6	-31.59
EW-2	08/04/2015	17:17	126.01	157.61	-31.6
EW-2	09/07/2015	12:30	126.01	157.58	-31.57
EW-2	10/29/2015	10:00	126.01	157.3	-31.29
EW-2	11/09/2015	9:56	126.01	157.48	-31.47
EW-2	12/14/2015	14:17	126.01	147.39	-21.38
EW-14	10/06/2014	14:10	127.63	162.39	-34.76
EW-14	11/03/2014	9:51	127.63	164.14	-36.51
EW-14	11/03/2014	9:51	127.63	164.14	-36.51
EW-14	12/01/2014	13:20	127.63	162.14	-34.51
EW-14	01/05/2015	12:53	127.63	161.86	-34.23
EW-14	02/02/2015	9:16	127.63	152.91	-25.28
EW-14	02/02/2015	9:16	127.63	152.91	-25.28
EW-14	03/08/2015	9:16	127.63	163.49	-35.86
EW-14	04/14/2015	17:04	127.63	153.36	-25.73

Table B-1
Groundwater Elevations - 1 October 2014 through 31 December 2015
TSA Remedy - Gresham, Oregon

Well ID	Date	Time	Top of Casing Elevation (ft, MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft. MSL)
EW-14	05/04/2015	11:03	127.63	162.11	-34.48
EW-14	05/05/2015	11:03	127.63	162.11	-34.48
EW-14	06/01/2015	11:37	127.63	153.36	-25.73
EW-14	07/06/2015	12:55	127.63	154.21	-26.58
EW-14	08/03/2015	10:21	127.63	160.68	-33.05
EW-14	08/04/2015	17:11	127.63	161.53	-33.9
EW-14	09/07/2015	14:03	127.63	162.36	-34.73
EW-14	10/29/2015	10:33	127.63	164.86	-37.23
EW-14	11/09/2015	10:20	127.63	164.58	-36.95
EW-14	12/14/2015	14:25	127.63	164.06	-36.43
EW-16	10/06/2014	13:48	83.71	100.48	-16.77
EW-16	11/03/2014	9:33	83.71	103.38	-19.67
EW-16	11/03/2014	9:33	83.71	103.38	-19.67
EW-16	02/02/2015	11:21	83.71	66.77	16.94
EW-16	05/04/2015	11:42	83.71	66.14	17.57
EW-16	05/05/2015	11:42	83.71	66.14	17.57
EW-16	08/04/2015	13:50	83.71	65.21	18.5
EW-16	10/29/2015	11:00	83.71	67.14	16.57
EW-16	11/09/2015	11:29	83.71	70.86	12.85
EW-23	10/06/2014	13:35	83.93	84.02	-0.09
EW-23	11/03/2014	8:19	83.93	84.21	-0.28
EW-23	11/03/2014	9:19	83.93	84.21	-0.28
EW-23	12/01/2014	12:07	83.93	83.41	0.52
EW-23	01/05/2015	12:11	83.93	82.08	1.85
EW-23	02/02/2015	8:53	83.93	82.39	1.54
EW-23	02/02/2015	8:53	83.93	82.39	1.54
EW-23	03/08/2015	8:53	83.93	83.39	0.54
EW-23	04/14/2015	16:22	83.93	82.61	1.32
EW-23	05/04/2015	10:17	83.93	82.48	1.45
EW-23	05/05/2015	10:17	83.93	82.48	1.45
EW-23	06/01/2015	11:08	83.93	82.96	0.97
EW-23	07/06/2015	12:26	83.93	84.43	-0.5
EW-23	08/03/2015	9:27	83.93	85.98	-2.05
EW-23	08/04/2015	10:34	83.93	86.06	-2.13
EW-23	09/07/2015	12:14	83.93	91.48	-7.55
EW-23	11/09/2015	8:11	83.93	93.45	-9.52
EW-23	12/14/2015	12:59	83.93	90.71	-6.78
Monitoring Wells					
BOP-13dg	02/02/2015	7:41	128.71	119.31	9.40
BOP-13dg	08/03/2015	8:34	128.71	121.03	7.68
BOP-13ds	11/03/2014	8:02	128.94	120.60	8.34
BOP-13ds	02/02/2015	7:39	128.94	119.04	9.90
BOP-13ds	05/01/2015	15:04	128.94	118.27	10.67
BOP-13ds	08/03/2015	8:31	128.94	120.66	8.28
BOP-13ds	11/02/2015	8:55	128.94	125.6	3.34
BOP-20dg	11/03/2014	16:19	77.32	65.39	11.93
BOP-20dg	02/02/2015	12:42	77.32	63.95	13.37
BOP-20dg	08/03/2015	12:30	77.32	68.00	9.32

Table B-1
Groundwater Elevations - 1 October 2014 through 31 December 2015
TSA Remedy - Gresham, Oregon

Well ID	Date	Time	Top of Casing Elevation (ft, MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft. MSL)
BOP-20ds	11/03/2014	16:21	77.45	65.40	12.05
BOP-20ds	02/02/2015	12:40	77.45	64.02	13.43
BOP-20ds	08/03/2015	12:35	77.45	68.05	9.40
BOP-21ds	11/03/2014	16:43	78.02	65.86	12.16
BOP-21ds	02/02/2015	13:17	78.02	64.32	13.70
BOP-21ds	08/03/2015	16:12	78.02	69.01	9.01
BOP-22dg	11/03/2014	12:24	81.05	67.90	13.15
BOP-22dg	02/02/2015	14:08	81.05	65.08	15.97
BOP-22dg	08/03/2015	9:14	81.05	74.73	6.32
BOP-22Rds	11/03/2014	12:22	82.91	70.59	12.32
BOP-22Rds	02/02/2015	13:55	82.91	68.85	14.06
BOP-22Rds	08/03/2015	9:24	82.91	74.21	8.70
BOP-23dg	02/02/2015	12:33	76.96	63.78	13.18
BOP-23dg	08/03/2015	9:25	76.96	67.32	9.64
BOP-31dg	02/02/2015	10:29	98.51	85.71	12.80
BOP-31dg	08/03/2015	9:21	98.51	88.00	10.51
BOP-31ds	11/03/2014	16:04	99.04	87.82	11.22
BOP-31ds	02/02/2015	10:31	99.04	86.26	12.78
BOP-31ds	05/01/2015	14:32	99.04	85.50	13.54
BOP-31ds	08/03/2015	9:15	99.04	88.35	10.69
BOP-42dg	02/02/2015	11:41	130.71	117.30	13.41
BOP-42dg	08/03/2015	8:27	130.71	120.28	10.43
BOP-42ds	02/02/2015	11:38	130.74	117.05	13.69
BOP-42ds	08/03/2015	8:25	130.74	119.34	11.40
BOP-44dg	02/02/2015	10:01	35.15	23.11	12.04
BOP-44dg	08/04/2015	9:58	35.15	26.04	9.11
BOP-44dg	10/21/2015	14:41	35.15	31.53	3.62
BOP-44dg	11/09/2015	10:47	35.15	30.84	4.31
BOP-44ds	02/02/2015	10:03	35.24	22.65	12.59
BOP-44ds	08/04/2015	9:59	35.24	25.73	9.51
BOP-44ds	10/21/2015	14:33	35.24	31.04	4.2
BOP-44ds	11/09/2015	10:44	35.24	30.23	5.01
BOP-60dg	02/02/2015	10:51	93.59	79.85	13.74
BOP-60dg	08/03/2015	10:56	93.59	84.86	8.73
BOP-60Rds	11/03/2014	15:04	82.8	70.66	12.14
BOP-60Rds	02/02/2015	10:08	82.8	69.04	13.76
BOP-60Rds	08/03/2015	10:17	82.8	73.68	9.12
BOP-61dg	02/02/2015	11:22	94.43	83.14	11.29
BOP-61dg	08/03/2015	11:37	94.43	86.26	8.17
BOP-61ds	02/02/2015	11:19	94.64	83.30	11.34
BOP-61ds	08/03/2015	11:30	94.64	86.21	8.43
BOP-62ds	02/02/2015	11:17	112.29	98.84	13.45
BOP-62ds	08/03/2015	8:15	112.29	103.24	9.05
BOP-65ds	02/02/2015	11:57	104.22	90.75	13.47
BOP-65ds	08/03/2015	8:48	104.22	94.66	9.56
BOP-66ds	02/02/2015	12:08	102.97	90.03	12.94
BOP-66ds	08/03/2015	8:55	102.97	92.78	10.19

Table B-1
Groundwater Elevations - 1 October 2014 through 31 December 2015
TSA Remedy - Gresham, Oregon

Well ID	Date	Time	Top of Casing Elevation (ft, MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft. MSL)
BOP-70ds (215)	11/09/2015	12:20	65.15	66.34	-1.19
BOP-71ds	11/09/2015	12:16	87.88	90.59	-2.71
CMW-3	02/02/2015	14:32	147.69	130.26	17.43
CMW-3	08/04/2015	17:53	147.69	130.38	17.31
CMW-3	11/09/2015	10:26	147.69	133.34	14.35
CMW-8dg	02/02/2015	14:13	136.21	128.91	7.3
CMW-8dg	08/04/2015	18:14	136.21	128.95	7.26
CMW-8dg	11/09/2015	10:58	136.21	132.92	3.29
CMW-10dg	02/02/2015	14:18	135.05	125.8	9.25
CMW-10dg	08/04/2015	18:04	135.05	125.77	9.28
CMW-10dg	11/09/2015	10:50	135.05	128.73	6.32
CMW-10ds	11/03/2014	13:30	134.54	121.73	12.81
CMW-10ds	02/02/2015	14:21	134.54	121.18	13.36
CMW-10ds	05/05/2015	12:56	134.54	120.71	13.83
CMW-10ds	08/04/2015	18:09	134.54	120.66	13.88
CMW-10ds	10/29/2015	13:33	134.54	122.41	12.13
CMW-10ds	11/09/2015	10:45	134.54	122.84	11.7
CMW-14Rds	11/03/2014	12:05	83.48	62	21.48
CMW-14Rds	02/02/2015	12:52	83.48	60.94	22.54
CMW-14Rds	05/05/2015	11:38	83.48	59.69	23.79
CMW-14Rds	08/04/2015	17:26	83.48	60.08	23.4
CMW-14Rds	10/29/2015	12:15	83.48	62.74	20.74
CMW-14Rds	11/09/2015	9:00	83.48	62.72	20.76
CMW-17ds	11/03/2014	10:10	121.89	102.91	18.98
CMW-17ds	02/02/2015	12:43	121.89	102.71	19.18
CMW-17ds	05/05/2015	11:25	121.89	102.19	19.7
CMW-17ds	08/04/2015	16:52	121.89	102.02	19.87
CMW-17ds	10/29/2015	10:43	121.89	103.16	18.73
CMW-17ds	11/09/2015	8:35	121.89	102.91	18.98
CMW-18ds	11/03/2014	11:55	117.66	102.75	14.91
CMW-18ds	02/02/2015	12:49	117.66	102.63	15.03
CMW-18ds	05/05/2015	11:34	117.66	102.27	15.39
CMW-18ds	08/04/2015	17:21	117.66	101.71	15.95
CMW-18ds	10/29/2015	12:00	117.66	102.78	14.88
CMW-18ds	11/09/2015	8:50	117.66	102.66	15
CMW-19ds	11/03/2014	13:10	144.08	128.73	15.35
CMW-19ds	02/02/2015	14:06	144.08	128.38	15.7
CMW-19ds	05/05/2015	12:48	144.08	127.97	16.11
CMW-19ds	08/04/2015	17:58	144.08	128.21	15.87
CMW-19ds	10/29/2015	13:10	144.08	130.89	13.19
CMW-19ds	11/09/2015	10:38	144.08	130.95	13.13
CMW-20ds	02/02/2015	11:45	152.72	138.66	14.06
CMW-20ds	11/09/2015	10:12	152.72	141.08	11.64
CMW-22dg	02/02/2015	11:28	81.65	63.78	17.87
CMW-22dg	08/04/2015	17:32	81.65	64.71	16.94
CMW-22dg	11/09/2015	11:14	81.65	68.42	13.23

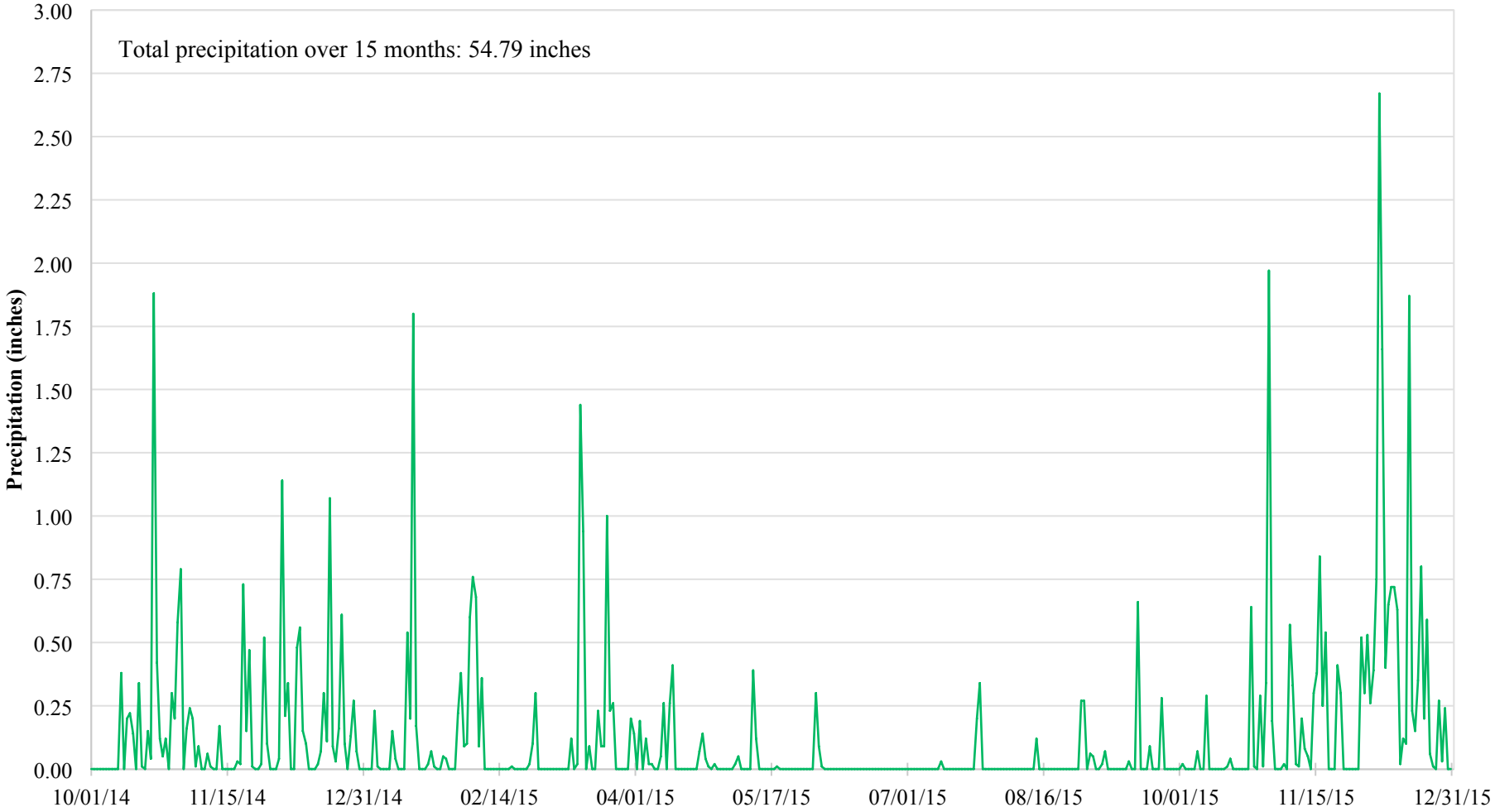
Table B-1
Groundwater Elevations - 1 October 2014 through 31 December 2015
TSA Remedy - Gresham, Oregon

Well ID	Date	Time	Top of Casing Elevation (ft, MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft. MSL)
CMW-24dg (EW-5)	02/02/2015	12:57	77.74	62.53	15.21
CMW-24dg (EW-5)	08/04/2015	8:38	77.74	63.58	14.16
CMW-24dg (EW-5)	11/09/2015	9:24	77.74	68.14	9.6
CMW-25dg	02/02/2015	13:20	75.28	61.68	13.6
CMW-25dg	08/04/2015	9:21	75.28	63.61	11.67
CMW-25dg	11/09/2015	12:10	75.28	70.54	4.74
CMW-26dg	11/03/2014	12:30	108.98	94.54	14.44
CMW-26dg	02/02/2015	13:40	108.98	93.34	15.64
CMW-26dg	05/05/2015	12:09	108.98	92.85	16.13
CMW-26dg	08/04/2015	14:42	108.98	94.47	14.51
CMW-26dg	10/29/2015	12:40	108.98	96.69	12.29
CMW-26dg	11/09/2015	11:51	108.98	96.5	12.48
CMW-36dg	02/02/2015	11:06	78.84	61.36	17.48
CMW-36dg	08/04/2015	13:53	78.84	65.28	13.56
CMW-36dg	10/29/2015	12:50	78.84	71.18	7.66
CMW-36dg	11/09/2015	11:22	78.84	70.22	8.62
D-16ds	02/02/2015	10:26	16.91	3.94	12.97
D-16ds	08/04/2015	12:03	16.91	8.07	8.84
D-16ds	11/09/2015	12:41	16.91	12.83	4.08
D-17dg	02/02/2015	12:38	124.61	113.79	10.82
D-17dg	08/04/2015	8:08	124.61	115.83	8.78
D-17dg	11/09/2015	10:07	124.61	117.07	7.54
D-17ds	11/03/2014	11:00	123.28	115.1	8.18
D-17ds	02/02/2015	12:34	123.28	115.17	8.11
D-17ds	05/05/2015	11:04	123.28	113.05	10.23
D-17ds	08/04/2015	8:11	123.28	113.88	9.40
D-17ds	10/29/2015	11:30	123.28	117.21	6.07
D-17ds	11/09/2015	10:04	123.28	115.46	7.82
D-18ds	02/02/2015	10:11	18.01	4.33	13.68
D-18ds	08/04/2015	11:29	18.01	9.65	8.36
D-18ds	11/09/2015	12:31	18.01	17.83	0.18
EW-3	11/03/2014	15:23	94.26	83.30	10.96
EW-3	02/02/2015	10:36	94.26	82.88	11.38
EW-3	08/03/2015	11:04	94.26	87.42	6.84
EW-8	02/02/2015	9:50	77.16	63.26	13.9
EW-8	08/04/2015	10:44	77.16	66.41	10.75
EW-8	11/09/2015	8:20	77.16	74.91	2.25
EW-11	08/04/2015	13:19	114.73	94.81	19.92
EW-11	11/09/2015	10:21	114.73	100.21	14.52
EW-12	11/03/2014	11:40	94.14	83.76	10.38
EW-12	02/02/2015	12:19	94.14	82.01	12.13
EW-12	05/05/2015	11:10	94.14	81.64	12.5
EW-12	08/04/2015	17:00	94.14	83.83	10.31
EW-12	10/29/2015	11:45	94.14	90.61	3.53
EW-12	11/09/2015	10:15	94.14	84.14	10
EW-13	11/03/2014	15:56	103.59	90.41	13.18
EW-13	02/02/2015	11:27	103.59	90.21	13.38
EW-13	08/03/2015	11:43	103.59	93.45	10.14

Table B-1
Groundwater Elevations - 1 October 2014 through 31 December 2015
TSA Remedy - Gresham, Oregon

Well ID	Date	Time	Top of Casing Elevation (ft, MSL)	Depth to Water (ft below TOC)	Groundwater Elevation (ft. MSL)
EW-15	08/04/2015	14:12	116.21	62.82	53.39
EW-15	11/09/2015	11:37	116.21	63.79	52.42
DEQ-1dg	02/02/2015	11:56	150.58	132.93	17.65
DEQ-1dg	08/04/2015	17:40	150.58	136.38	14.2
DEQ-1dg	11/09/2015	9:36	150.58	139.28	11.3
DEQ-5dg	02/02/2015	11:35	155.95	142.03	13.92
DEQ-5dg	08/04/2015	18:21	155.95	143.19	12.76
DEQ-5dg	11/09/2015	9:51	155.95	150.21	5.74
DEQ-5ds	02/02/2015	11:38	155.68	141.69	13.99
DEQ-5ds	08/04/2015	18:25	155.68	142.74	12.94
DEQ-5ds	11/09/2015	9:59	155.68	147.72	7.96
PMX-167	02/02/2015	10:47	44.84	6.61	38.23
PMX-167	08/04/2015	12:52	44.84	33.95	10.89
PMX-167	11/09/2015	13:08	44.84	16.12	28.72
PMX-196	02/02/2015	11:08	89.27	Inaccessible	Inaccessible
PMX-196	11/09/2015	11:41	89.27	Inaccessible	Inaccessible
PMX-208dg	02/02/2015	10:57	81.14	58.54	22.6
PMX-208dg	08/04/2015	17:45	81.14	60.21	20.93
PMX-208dg	11/09/2015	13:30	81.14	64.7	16.44
PWB-1lts	02/02/2015	10:37	16.48	4.77	11.71
PWB-1lts	08/04/2015	12:40	16.48	6.94	9.54
PWB-1lts	11/09/2015	12:55	16.48	11.51	4.97
PWB-1uts	02/02/2015	10:39	15.98	5.27	10.71
PWB-1uts	08/04/2015	12:43	15.98	6.46	9.52
PWB-1uts	11/09/2015	12:57	15.98	10.68	5.3
PWB-2lts	02/02/2015	10:49	44.32	32.44	11.88
PWB-2lts	08/04/2015	13:04	44.32	38.23	6.09
PWB-2lts	11/09/2015	13:11	44.32	39.1	5.22
RPW-1ds	02/02/2015	10:33	15.9	3.03	12.87
RPW-1ds	08/04/2015	12:33	15.9	4.78	11.12
RPW-1ds	11/09/2015	12:53	15.9	8.52	7.38

Notes:
ft MSL = feet above mean sea level
ft below TOC = feet below top of casing



Note: Data from NOAA National Weather Service Preliminary Local Climatological Data (WS Form: F-6); Portland International Airport

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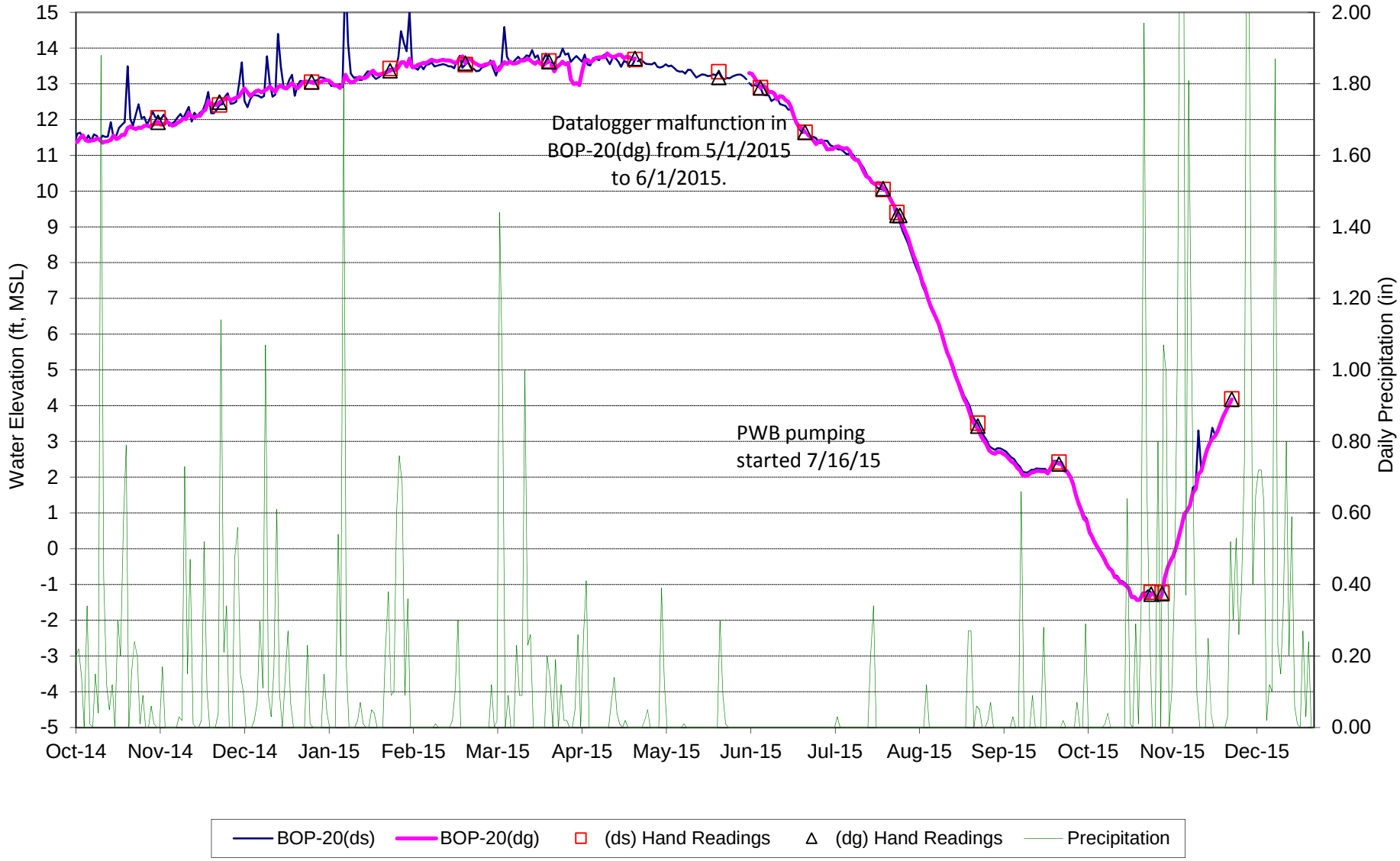
Cascade Corporation Gresham, Oregon	**Precipitation Graph** **10/01/2014 - 12/31/2015**	Figure B-1

Source: P:\025\116\WIP\R\TSA\Semiannual Reports\2015 Rpt



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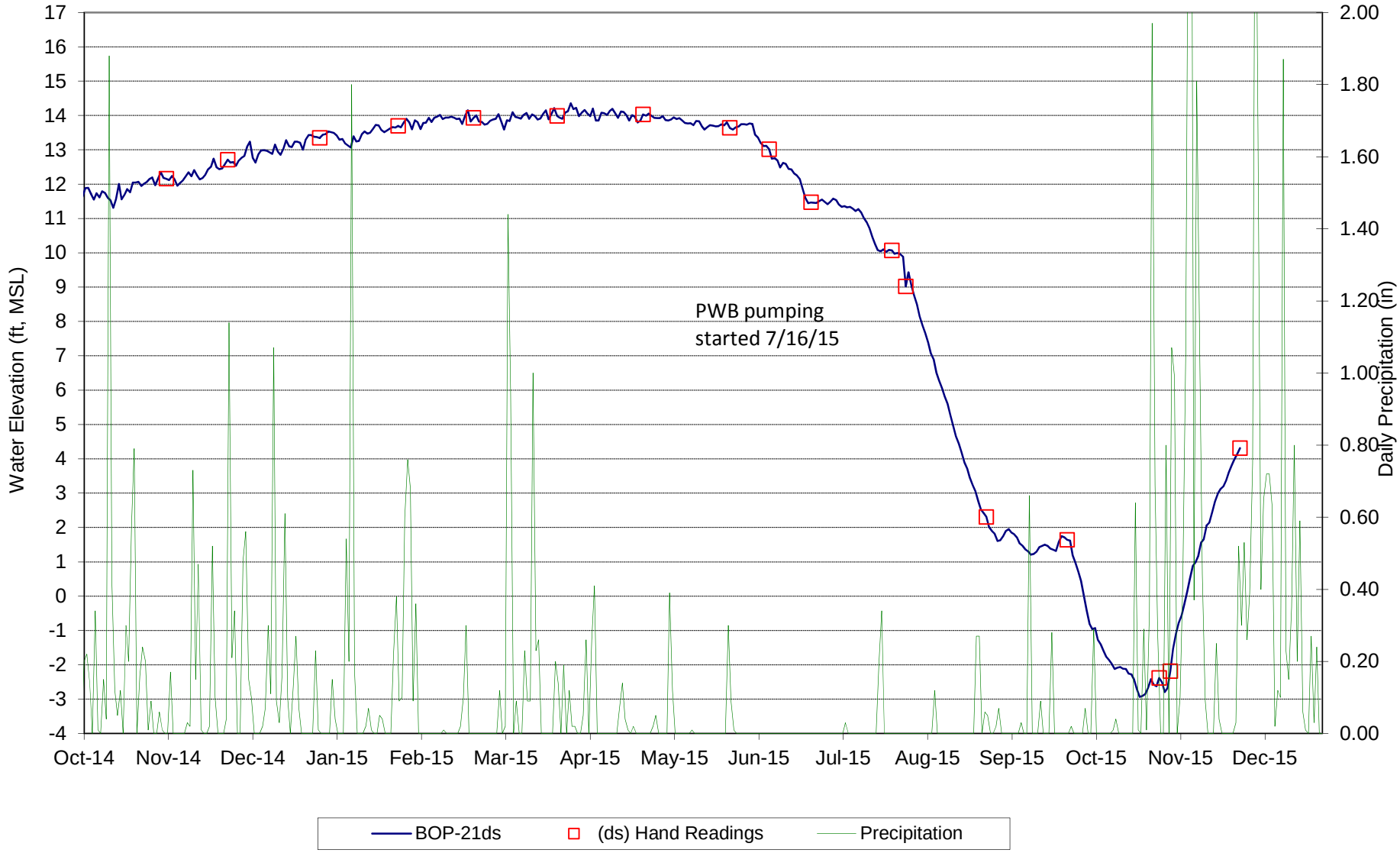
Gresham, Oregon

Hydrograph for TSA Well BOP-20(ds,dg)

Figure
B-2

Source: P:\025\116\WIP\R\TSA\Semiannual Reports\2015 Rpt



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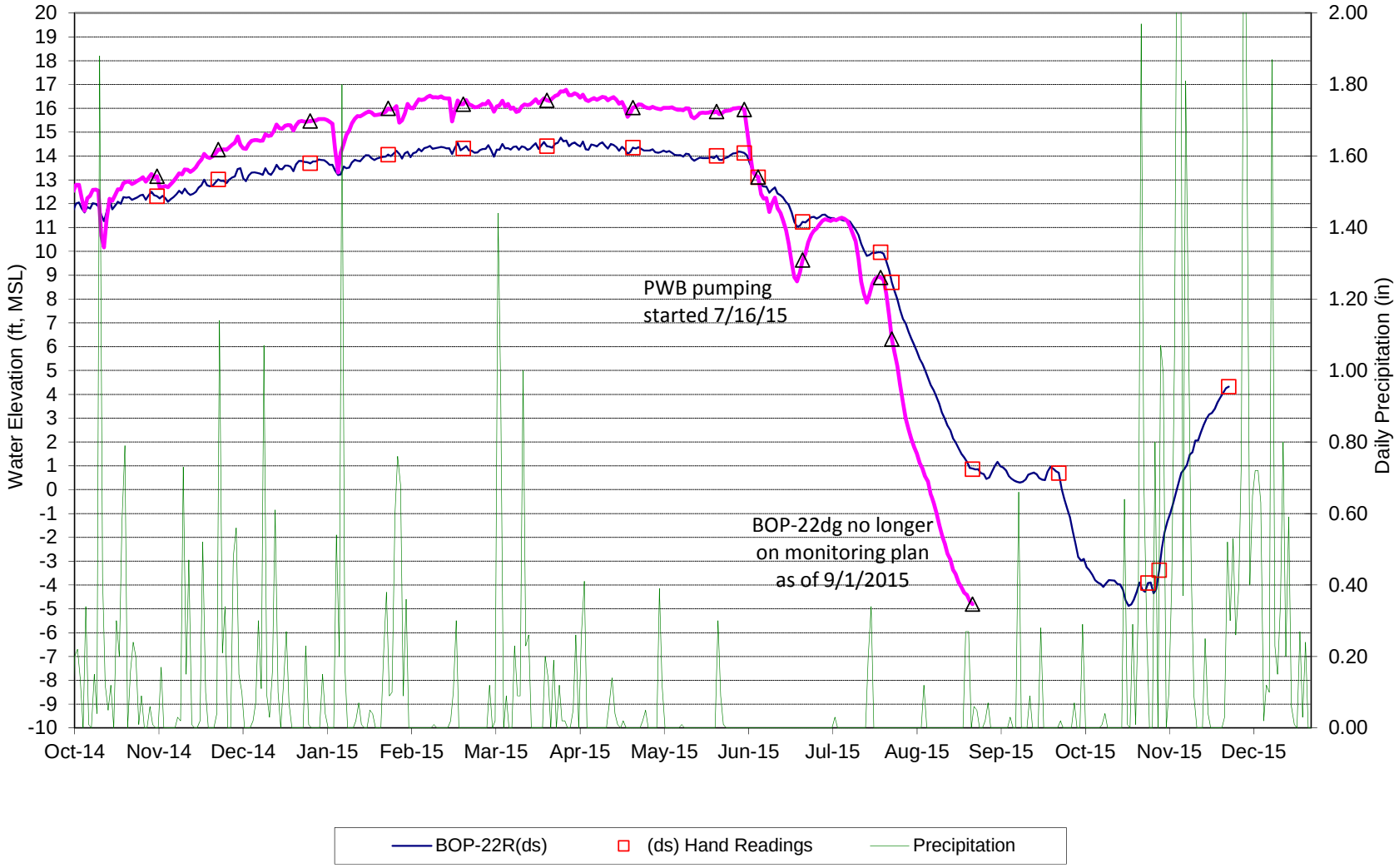
Gresham, Oregon

Hydrograph for TSA Well BOP-21(ds)

Figure
B-3

Source: P:\025\116\WIP\R\TSA\Semiannual Reports\2015 Rpt



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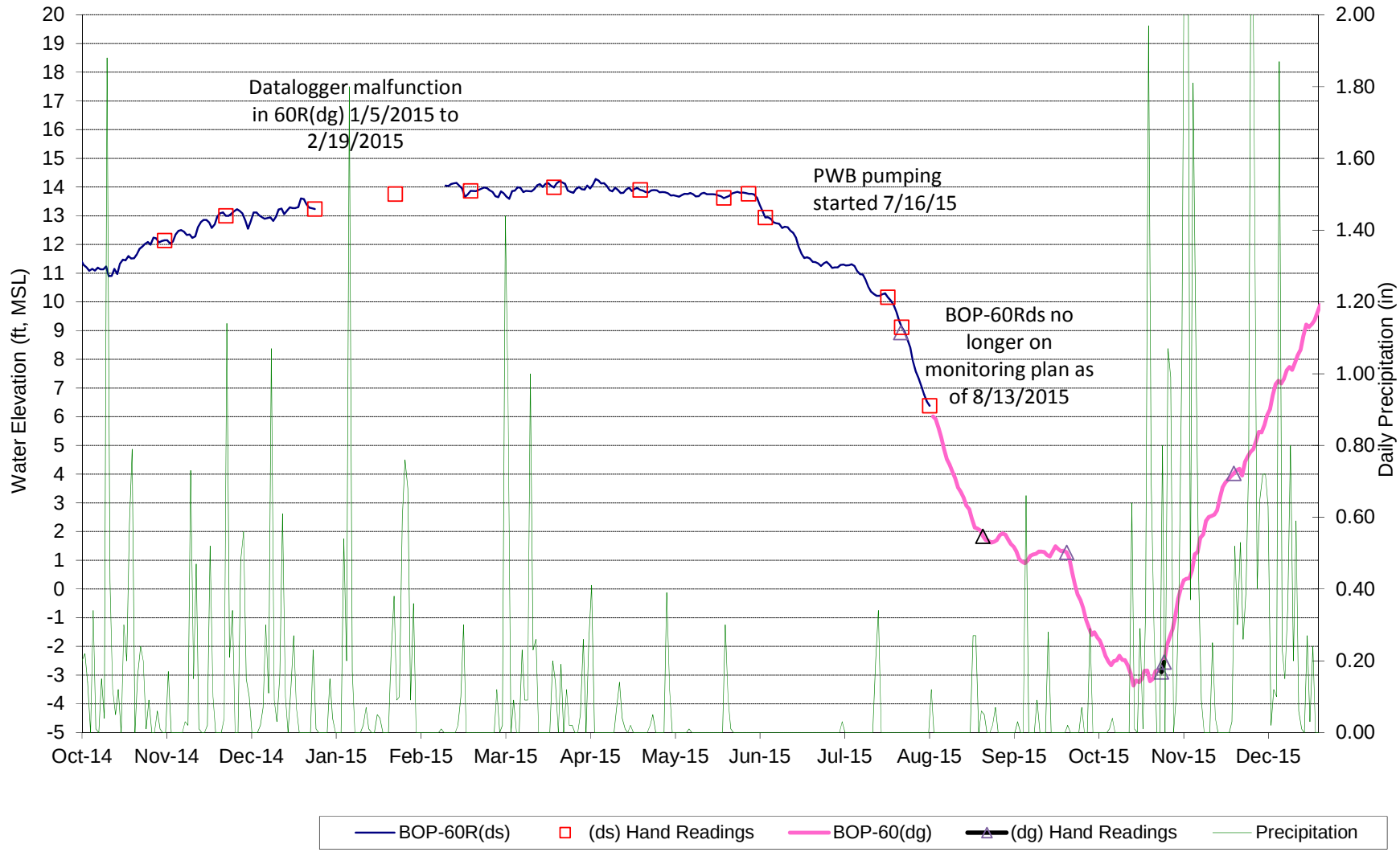
Gresham, Oregon

Hydrograph for TSA Wells BOP-22R(ds) and BOP-22(dg)

Figure
B-4

Source: P:\025\116\WIP\R\TSA\Semiannual Reports\2015 Rpt



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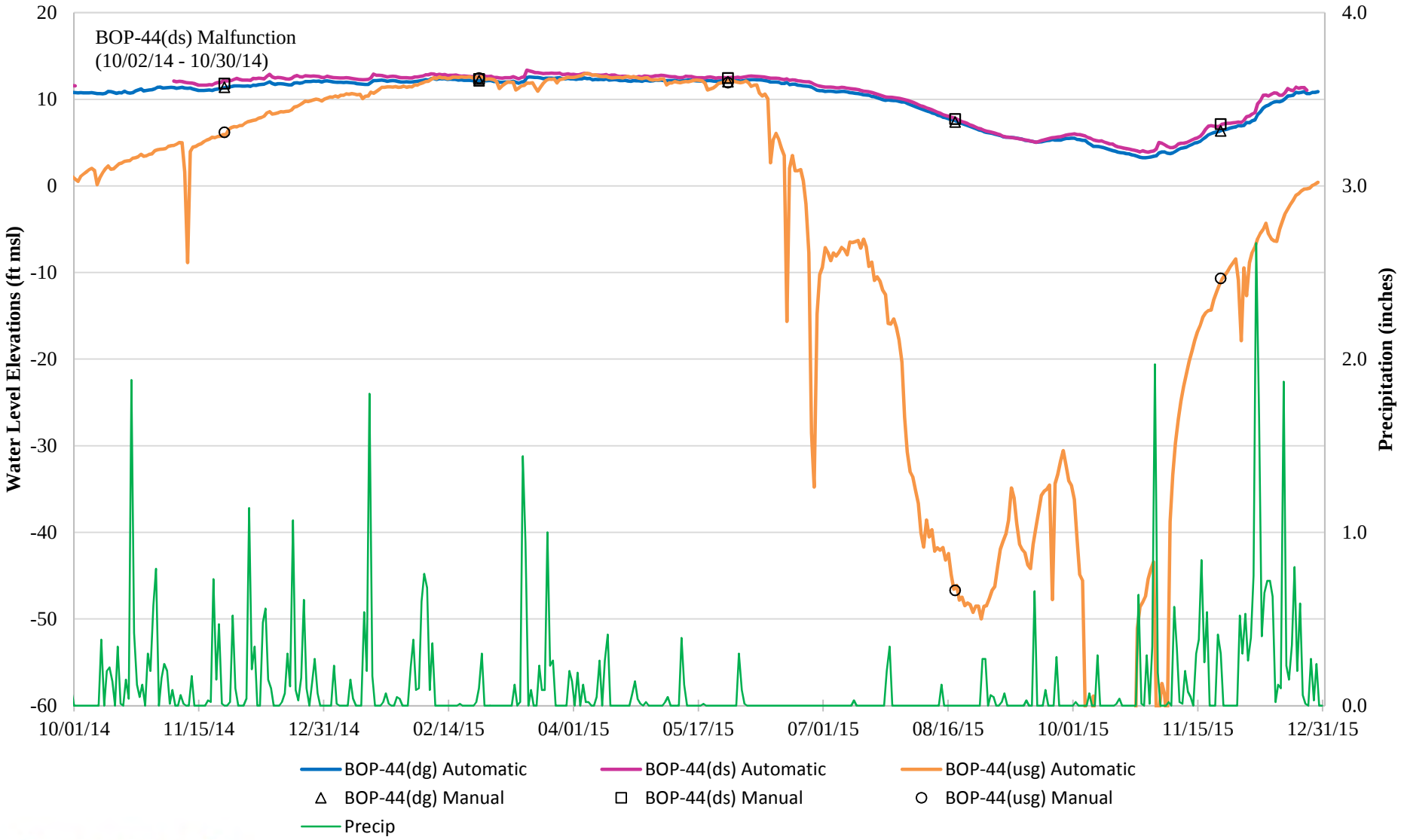
Boeing Portland
Gresham, Oregon

Hydrograph for
TSA Well BOP-60R(ds,dg)

Figure
B-5



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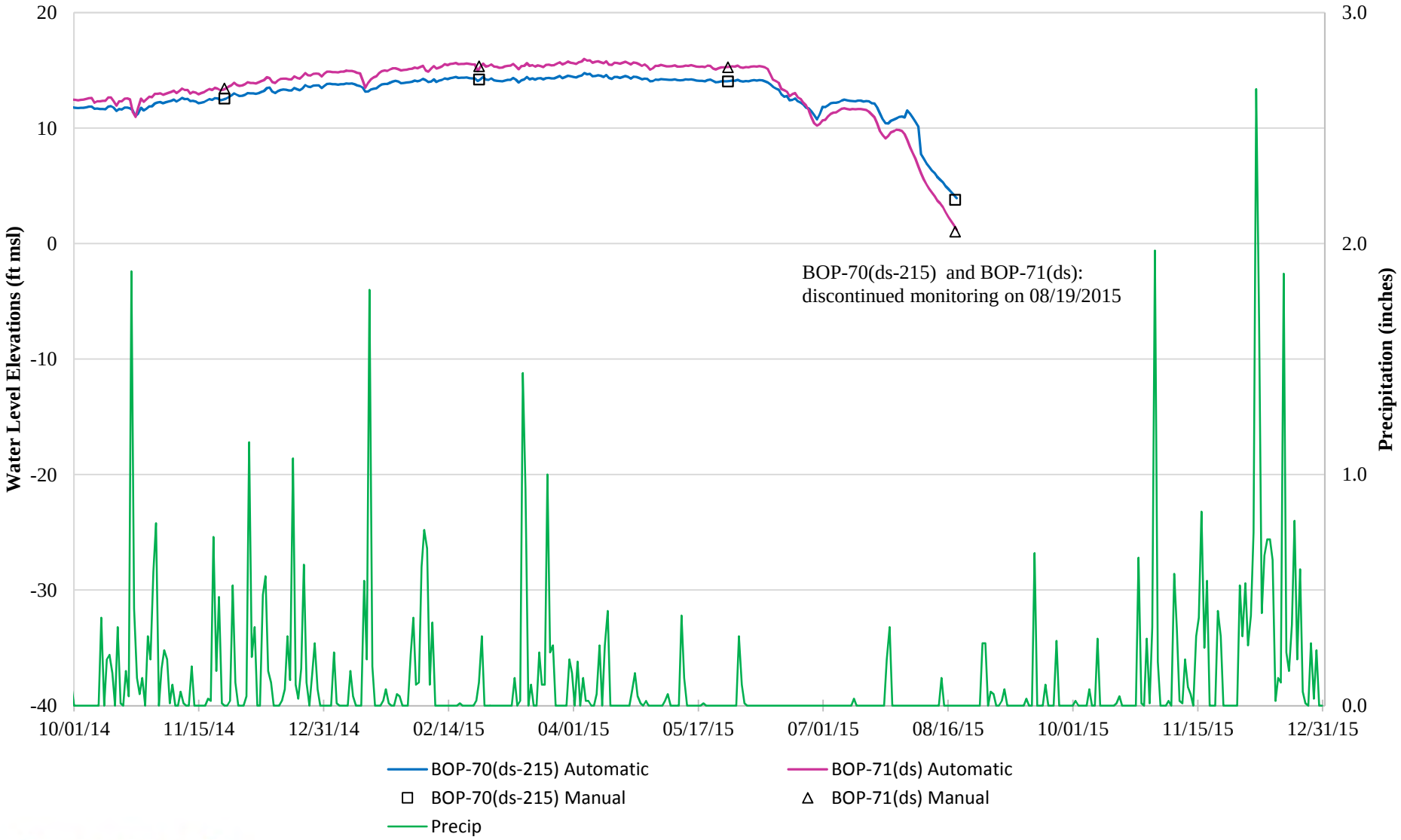
Cascade Corporation Gresham, Oregon	**Hydrograph for TSA Wells BOP-44(ds,dg) and SGA Well BOP-44(usg)**	Figure B-6



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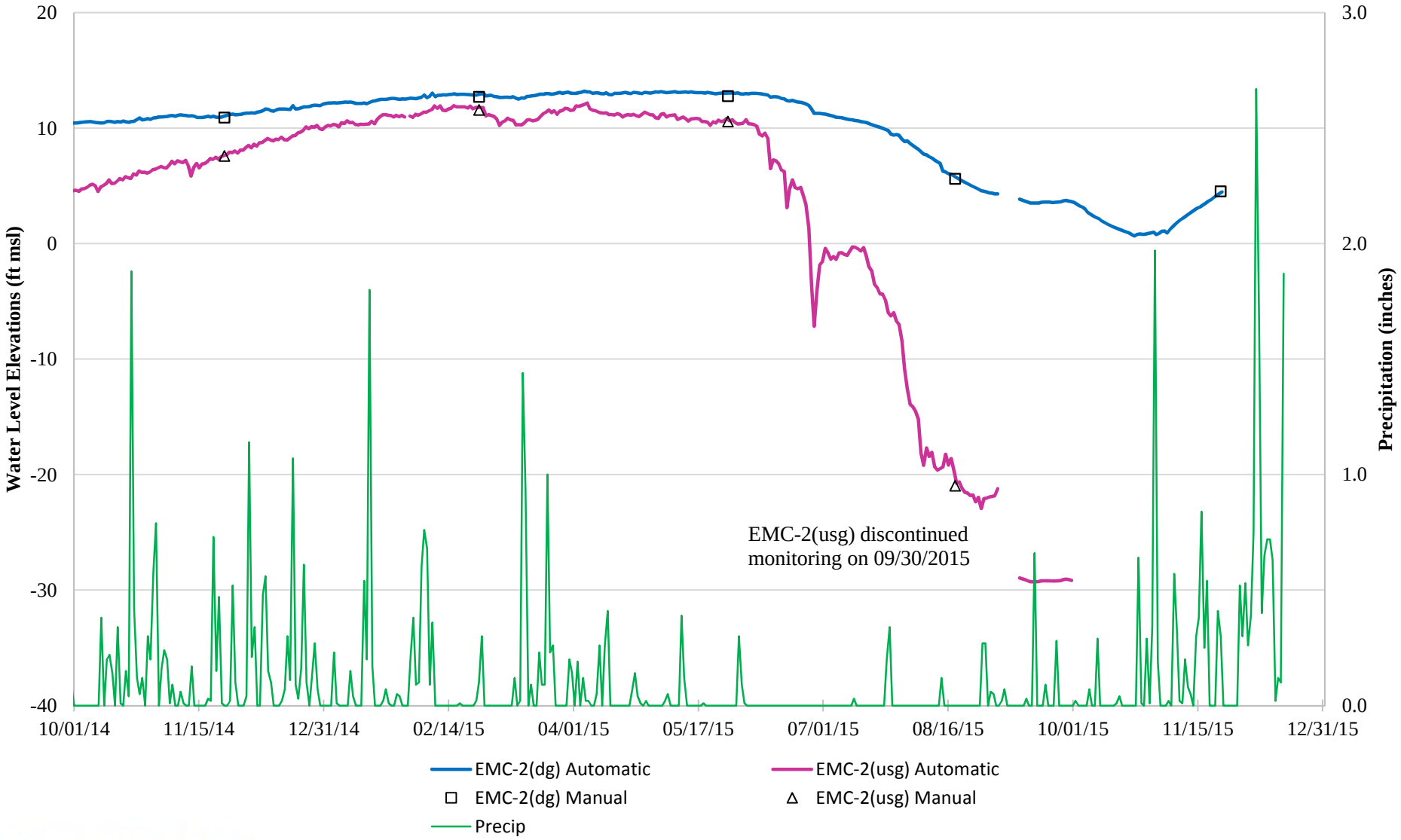
Cascade Corporation Gresham, Oregon	**Hydrograph for TSA Wells** **BOP-70(ds-215) and BOP-71(ds)**	Figure B-7



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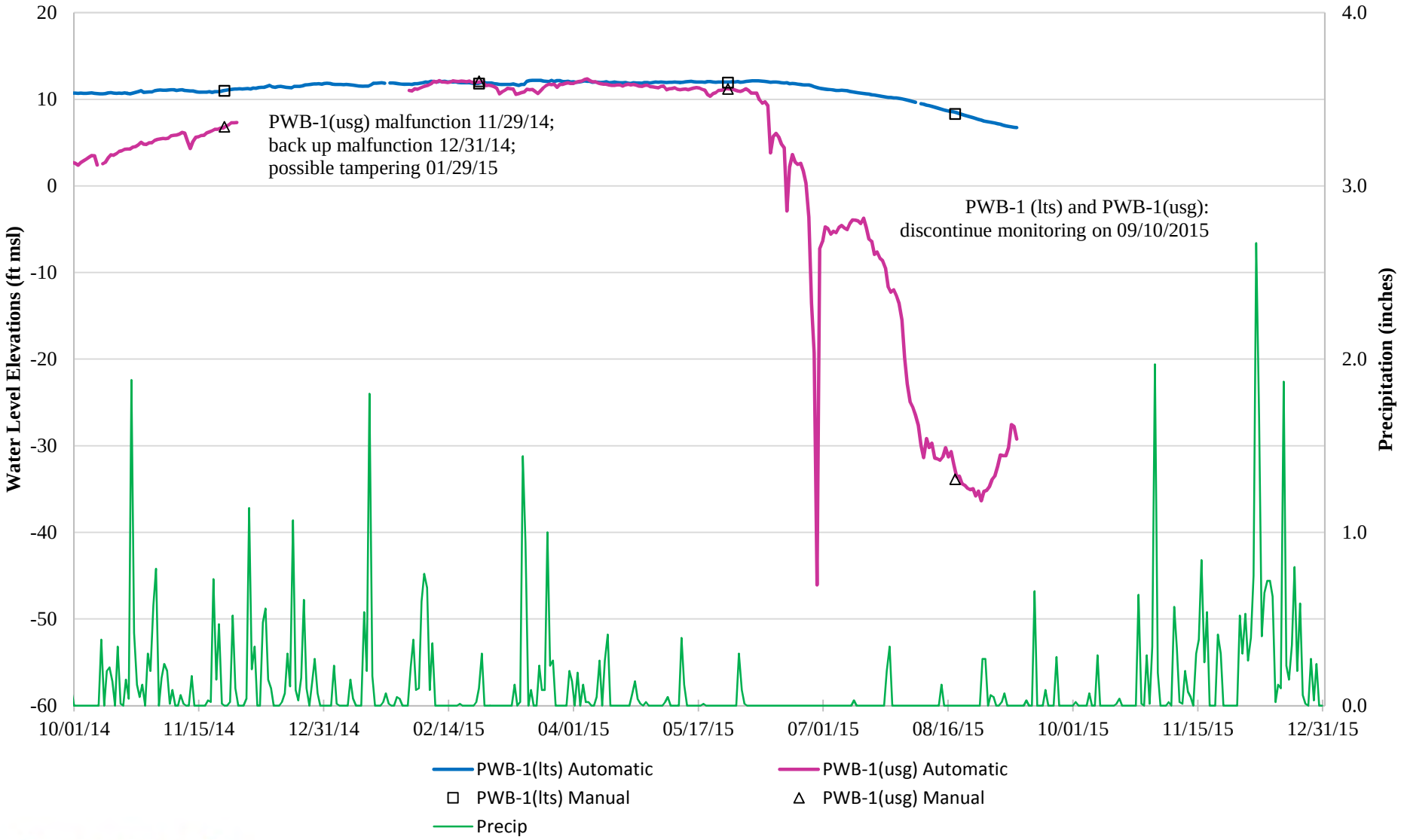
Cascade Corporation Gresham, Oregon	**Hydrograph for TSA Wells EMC-2(dg) and SGA Well EMC-2(usg)**	Figure B-8



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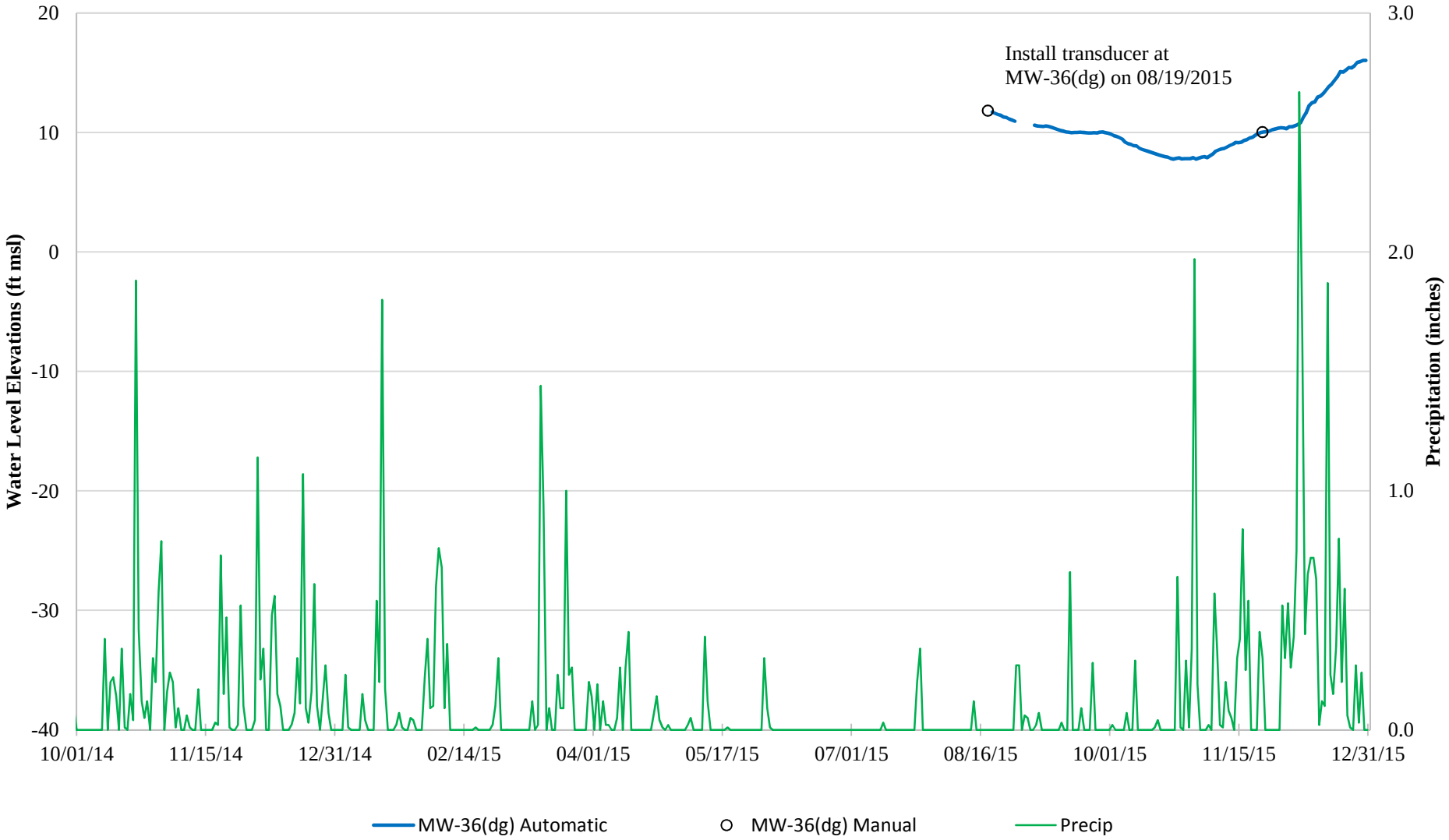
Cascade Corporation Gresham, Oregon	**Hydrograph for TSA Wells PWB-1(lts) and SGA Well PWB-1(usg)**	Figure B-9



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Cascade Corporation Gresham, Oregon	**Hydrograph for TSA Wells MW-36(dg)**	Figure B-10

APPENDIX C

Groundwater Quality Data

Table C-1
Groundwater Analytical Results - (ug/L)
1 Oct. 2014 through 31 Dec. 2015
TSA Remedy - Gresham, Oregon

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride
System Influent/Effluent								
Lower	TS-C-Inf	TS-C-INF-020215	2/2/2015	6.4	< 1.0	< 1.0	< 1.0	< 1.0
Lower	TS-C-Inf	TS-C-INF-050515	5/5/2015	3.5	< 1.0	< 1.0	< 1.0	< 1.0
Lower	TS-C-Inf	TS-C-INF-080315	8/3/2015	5.4	< 1.0	< 1.0	< 1.0	< 1.0
Lower	TS-C-Inf	TS-C-INF-102915	10/29/2015	3.96	< 1.0	< 1.0	< 1.0	< 1.0
Lower	TS-C-Eff	TS-C-EFF-020215	2/2/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	TS-C-Eff	TS-C-EFF-020215-DUP	2/2/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	TS-C-Eff	TS-C-EFF-050515	5/5/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	TS-C-Eff	TS-C-EFF-050515-DUP	5/5/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	TS-C-Eff	TS-C-EFF-080315	8/3/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	TS-C-Eff	TS-C-EFF-080315-DUP	8/3/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	TS-C-Eff	TS-C-EFF-102915	10/29/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	TS-C-Eff	TS-C-EFF-102915-DUP	10/29/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Extraction Wells								
Lower	EW-1	EW1-020215	2/2/2015	2.6	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-1	EW1-050515	5/5/2015	3.2	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-1	EW-1-080315	8/3/2015	3.5	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-1	EW1-102915	10/29/2015	3.74	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-2	EW2-020215	2/2/2015	12	< 1.0	1.2	< 1.0	< 1.0
Lower	EW-2	EW2-050515	5/5/2015	10	< 1.0	1.2	< 1.0	< 1.0
Lower	EW-2	EW-2-080315	8/3/2015	10	< 1.0	1.1	< 1.0	< 1.0
Lower	EW-2	EW2-102915	10/29/2015	10.6	< 1.0	1.10	< 1.0	< 1.0
Lower	EW-14	EW14-020215	2/2/2015	7.8	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-14	EW14-050515	5/5/2015	6.5	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-14	EW-14-080315	8/3/2015	6.8	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-14	EW-14-080315-DUP	8/3/2015	7.1	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-14	EW14-102915	10/29/2015	8.01	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-15	EW-15-080415-L	8/4/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-15	EW-15-080415-U	8/4/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-16	EW16-020215	2/2/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-16	EW16-050515	5/5/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-16	EW-16-080315	8/3/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-16	EW16-102915	10/29/2015	< 1.00	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-23	EW23-020215	2/2/2015	4.5	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-23	EW-23-080315	8/3/2015	1.9	< 1.0	< 1.0	< 1.0	< 1.0
Monitoring Wells								
Lower	BOP-13dg	BOP-13dg-0815	8/6/2015	0.80	< 0.20	< 0.20	< 0.20	< 0.20
Lower	BOP-13dg	BOP-13dg-0816	8/7/2015	0.81	< 0.21	< 0.21	< 0.21	< 0.21
Lower	BOP-20dg	BOP-20dg-1115	11/5/2015	0.90	< 0.20	< 0.20	< 0.20	< 0.20
Lower	BOP-22dg	BOP-22dg-0815	8/28/2015	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Lower	BOP-23dg	BOP-23dg-0815	8/6/2015	0.70	< 0.20	< 0.20	< 0.20	< 0.20
Lower	BOP-23dg	BOP-23dg-1115	11/5/2015	0.80	< 0.20	< 0.20	< 0.20	< 0.20
Lower	BOP-31dg	BOP-31dg-0215	2/3/2015	5.2	0.50	0.60	< 0.20	< 0.20
Lower	BOP-31dg	BOP-31dg-0815	8/6/2015	4.6	0.40	0.50	< 0.20	< 0.20
Lower	BOP-42dg	BOP-42dg-0815	8/5/2015	1.3	< 0.20	0.30	< 0.20	< 0.20

Table C-1
Groundwater Analytical Results - (ug/L)
1 Oct. 2014 through 31 Dec. 2015
TSA Remedy - Gresham, Oregon

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride
Lower	BOP-44dg	BOP-44DG-080415	8/4/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	BOP-60dg	BOP-60(dg)-0815	8/6/2015	1.5	< 0.20	< 0.20	< 0.20	< 0.20
Lower	BOP-60dg	BOP-Y-0815	8/6/2015	1.5	< 0.20	< 0.20	< 0.20	< 0.20
Lower	BOP-60dg	BOP-60dg-1115	11/5/2015	2.1	< 0.20	0.20	< 0.20	< 0.20
Lower	BOP-60dg	BOP-Z-1115	11/5/2015	2.2	< 0.20	0.20	< 0.20	< 0.20
Lower	BOP-61dg	BOP-61dg-0215	2/3/2015	5.1	< 0.20	0.50	< 0.20	< 0.20
Lower	BOP-61dg	BOP-61dg-0815	8/6/2015	5.8	0.20	0.70	< 0.20	< 0.20
Lower	CMW-8dg	MW-8DG-080515	8/5/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-10dg	MW-10DG-080515	8/5/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-14Rds	CMW14RDS-020215	2/2/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-14Rds	CMW14RDS-050515	5/5/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-14Rds	MW-14RDS-080315	8/3/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-14Rds	CMW14RDS-102915	10/29/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-22dg	MW-22DG-080315	8/3/2015	1.4	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-24dg (EW-5)	CMW24DG-020215-L	2/2/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-24dg (EW-5)	CMW24DG-020215-U	2/2/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-24dg (EW-5)	MW-24DG-080415-L	8/4/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-24dg (EW-5)	MW-24DG-080415-U	8/4/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-25dg	CMW25DG-020215	2/2/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-25dg	MW-25DG-080415	8/4/2015	1.3	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-26dg	CMW26DG-020215	2/2/2015	3.3	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-26dg	CMW26DG-050515	5/5/2015	2.9	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-26dg	MW-26DG-080415	8/4/2015	2.3	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-26dg	MW-26DG-080415-DUP	8/4/2015	3.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-26dg	CMW26-102915	10/29/2015	3.49	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-36dg	MW-36DG-080315	8/3/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	CMW-36dg	CMW36DG-102915	10/29/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	D-17dg	D17DG-020215	2/2/2015	8.6	< 1.0	1.8	< 1.0	< 1.0
Lower	D-17dg	D-17DG-080315	8/3/2015	9.0	< 1.0	2.2	< 1.0	< 1.0
Lower	D-17ds	D17DS-020215	2/2/2015	32	1.2	8.2	< 1.0	< 1.0
Lower	D-17ds	D17DS-050515	5/5/2015	34	< 1.0	12	< 1.0	< 1.0
Lower	D-17ds	D-17DS-080315	8/3/2015	27	< 1.0	7.9	< 1.0	< 1.0
Lower	D-17ds	D17DS-102915	10/29/2015	37.7	< 1.00	11.1	< 1.0	< 1.0
Lower	EW-8	EW8-020215-L	2/2/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-8	EW8-020215-U	2/2/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-8	EW-8-080415-L	8/4/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-8	EW-8-080415-U	8/4/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-11	EW-11-080415-L	8/4/2015	1.1	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-11	EW-11-080415-U	8/4/2015	1.2	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-12	EW12-020215-L	2/2/2015	4.0	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-12	EW12-020215-U	2/2/2015	4.1	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-12	EW12-050515-L	5/5/2015	3.9	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-12	EW12-050515-U	5/5/2015	3.3	< 1.0	< 1.0	< 1.0	< 1.0

Table C-1
Groundwater Analytical Results - (ug/L)
1 Oct. 2014 through 31 Dec. 2015
TSA Remedy - Gresham, Oregon

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride
Lower	EW-12	EW-12-080315-L	8/3/2015	3.3	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-12	EW-12-080315-U	8/3/2015	3.5	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-12	EW12-102915-U	10/29/2015	2.60	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-12	EW12-102915-L	10/29/2015	2.67	< 1.0	< 1.0	< 1.0	< 1.0
Lower	EW-13	EW-13-0215	2/11/2015	0.70	< 0.20	< 0.20	< 0.20	< 0.20
Lower	EW-13	EW-13-0815	8/7/2015	0.60	< 0.20	0.20	< 0.20	< 0.20
Lower	PWB-1lts	PWB-1LTS-080515	8/5/2015	1.6	< 1.0	< 1.0	< 1.0	< 1.0
Upper	BOP-13ds	BOP-13ds-0215	2/5/2015	2.8	< 0.20	0.40	< 0.20	< 0.20
Upper	BOP-13ds	BOP-Z-0215	2/5/2015	3.0	< 0.20	0.40	< 0.20	< 0.20
Upper	BOP-13ds	BOP-13ds-0515	5/4/2015	2.9	< 0.20	0.40	< 0.20	< 0.20
Upper	BOP-13ds	BOP-13ds-0815	8/6/2015	3.7	< 0.20	0.50	< 0.20	< 0.20
Upper	BOP-13ds	BOP-13ds-1115	11/3/2015	3.7	< 0.20	0.50	< 0.20	< 0.20
Upper	BOP-20ds	BOP-20ds-0815	8/6/2015	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-20ds	BOP-Z-0815	8/6/2015	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-20ds	BOP-20ds-1115	11/5/2015	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-21ds	BOP-21ds-0815	8/6/2015	1.3	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-21ds	BOP-21ds-1115	11/5/2015	< 0.20	< 0.20	1.3	< 0.20	< 0.20
Upper	BOP-22Rds	BOP-22R(ds)-0815	8/6/2015	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-22Rds	BOP-22Rds-1115	11/5/2015	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-31ds	BOP-31ds-0215	2/5/2015	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-31ds	BOP-31ds-0515	5/4/2015	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-31ds	BOP-31ds-0815	8/6/2015	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-42ds	BOP-42ds-0815	8/5/2015	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-44ds	BOP-44DS-080415	8/4/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Upper	BOP-60Rds	BOP-60R(ds)-0815	8/6/2015	0.40	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-61ds	BOP-61ds-0215	2/9/2015	8.7	0.40	1.3	< 0.20	< 0.20
Upper	BOP-61ds	BOP-61ds-0815	8/6/2015	5.1	0.20	0.40	< 0.20	< 0.20
Upper	BOP-62ds	BOP-62ds-0815	8/6/2015	0.70	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-65ds	BOP-65ds-0215	2/11/2015	1.3	< 0.20	0.40	< 0.20	< 0.20
Upper	BOP-65ds	BOP-65ds-0815	8/6/2015	0.90	< 0.20	0.20	< 0.20	< 0.20
Upper	BOP-66ds	BOP-66ds-0215	2/11/2015	3.6	< 0.20	< 0.20	< 0.20	< 0.20
Upper	BOP-66ds	BOP-66ds-0815	8/6/2015	2.9	< 0.20	< 0.20	< 0.20	< 0.20
Upper	CMW-10ds	CMW10DS-020215	2/2/2015	22	< 1.0	< 1.0	< 1.0	< 1.0
Upper	CMW-10ds	CMW10DS-050515	5/5/2015	23	1.0	< 1.0	< 1.0	< 1.0
Upper	CMW-10ds	MW-10DS-080515	8/5/2015	21	< 1.0	< 1.0	< 1.0	< 1.0
Upper	CMW-10ds	CMW10DS-102915	10/29/2015	22.3	< 1.0	< 1.0	< 1.0	< 1.0
Upper	CMW-17ds	CMW17DS-020215	2/2/2015	52	2.5	7.3	< 1.0	< 1.0
Upper	CMW-17ds	CMW17DS-050515	5/5/2015	50	2.2	8.6	< 1.0	< 1.0
Upper	CMW-17ds	MW-17DS-080315	8/3/2015	37	1.4	7.0	< 1.0	< 1.0
Upper	CMW-17ds	CMW17DS-102915	10/29/2015	42.1	1.94	6.70	< 1.0	< 1.0
Upper	CMW-17ds	CMW17DS-102915-DUP	10/29/2015	40.2	1.91	6.30	< 1.0	< 1.0
Upper	CMW-17ds	CMW17DS-113015	11/30/2015	43.7	1.45	6.71	< 1.0	< 1.0
Upper	CMW-17ds	CMW17DS-122815	12/28/2015	49.4	1.69	7.07	< 1.0	< 1.0

Table C-1
Groundwater Analytical Results - (ug/L)
1 Oct. 2014 through 31 Dec. 2015
TSA Remedy - Gresham, Oregon

TSA Zone	Monitoring Well ID	Sample ID	Sample Date	Trichloroethene (TCE)	Tetrachloroethene (PCE)	cis-1,2-Dichloroethene	1,1-Dichloroethene	Vinyl Chloride
Upper	CMW-18ds	CMW18DS-020215	2/2/2015	57	2.8	6.4	< 1.0	< 1.0
Upper	CMW-18ds	CMW18DS-050515	5/5/2015	58	1.1	8.5	< 1.0	< 1.0
Upper	CMW-18ds	CMW18DS-050515-DUP	5/5/2015	60	1.3	9.4	< 1.0	< 1.0
Upper	CMW-18ds	MW-18DS-080315	8/3/2015	54	< 1.0	8.6	< 1.0	< 1.0
Upper	CMW-18ds	CMW18DS-102915	10/29/2015	75.7	2.52	11.1	< 1.0	< 1.0
Upper	CMW-18ds	CMW18DS-102915-DUP	10/29/2015	79.2	2.76	11.3	< 1.0	< 1.0
Upper	CMW-19ds	CMW19DS-020215	2/2/2015	5.4	< 1.0	< 1.0	< 1.0	< 1.0
Upper	CMW-19ds	CMW19DS-050515	5/5/2015	1.6	< 1.0	< 1.0	< 1.0	< 1.0
Upper	CMW-19ds	MW-19DS-080515	8/5/2015	1.1	< 1.0	< 1.0	< 1.0	< 1.0
Upper	CMW-19ds	CMW19DS-102915	10/29/2015	6.66	< 1.0	< 1.0	< 1.0	< 1.0
Upper	CMW-20ds	MW-20DS-080515	8/5/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Upper	D-16ds	D-16DS-080415	8/4/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Upper	D-18ds	D-18DS-080415	8/4/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Upper	D-18ds	D-18DS-080415-DUP	8/4/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Upper	EW-3	EW-3-0215	2/11/2015	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Upper	EW-3	EW-3-0815	8/7/2015	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Upper	PWB-1uts	PWB-1UTS-080515	8/5/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N/A	IDW	SOILBIN-20151110	11/10/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
N/A	IDW	MW99-20151110	11/10/2015	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

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.

Sample ID with "DUP" indicates duplicate sample.

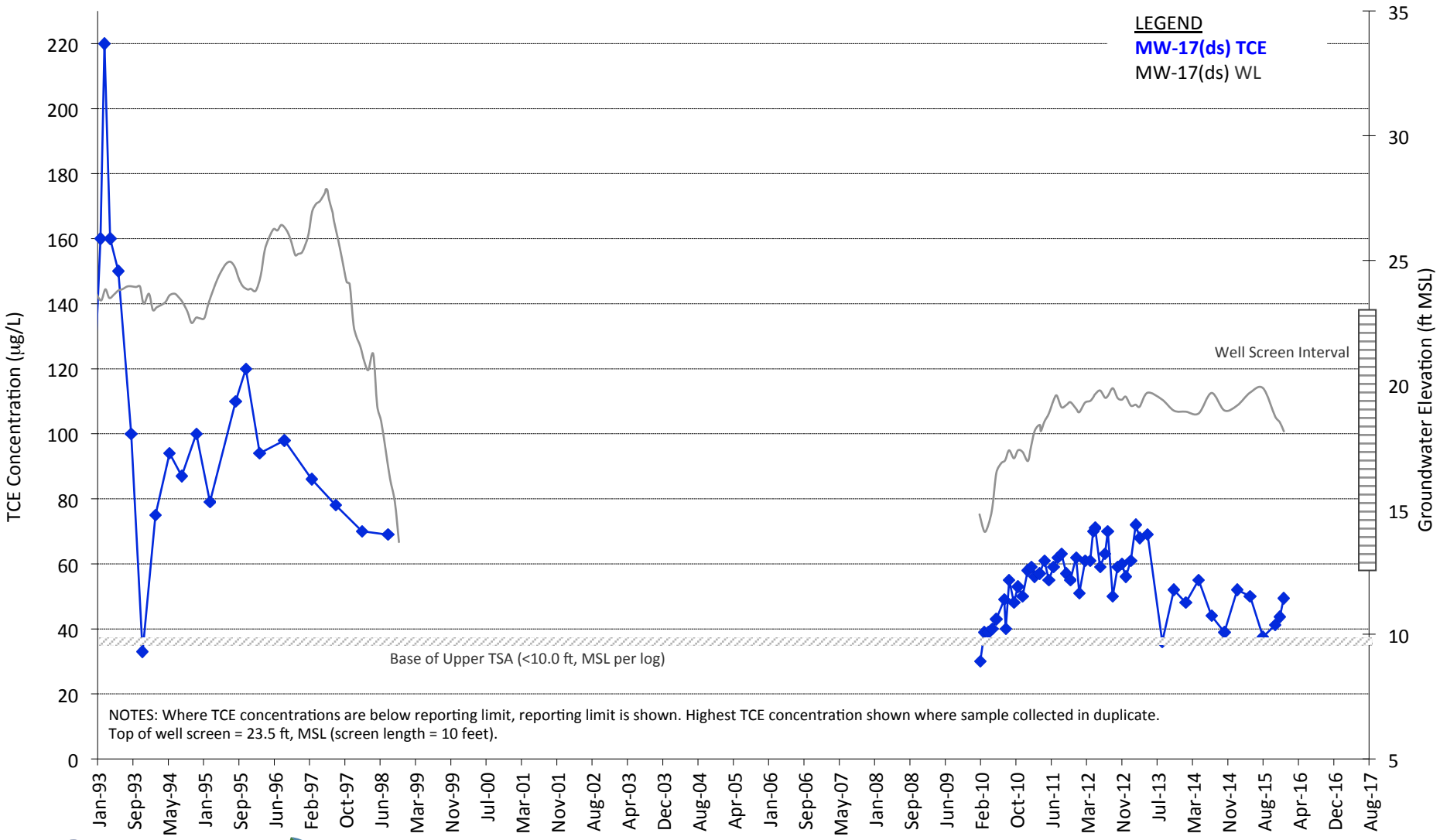
Sample ID with "U" indicates sample collected from the upper portion of the screened interval.

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.

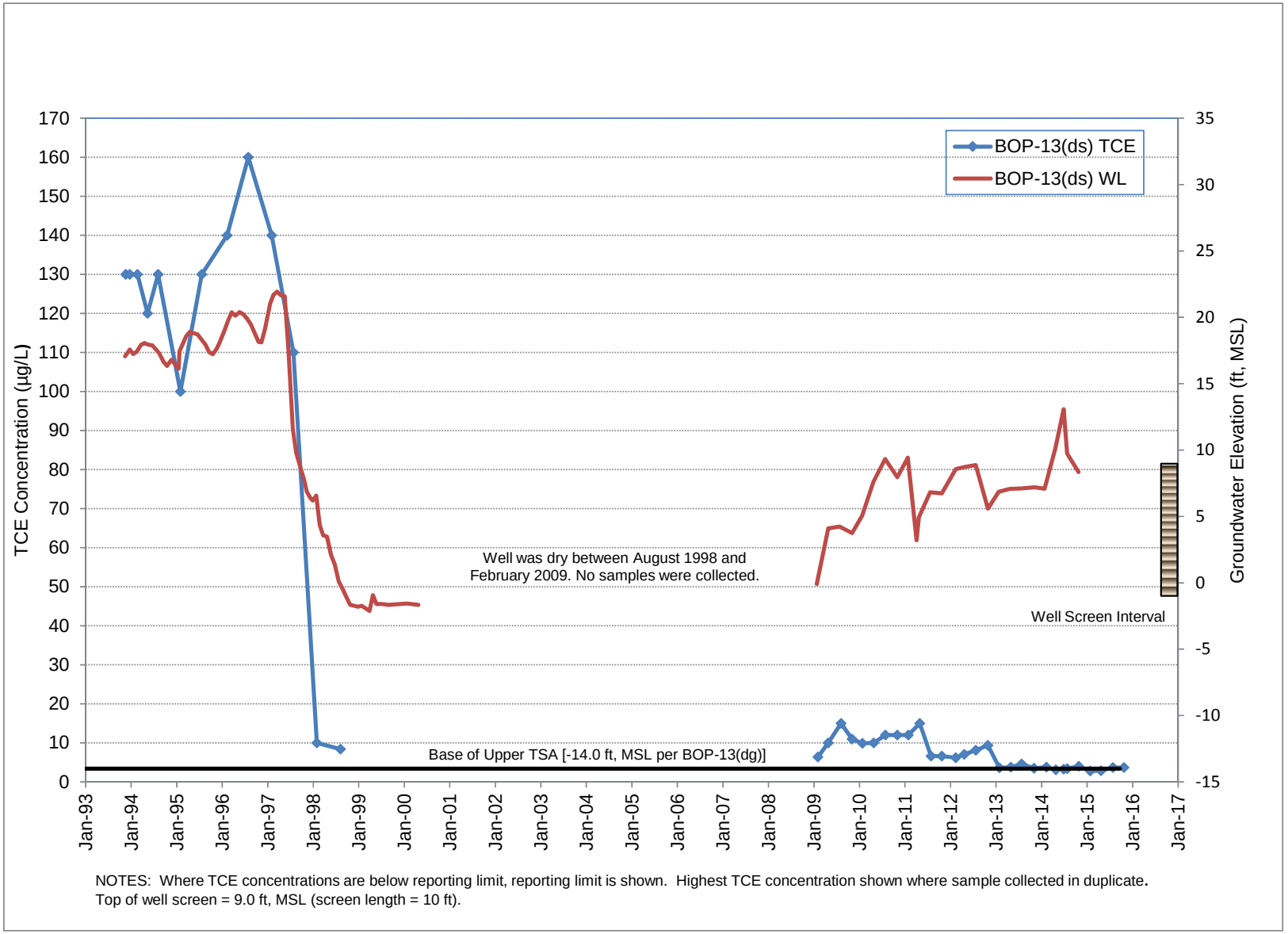
Laboratory and validation reports for above listed samples are presented on a disc in Appendix F.

N/A = not applicable



Geosyntec consultants

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

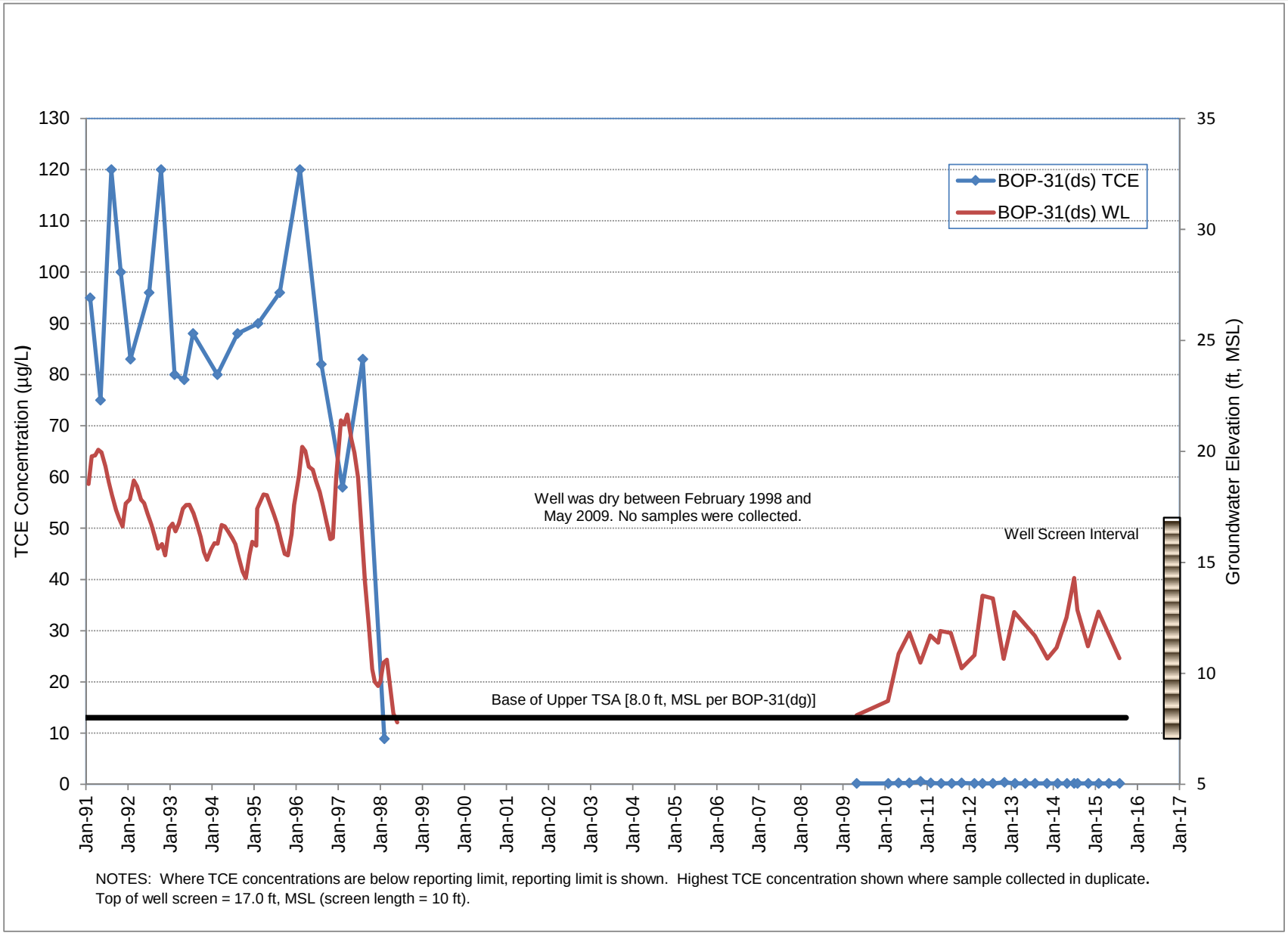


NOTES: Where TCE concentrations are below reporting limit, reporting limit is shown. Highest TCE concentration shown where sample collected in duplicate.
Top of well screen = 9.0 ft, MSL (screen length = 10 ft).

LANDAU ASSOCIATES

Boeing Portland Gresham, Oregon	**TCE Concentration Profile Well BOP-13(ds)**	Figure C-2

Source: P:\025\116\WIP\R\TSA\Semiannual Reports\2015 Rpt



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 = 17.0 ft, MSL (screen length = 10 ft).

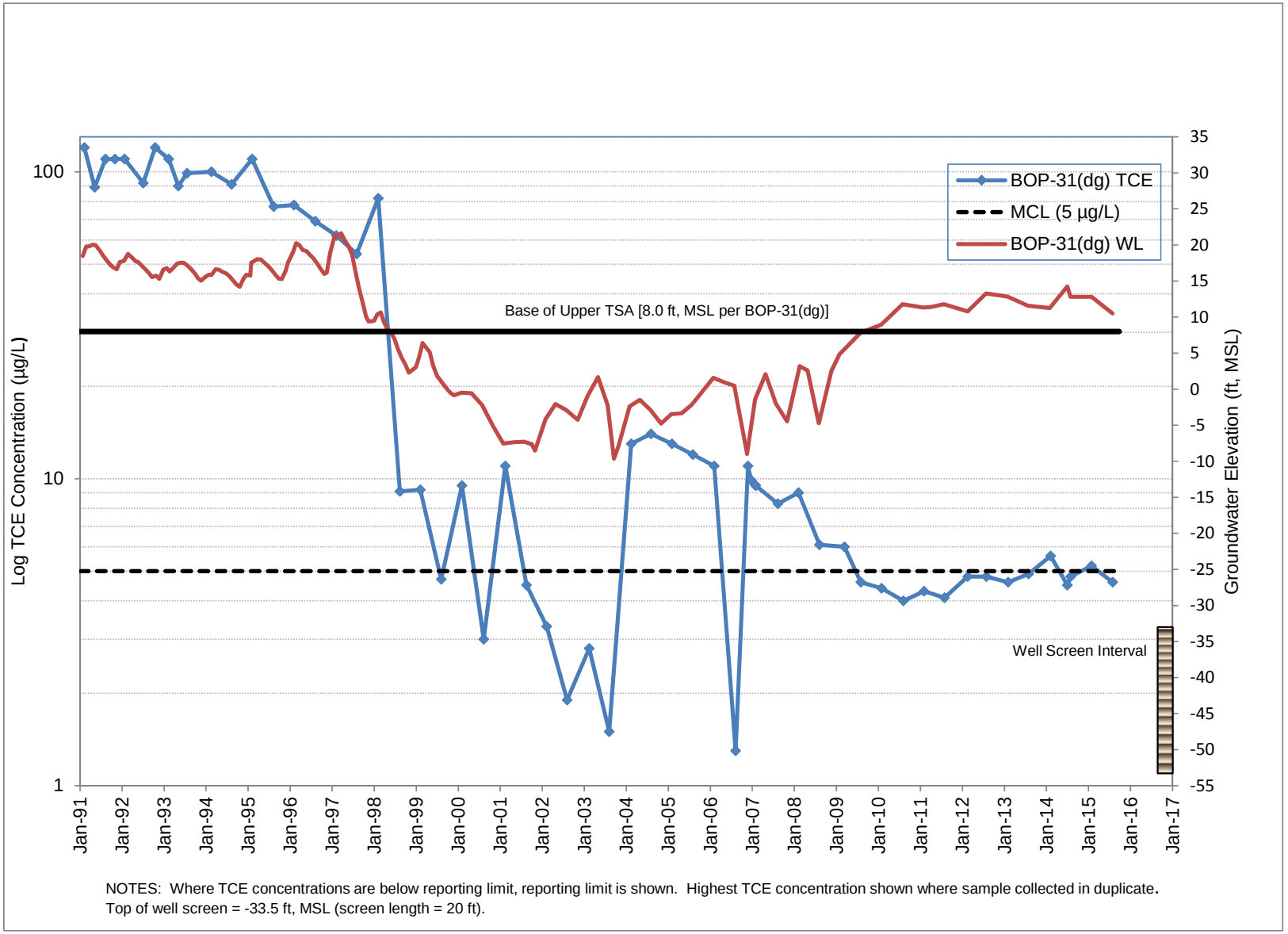
LANDAU ASSOCIATES

Boeing Portland
Gresham, Oregon

TCE Concentration Profile
Well BOP-31(ds)

Figure
C-3

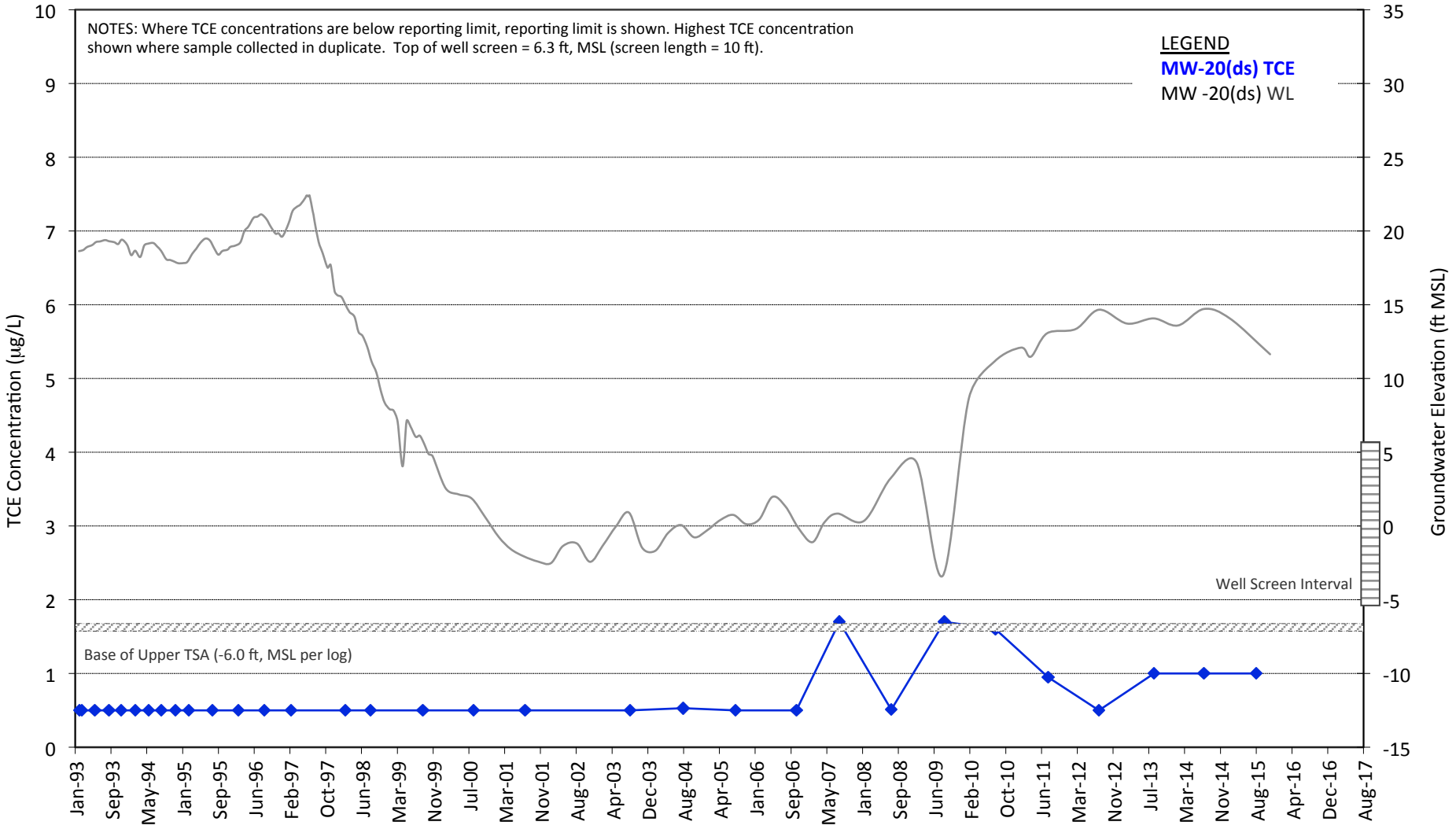
Source: P:\025\116\WIP\R\TSA\Semiannual Reports\2015 Rpt



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 = -33.5 ft, MSL (screen length = 20 ft).

LANDAU ASSOCIATES

Boeing Portland Gresham, Oregon	**TCE Concentration Profile Well BOP-31(dg)**	Figure C-4



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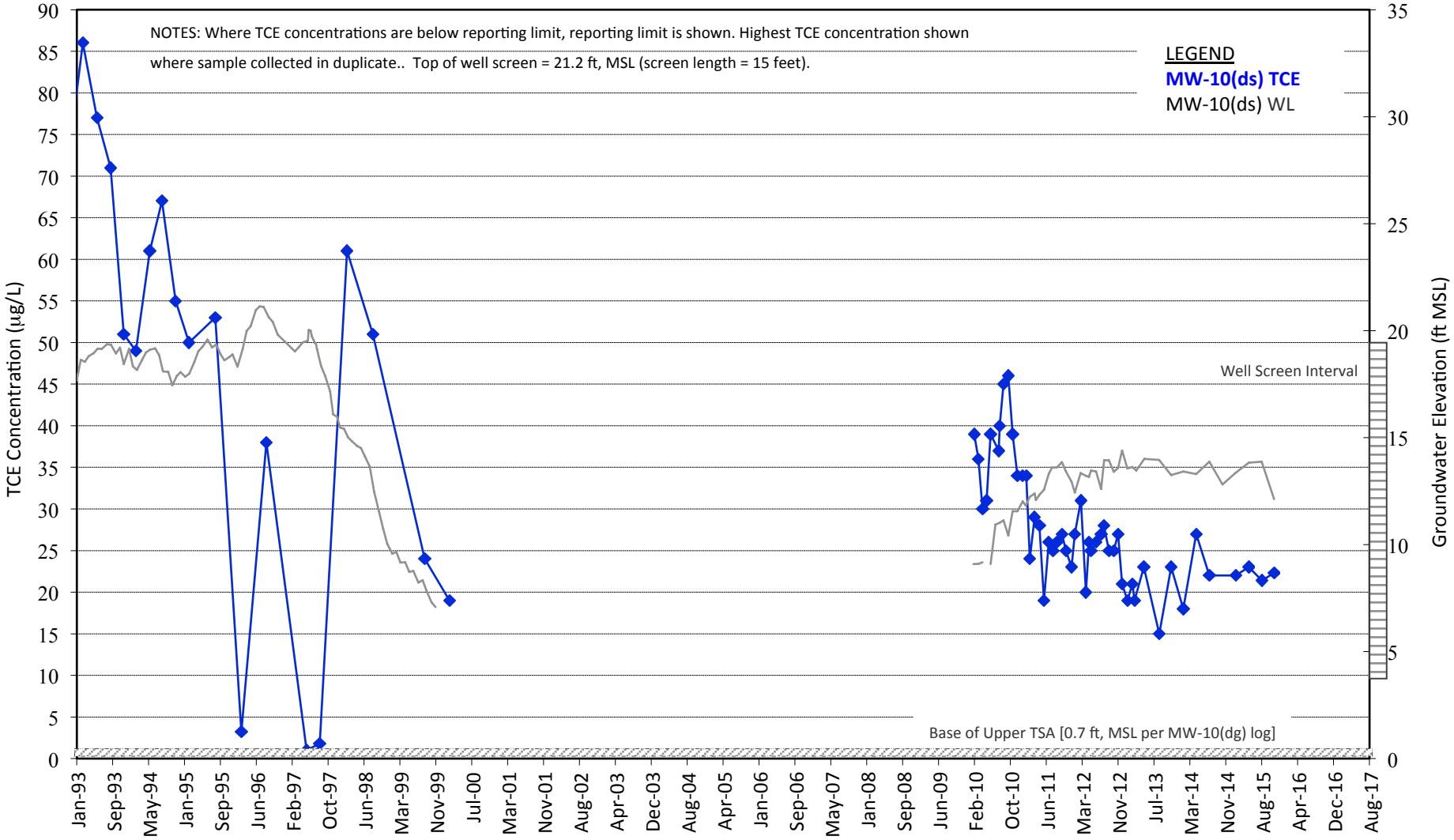
Cascade Corporation Gresham, Oregon	**TCE Concentration Profile MW-20(ds) TSA Remedy**	Figure C-5



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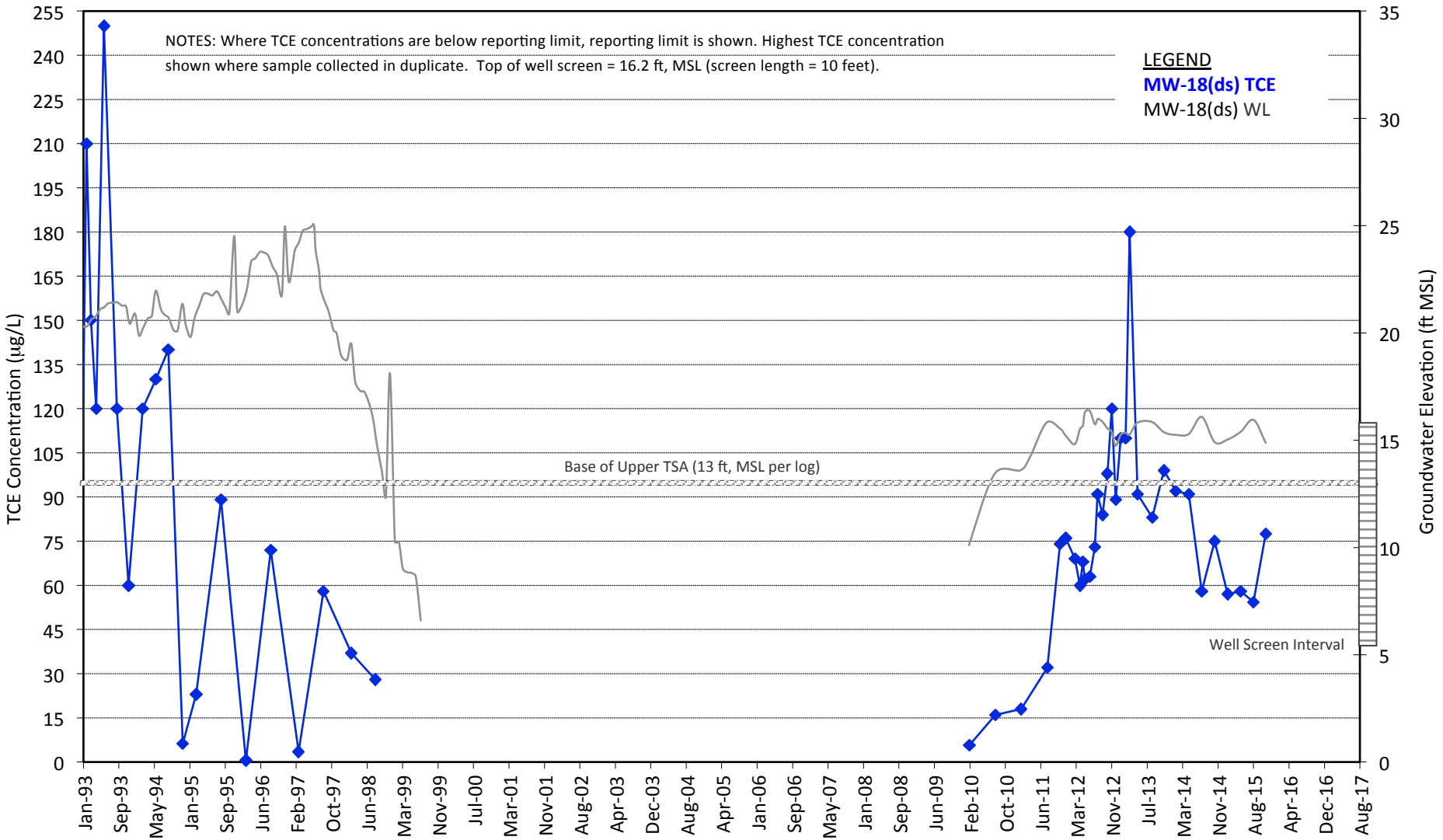
Cascade Corporation Gresham, Oregon	**TCE Concentration Profile MW-10(ds) TSA Remedy**	Figure C-6



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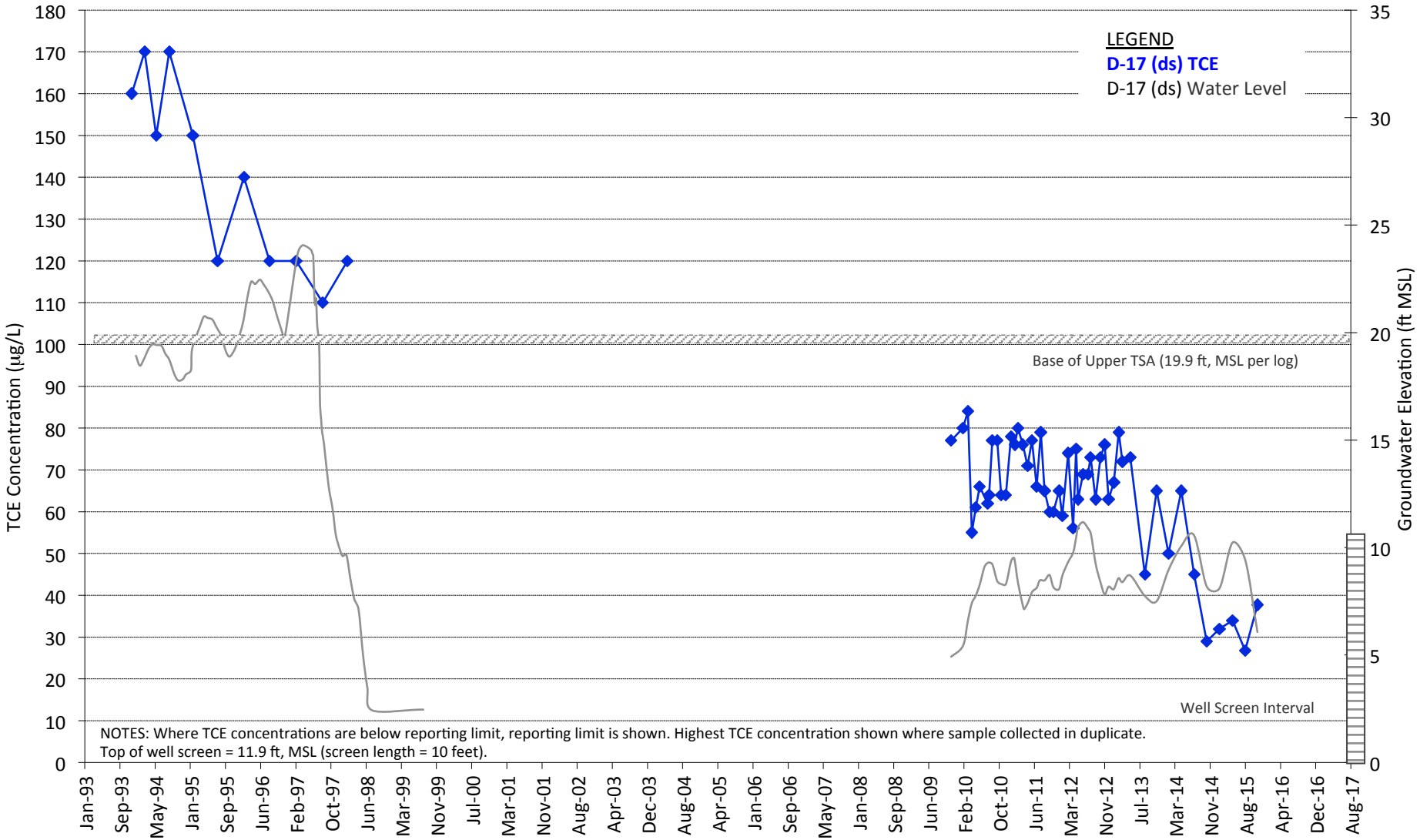
Cascade Corporation Gresham, Oregon	**TCE Concentration Profile MW-18(ds) TSA Remedy**	Figure C-7



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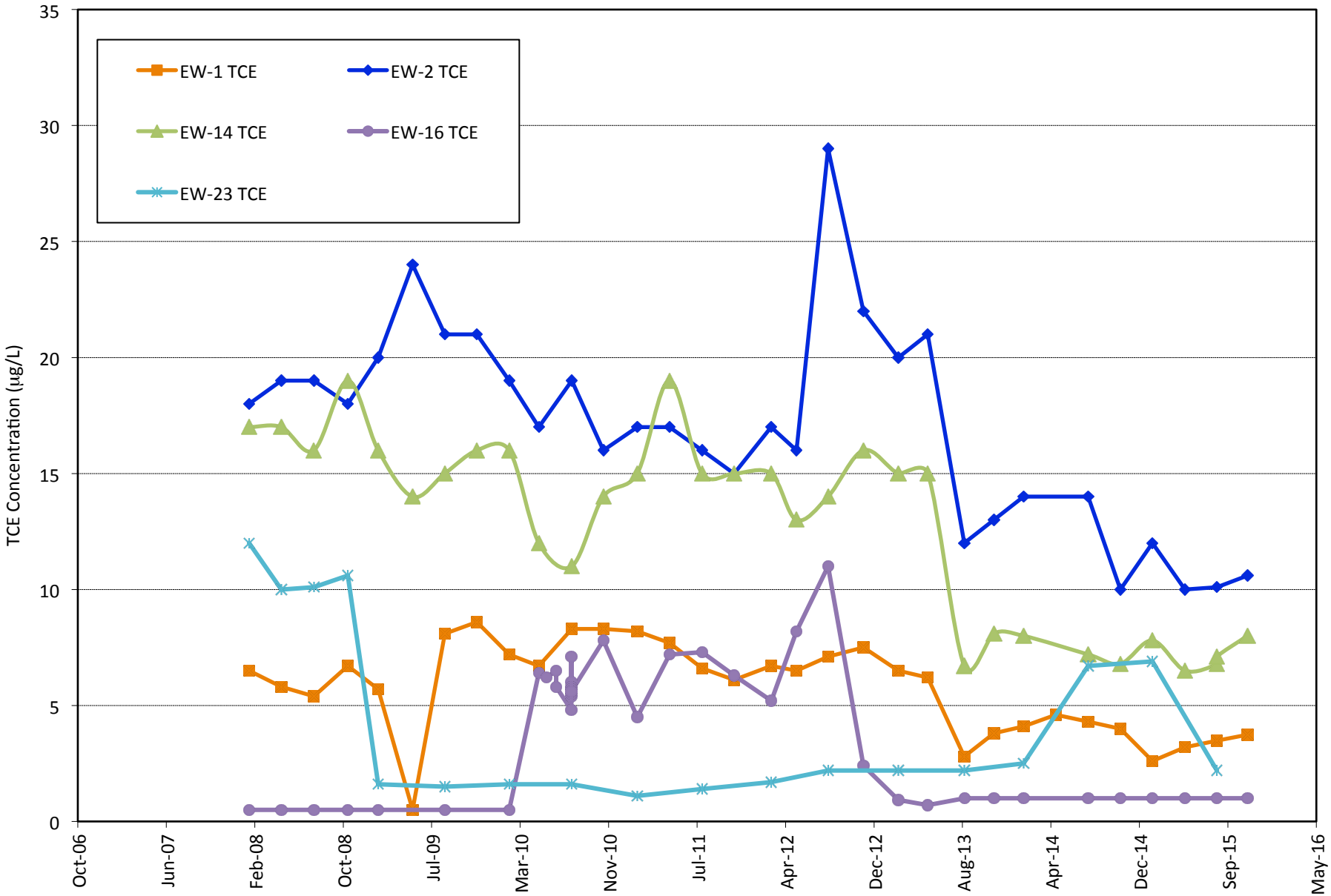
Cascade Corporation Gresham, Oregon	**TCE Concentration Profile D-17(ds)** **TSA Remedy**	Figure C-8



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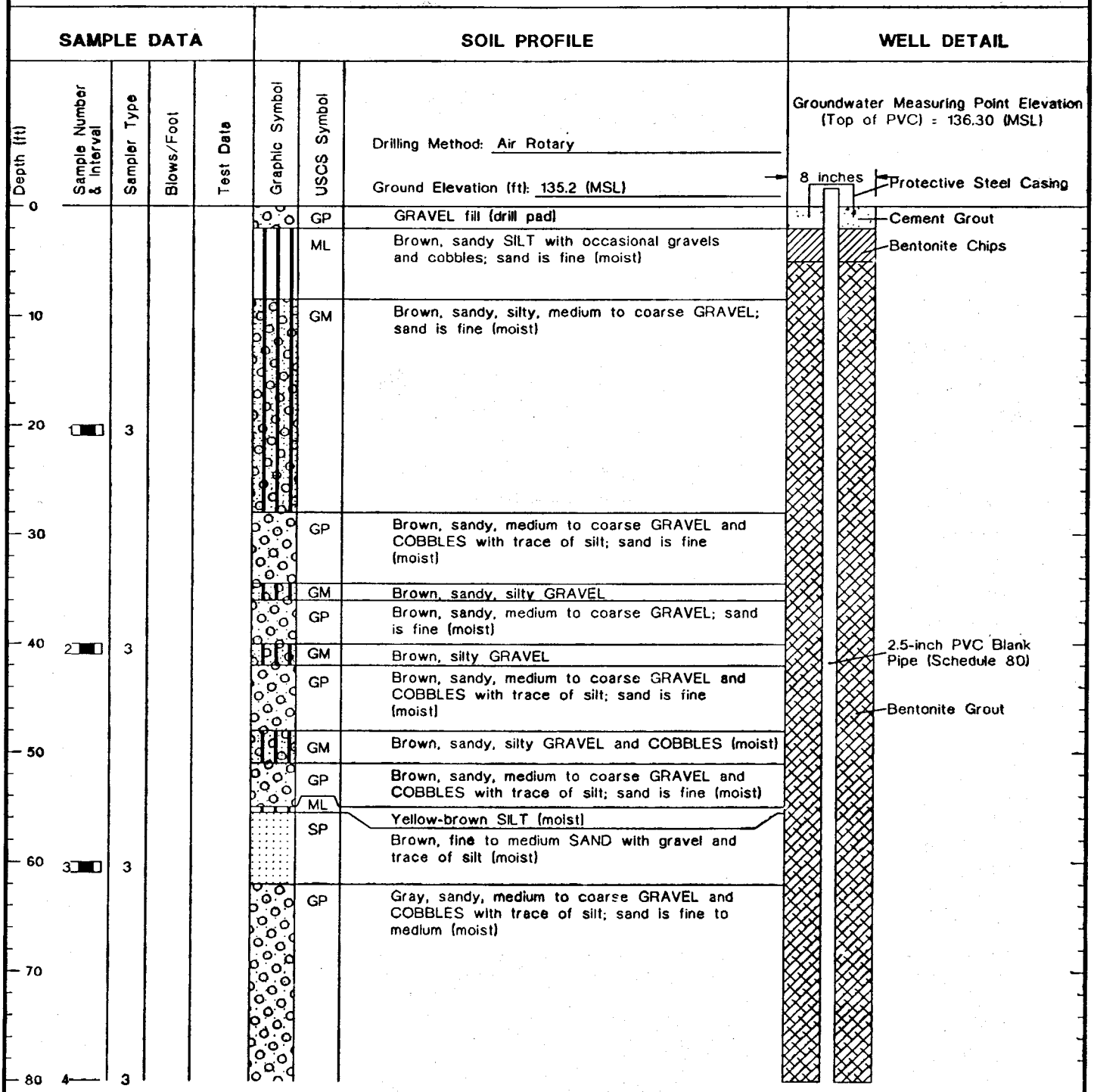
Cascade Corporation Gresham, Oregon	**Operating Extraction Wells TCE Concentration Profiles TSA Remedy**	Figure C-9

Figures C-1 to C-9 - VOC charts_121715.xlsx

APPENDIX D

Well Decommissioning

BOP-41(dg)



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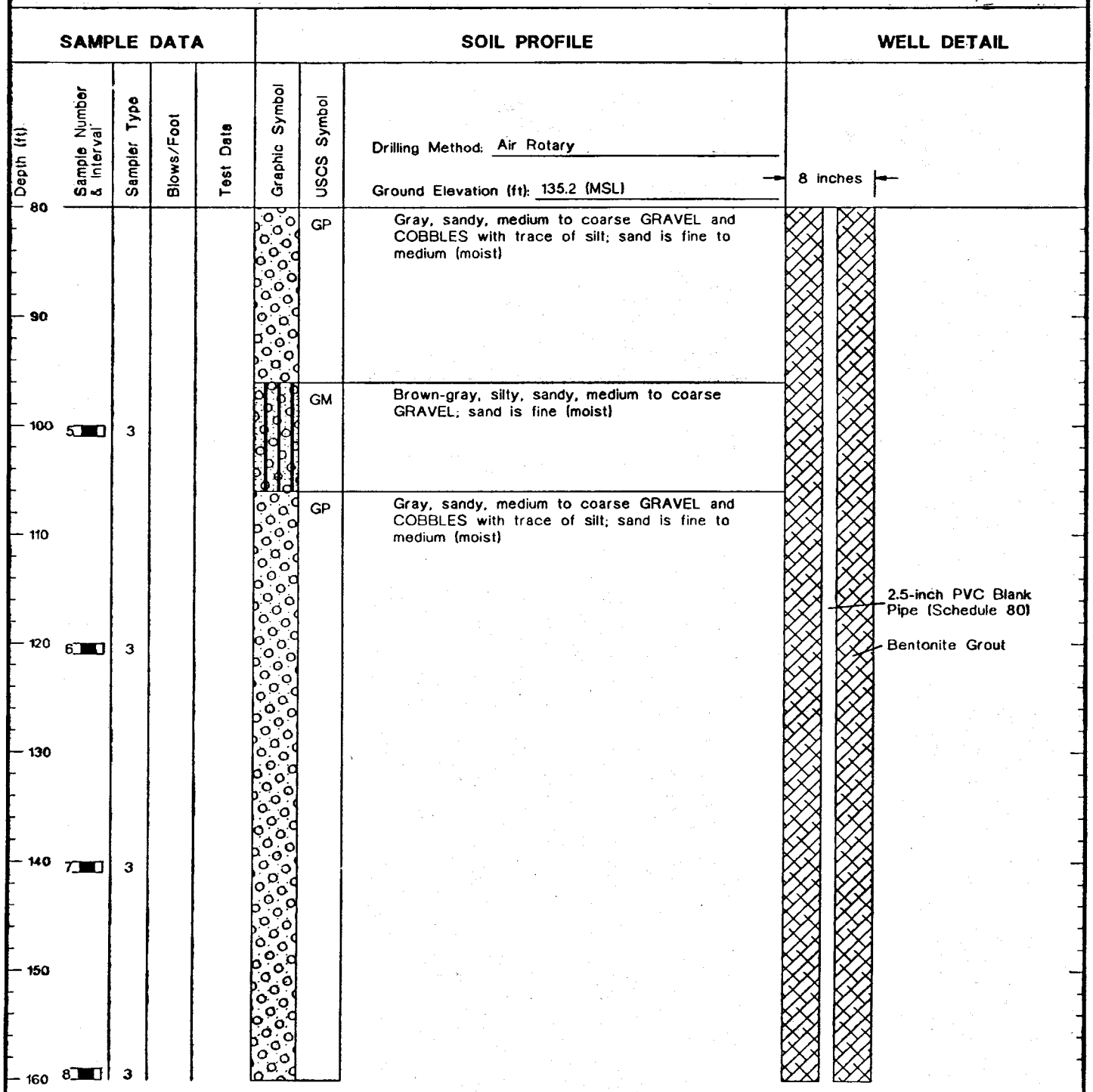
Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Log of Boring and Monitoring Well BOP-41(dg) | Figure C-3

BOP-41(dg) (Continued)

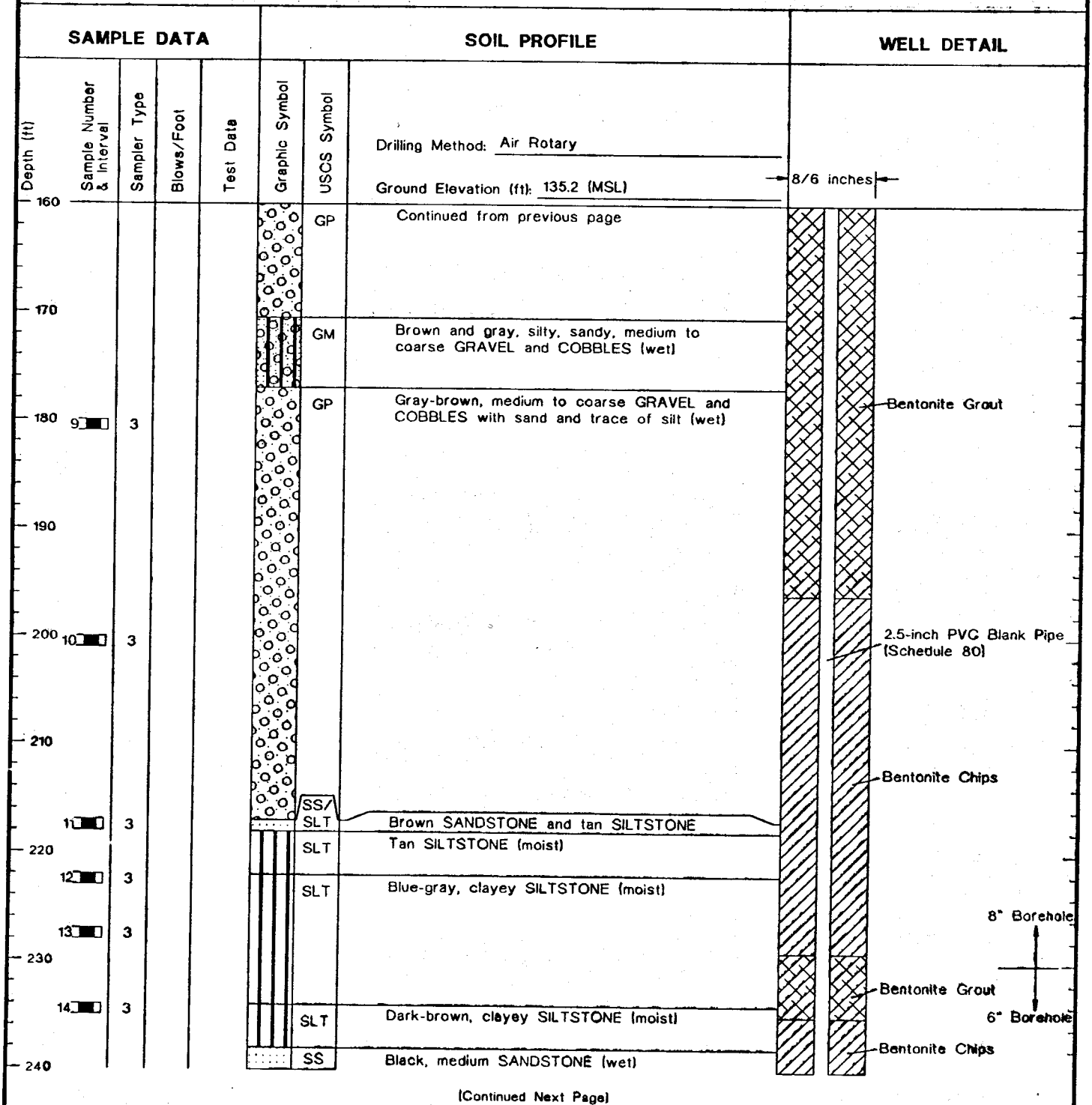


(Continued Next Page)

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Log of Boring and Monitoring Well BOP-41(dg) | Figure C-3

BOP-41(dg) (Continued)

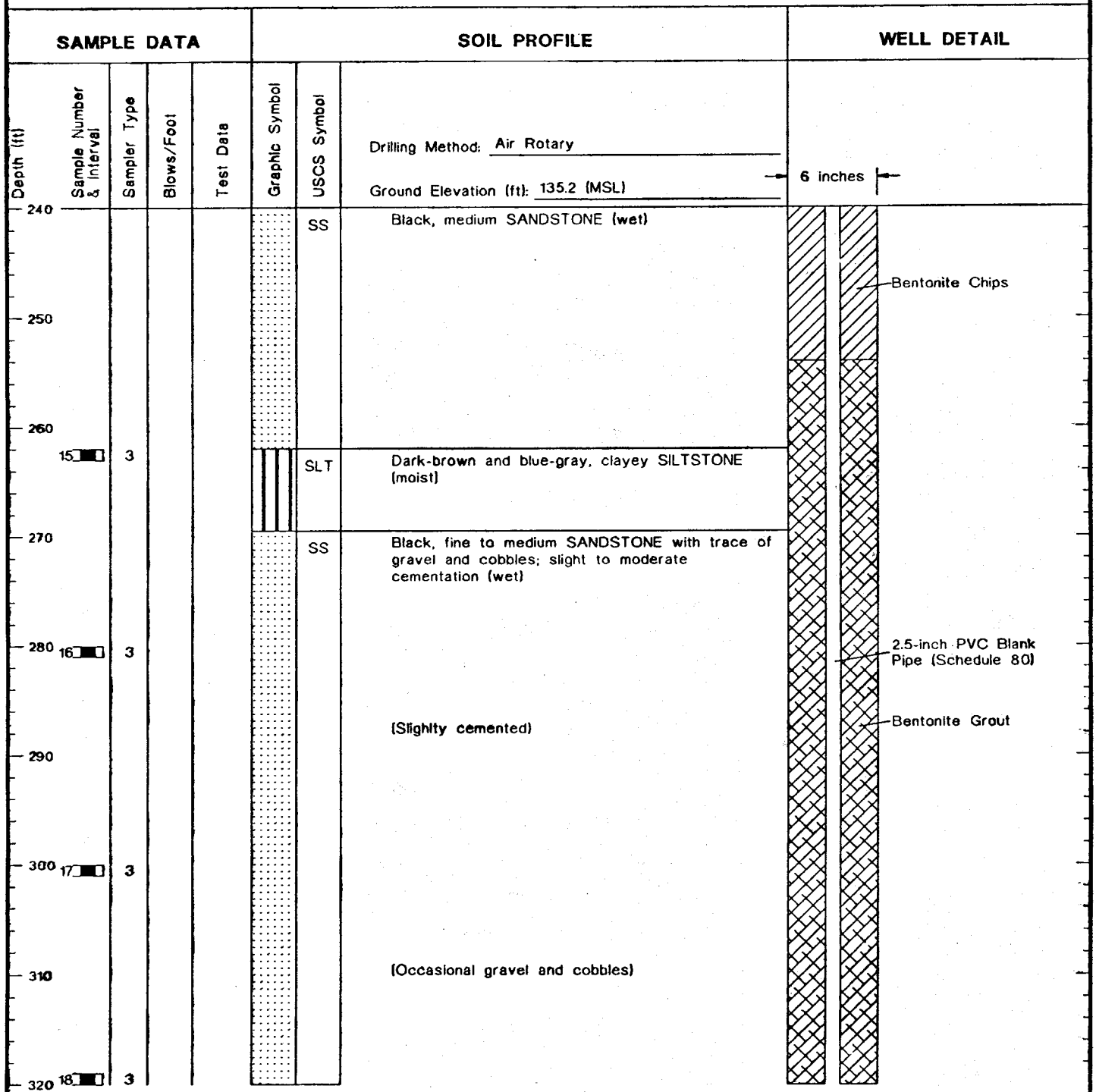


(Continued Next Page)

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Log of Boring and Monitoring Well BOP-41(dg) | Figure C-3

BOP-41(dg) (Continued)

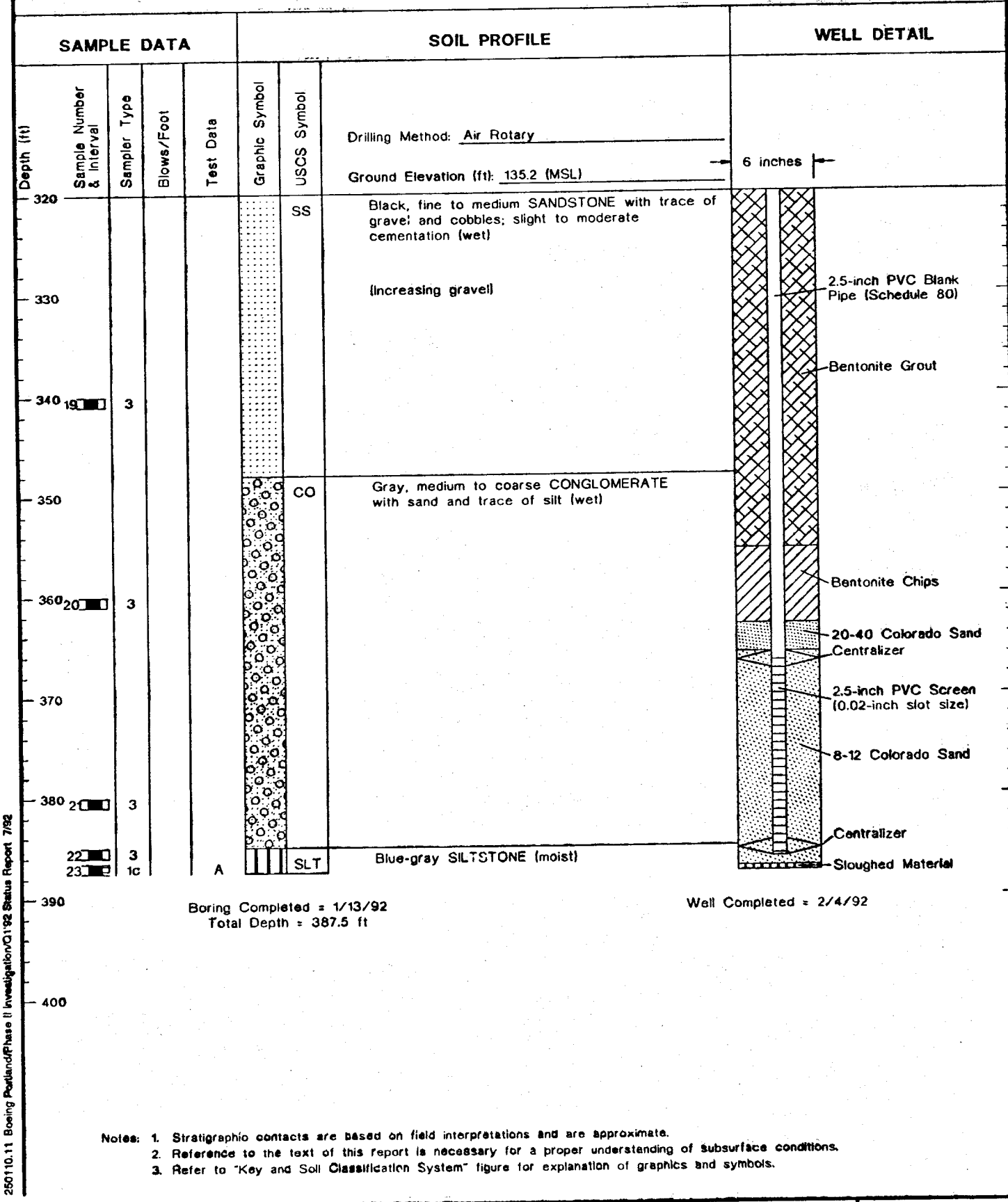


(Continued Next Page)

Notes: 1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Log of Boring and Monitoring Well BOP-41(dg) | Figure C-3

BOP-41(dg) (Continued)



Boring Completed = 1/13/92
Total Depth = 387.5 ft

Well Completed = 2/4/92

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

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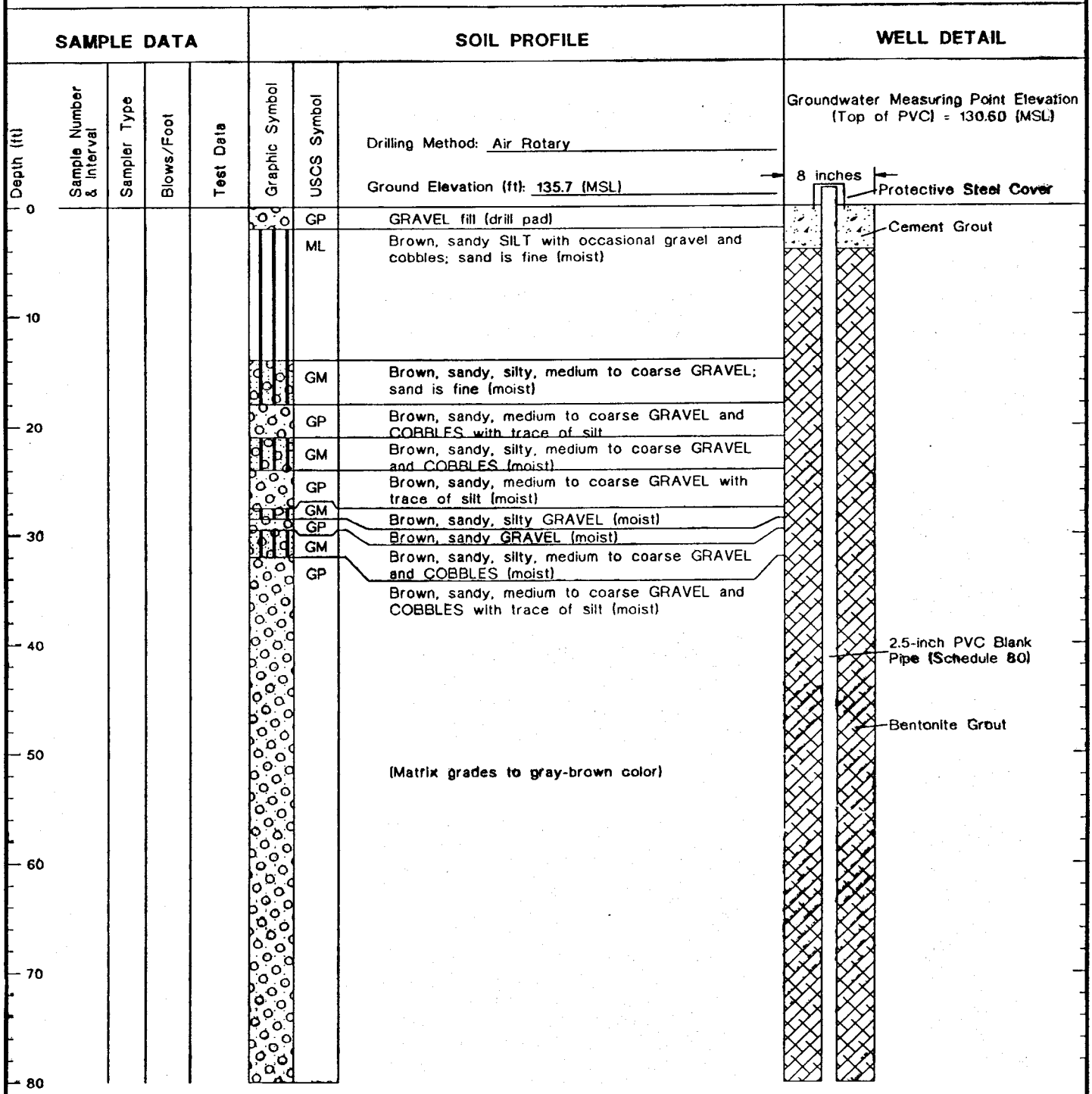
Log of Boring and Monitoring Well BOP-41(dg) | Figure C-3

BOP-41(ds)



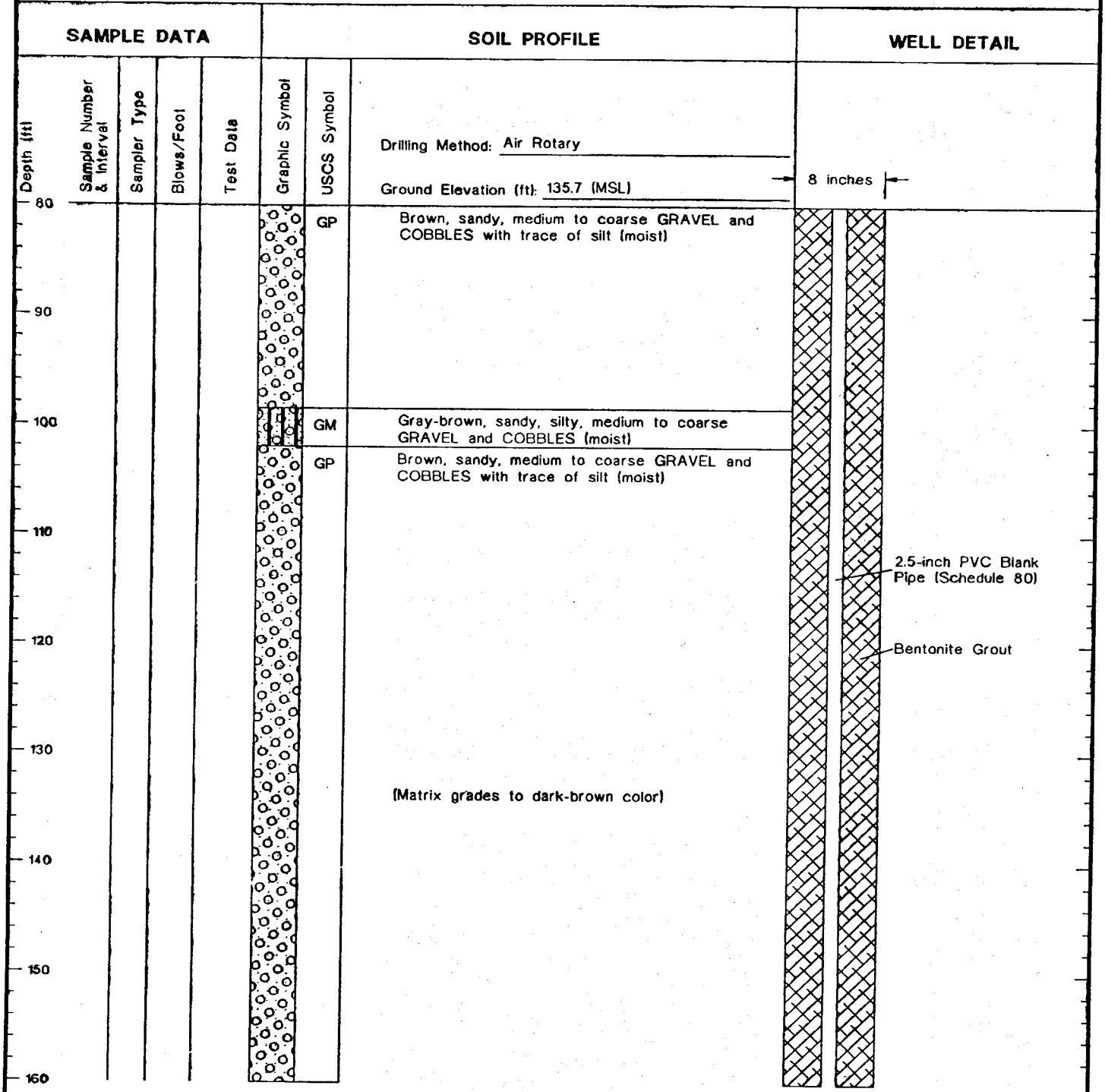
(Continued Next Page)

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

250110.tt Boeing Portland/Phase II Investigation/Oct '92 Status Report 7/92

Log of Boring and Monitoring Well BOP-41(ds) | Figure C-2

BOP-41(ds) (Continued)

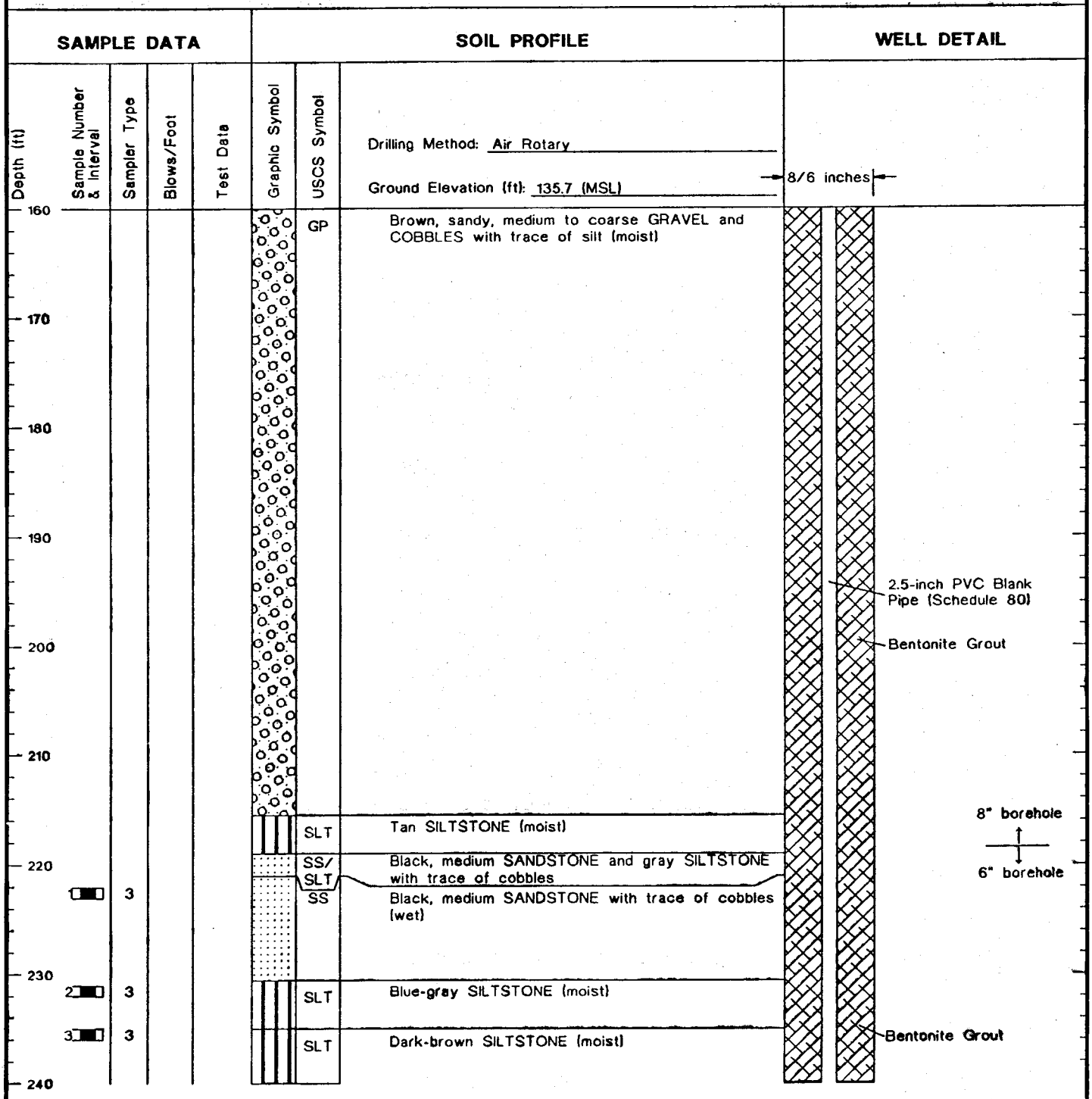


(Continued Next Page)

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Log of Boring and Monitoring Well BOP-41(ds) | Figure C-2

BOP-41(ds) (Continued)

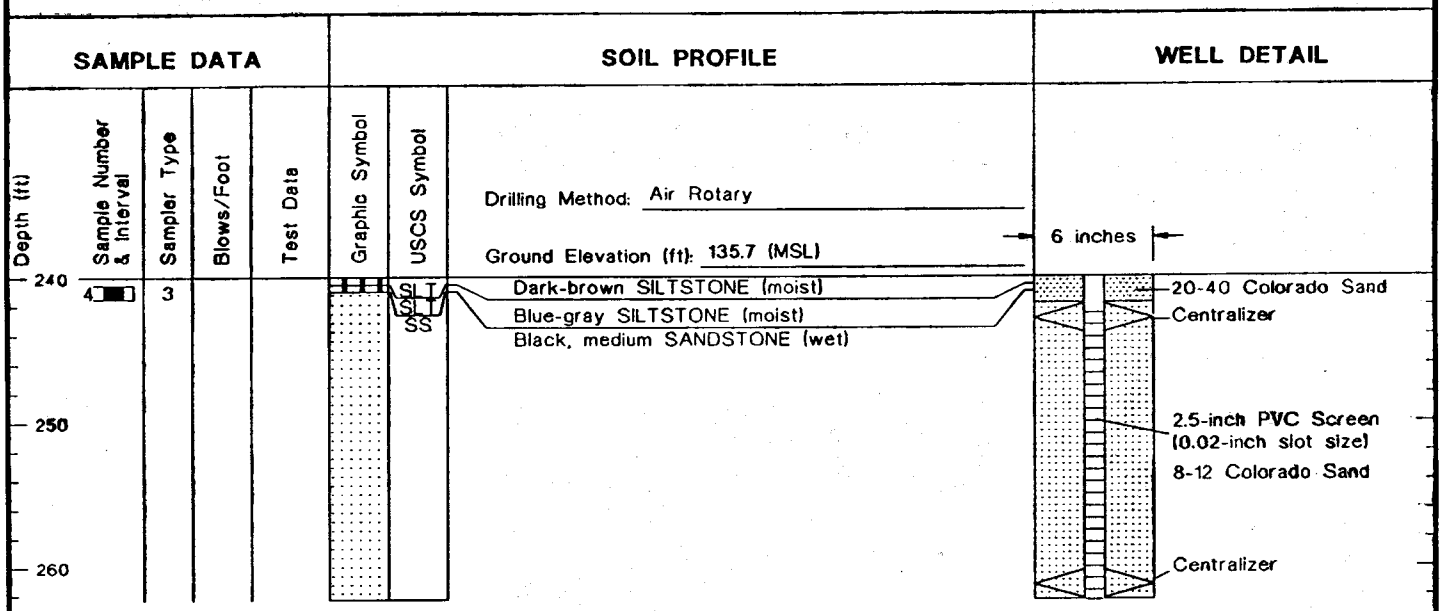


(Continued Next Page)

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Log of Boring and Monitoring Well BOP-41(ds) | Figure C-2

BOP-41(ds) (Continued)



Boring Completed = 1/16/92
Total Depth = 262.3 ft

Well Completed = 1/27/92

Notes:
1. Stratigraphic contacts are based on field interpretations and are approximate.
2. Reference to the text of this report is necessary for a proper understanding of subsurface conditions.
3. Refer to "Key and Soil Classification System" figure for explanation of graphics and symbols.

Log of Boring and Monitoring Well BOP-41(ds) | Figure C-2

EW-4

LOG OF EXPLORATORY BORING

PROJECT NAME	CASCADE CORPORATION	BORING NO.	MW- 16DG
LOCATION	Troutdale, Oregon	PAGE	1 OF 3
DRILLED BY	Staco Well Services	REFERENCE ELEV.	76.50'
DRILL METHOD	Cable Tool	TOTAL DEPTH	123.35'
LOGGED BY	G. Forsythe	DATE COMPLETED	6/2/92

GROUND ELEV 6/98: 76.98

SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
S-1 SB				5				0-0.4 feet: GRAVEL (GP), angular fragments to 1-inch diameter. 0.4-5.8 feet: SANDY SILT (ML), olive gray, low plasticity, damp. Sand is fine to medium. Trace fine angular to subangular gravel. Abundant rootlets with iron oxide filling some root traces. (TOPSOIL)
S-2 GRAB				10				5.8-56.5 feet: SANDSTONE, dark reddish brown to blackish red, very fine to medium vitric sand, slightly fractured to massive, well indurated. Trace fines. (TROUTDALE SANDSTONE AQUIFER) @ 10 feet: Dusky brown, trace fine to medium, angular to subrounded, basalt and quartzite gravel.
				15				
S-3 GRAB								@ 17.5 feet: Trace very coarse, angular to subangular basaltic gravel.
S-4 GRAB				20				
S-5 GRAB								@ 22 feet: Black, fine to coarse vitric sand, few very fine to medium, angular to subrounded basaltic gravel.
S-6 GRAB				25				
S-7 GRAB				30				@ 30 feet: Increase in palagonite-cemented sand aggregates.
S-8 GRAB				35				
S-9 GRAB				40				
S-10 GRAB				45				@ 44 feet: Fine to coarse, angular to subangular vitric sand. Some fine to very coarse, angular to rounded basalt gravel, with few quartzite and andesite clasts. Large clasts have crusts of palagonite-cemented sand.
S-11 GRAB				50				

REMARKS

1) SB=3-Inch O.D. split barrel sampler. 2) Top of PVC casing elevation = 76.02 ft. MSL. Reference elevation is ground level. 3) Well completed with flush-mounted traffic-proof vault.

LOG OF EXPLORATORY BORING

EW-4

PROJECT NAME	CASCADE CORPORATION	BORING NO.	MW- 16DG
LOCATION	Troutdale, Oregon	PAGE	2 OF 3
DRILLED BY	Staco Well Services	REFERENCE ELEV.	76.50'
DRILL METHOD	Cable Tool	TOTAL DEPTH	123.35'
LOGGED BY	G. Forsythe	DATE COMPLETED	6/2/92

SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
S-12 GRAB			▼ 53.6'	55				5.8-56.5 feet: SANDSTONE, dark reddish brown to blackish red, very fine to medium vitric sand, slightly fractured to massive, well indurated. Trace fines. (TROUTDALE SANDSTONE AQUIFER)
S-13 GRAB								
S-14 GRAB								56.5-59 feet: GRAVELLY SANDSTONE, dark gray to grayish black, very fine to very coarse sand, few subangular to rounded, very fine to coarse basalt, quartzite and andesite gravel.
S-15 GRAB				60				59-73.5 feet: SANDY CONGLOMERATE, brownish gray, very fine to coarse, angular to rounded gravel. Fine to very coarse, subangular to subrounded vitric sand.
S-16 GRAB								@ 65 feet: Increase in sand, grayish black, few angular to rounded small cobbles.
S-17 GRAB				65				
S-18 GRAB								@ 70 feet: Increase in very fine to coarse gravel.
S-19 GRAB				70				
S-20 GRAB				75				73.5-78.5 feet: SANDSTONE, grayish black, very fine to very coarse, subangular to subrounded vitric basalt. Few very fine to coarse rounded gravel. Rare basaltic cobbles.
S-21 GRAB				80				78.5-94 feet: SANDY CONGLOMERATE, dark gray, very fine to very coarse, subangular to rounded gravel, very fine to very coarse, angular to subrounded sand. Rare small basalt cobbles.
S-22 GRAB				85				
S-23 GRAB				90				
S-24 GRAB				95				94-114.5 feet: CONGLOMERATE, dark gray, very fine to coarse, angular to rounded, basalt and quartzite gravel, little very fine to very coarse sand. Poorly cemented.
				100				

REMARKS

1) SB=3-inch O.D. split barrel sampler. 2) Top of PVC casing elevation = 76.02 ft. MSL. Reference elevation is ground level. 3) Well completed with flush-mounted traffic-proof vault.

LOG OF EXPLORATORY BORING

EW-4

PROJECT NAME	CASCADE CORPORATION	BORING NO.	MW- 16DG
LOCATION	Troutdale, Oregon	PAGE	3 OF 3
DRILLED BY	Staco Well Services	REFERENCE ELEV.	76.50'
DRILL METHOD	Cable Tool	TOTAL DEPTH	123.35'
LOGGED BY	G. Forsythe	DATE COMPLETED	6/2/92

SAMPLE NUMBER SAMPLE TYPE	RECOVERY PERCENT	BLOW COUNTS (N COMP)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	WELL DETAILS	LITHOLOGIC COLUMN	LITHOLOGIC DESCRIPTION
S-25 GRAB				105				@ 100 feet: Aggregates of sand and fine gravel in clay and silt matrix.
S-26 GRAB				110				
S-27 GRAB				115				
S-28 GRAB				120				114.5-118 feet: SANDY CONGLOMERATE, dark yellowish brown, very fine to coarse gravel. Sand and gravel aggregates in a mottled yellowish brown to greenish gray clay matrix.
S-29 GRAB								118-123.35 feet: CLAY (CL), dark greenish gray, medium plasticity, moist. Trace fine to coarse sand, trace fine gravel. (CONFINING UNIT 2)
S-30 GRAB				125				Bottom of boring at 123.35 feet below ground surface.
				130				
				135				
				140				
				145				
				150				

WELL COMPLETION DETAILS:
0-68 feet: 6-inch Schedule 40 PVC blank casing.
68-116 feet: 6-inch Type 304 wire-wrapped stainless steel screen with 0.020-inch continuous slots.
116-117.5 feet: Schedule 40 PVC threaded endcap.
0-1 feet: Concrete.
1-60.7 feet: Bentonite grout.
60.7-61.8 feet: 20x40 mesh silica sand.
61.8-65 feet: Hydrated bentonite pellets.
65-117.7 feet: 8x12 mesh silica sand.
117.7-123.35 feet: Hydrated bentonite chips.
10, 28, 67 and 116.5 feet: Stainless steel centralizers.

Sarah at Staco
says:
12 inch borehole diameter
top to bottom
BW 4-10-97

REMARKS

1) SB=3-Inch O.D. split barrel sampler. 2) Top of PVC casing elev on is ground level. 3) Well completed with flush-mounted traffic-proof vault.

EMCON Northwest, Inc.

X8303.03.X8303.VC/3.7/20/92

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)

MULT 3114 RECEIVED
AUG - 7 1992
WATER RESOURCES DEPT.
SALEM, OREGON

1N/3E/29 dc

Start Card # 41571

(1) OWNER/PROJECT:

WELL NO. 16-D-G

Name Cascasde Corporation
Address PO Box 10187
City Troutdale State OR Zip 97060

(2) TYPE OF WORK:

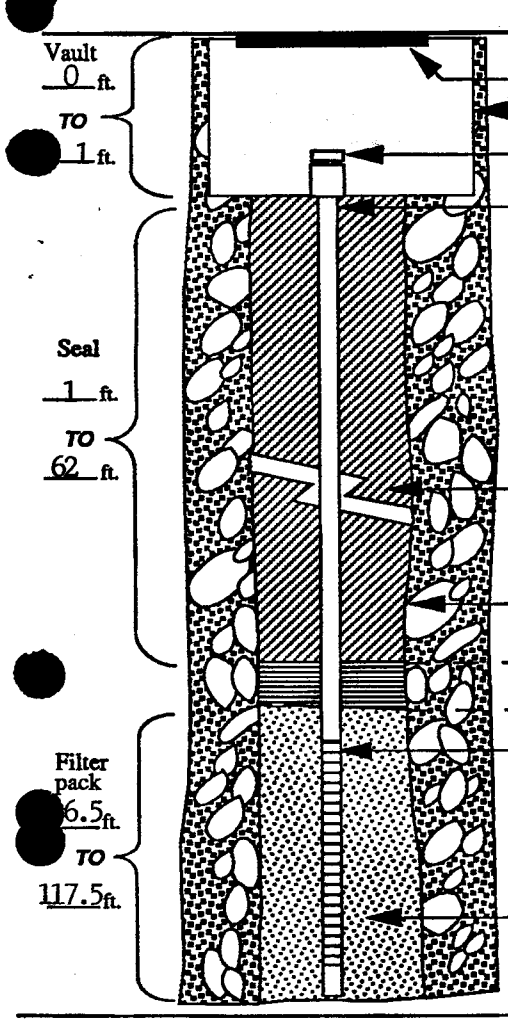
[x] New construction [ ] Repair [ ] Recondition
[ ] Conversion [ ] Deepening [ ] Abandonment

(3) DRILLING METHOD

[ ] Rotary Air [ ] Rotary Mud [x] Cable
[ ] Hollow Stem Auger [ ] Other

(4) BORE HOLE CONSTRUCTION

Special Standards Yes [ ] No [x]
Depth of completed well 118 ft.



Casing diameter 6 in. material PVC SCH 80 Welded [ ] Threaded [x] Glued [ ]
Liner diameter — in. material — Welded [ ] Threaded [ ] Glued [ ]
Well seal: Material Pure gold bentonite Amount 35 sacks
Borehole diameter 12 in.
Screen material S.S. interval(s): From 67 To 116.5 From — To — Slot size 20 in.
Filter pack: Material S.S. sand Size 8-12 in.

(5) WELL TEST: N/A

[ ] Pump [ ] Bailer [ ] Air [ ] Flowing Artesian
Permeability — Yield — GPM
Conductivity — PH —
Temperature of water 56 °F/C Depth artesian flow found — ft.
Was water analysis done? [ ] Yes [ ] No
By whom? —
Depth of strata to be analyzed. From — ft. to — ft.
Remarks: —

(6) LOCATION OF WELL By legal description

Well Location: County Miltnomah
Township 1N (N or S) Range 3E (E or W) Section 29
1. NE 1/4 of SE 1/4 of above section.
2. Street address of well location 2 blocks south of Sandy on 201st Avenue
3. Tax lot number of well location 35
4. ATTACH MAP WITH LOCATION IDENTIFIED.

(7) STATIC WATER LEVEL:

54 Ft. below land surface. Date 6/9/92
Artesian Pressure — lb/sq. in. Date —

(8) WATER BEARING ZONES:

Depth at which water was first found 57

From	To	Est. Flow Rate	SWL
57	118	15 GPM	54'
		OCT 30 1992	
		WATER RESOURCES DEPT SALEM, OREGON	

(9) WELL LOG:

Ground elevation —

Material	From	To	SWL
Top soil	0	1	
Clay and cobbles brown	1	7	
Sandstone hard brown	7	57	
Cemented gravels W.B. brown	57	118	54
Clay sticky gray	118	123	

Date started 5-20-92 Completed 6/9/92

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.
Signed Steve Villard MWC Number 1013 Date 8-6-92

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, 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 well constructio standards. This report is true to the best of my knowledge and belief.
MWC Number 1009

MULT 121636

AMENDED
1.27.2016

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

1/11/2016

WELL I.D. LABEL# L

START CARD # 1028789

(1) LAND OWNER

Owner Well I.D. EW-4

First Name _____ Last Name _____

Company ~~CASCADE CORP~~ Boyd Coffee

Address ~~7231 SW 2ND AVE~~ 19730 NE Sandy Blvd

City PORTLAND State OR Zip ~~97219~~ 97230

(2) TYPE OF WORK

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

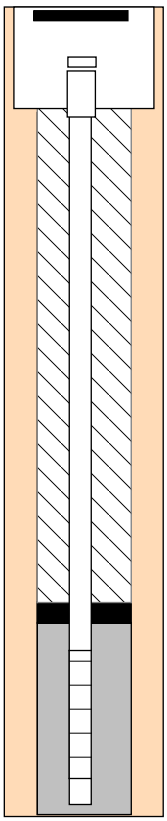
(3) DRILL METHOD

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

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well ~~104.00~~118 ft. Special Standard ☐



MONUMENT/VAULT
From _____ To _____

BORE HOLE
Diameter 10 From 0 To ~~104~~ 118

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

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

SEAL
From 0 To ~~104~~ 118
Material Bentonite Grout
Amount 26 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)

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~~ SE 1/4 of the ~~SE~~ NE 1/4 Tax Lot ~~35~~ 00900
Tax Map Number _____ Lot _____
Lat ° ' " or _____ DMS or DD
Long ° ' " or _____ DMS or DD

◯ Street address of well ◉ Nearest address

~~2 BLOCKS SOUTH OF SANDY ON 201ST AVE~~
19730 NE Sandy Blvd 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
Bentonite Grout	0	~~104~~ 118

Date Started 10/4/2015 Completed 10/12/2015

(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 806 Date 1/11/2016
Password : (if filing electronically) _____
Signed DAVID A DONNELLY (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 10306 Date 1/11/2016
Password : (if filing electronically) _____
Signed J TRENT CASTNER (E-filed)
Contact Info (optional) Cascade Drilling

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

Form Version:

START CARD # 1028789

1/11/2016

(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

Well Abandonment
Over drilled 10"
pulled casing and screen
grouted 0-104- 118'

Geologic Borehole Log/Well Construction

Maul Foster & Alongi, Inc.

Project Number	Well Number	Sheet
8076-001.001	EW-18	1 of 8

Project Name	Phase 2b TSA Remedy Implementation	TOC Elevation (feet above MSL)	
Project Location	Fairview, OR	Surface Elevation (feet above MSL)	
Start/End Date	5/6/98 to 5/8/98	Northing	689596.5
Driller/Equipment	Cascade Drilling/Ingersol Rand T3W-Downhole Air Rotary	Easting	1498965.0
Geologist/Engineer	E. Roth	Hole Depth	159.0-feet
Sample Method	Grab Sample/Split Spoon	Outer Hole Diam	12.75-inch

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
1									@ 1.0 foot: SANDY SILT (ML); reddish brown; 60% fines, low plasticity; 40% sand, fine; moist. (SILTY LOAM)
2				C	1				
3									
4									
5									
6									
7									
8									
9									
10									
11									
12				C	2				@ 12.0 feet: SANDY SILT (ML); reddish brown; 60% fines, low plasticity; 40% sand, fine; moist. (SILTY LOAM)
13									
14									
15				C	3				15.0 to 30.0 feet: SILT (ML); yellowish brown; 70% fines, low plasticity; 30% sand, fine to medium; dry. (CONFINING UNIT 1)
16									@ 16.0 feet: Added water to the hole.
17									
18									
19									
20									

NOTES: 1) Pilot hole was advanced from 0 to 12 feet below ground surface using a 18-inch O.D. tricone bit and a 16-inch O.D. steel casing was installed. 2) Borehole was drilled using a 12.75-inch under reaming bit system with 11.75-inch casing advanced. 3) C = Cuttings sample collected from the cyclone. 4) SS = Split Spoon sample 1.5-feet long x 2.0-inch O.D. driven using a 140-lb jar hammer. 5) A water-air mixture was used as a drilling fluid below 16-feet bgs. 6) White triangle = approximate depth at which water was encountered during drilling. Black triangle = water level in completed well. 7) Northing and Easting relative to NAD 27.

▽ Water level 50.0 feet (Borehole) ▼ Water level 94.6 feet (Well)

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Maul Foster & Alongi, Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
8076-001.001	EW-18	2 of 8

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
21				C	4				@ 20.0 feet: SILT (ML); yellowish brown with orange brown mottling; 60% fines, low to medium plasticity; 30% sand, fine to medium; 10% gravel, fine, subangular. (CONFINING UNIT 1)
22									
23									
24									
25				C	5				@ 25.0 feet: SILT (ML); yellowish brown; 50% fines, low plasticity; 30% sand, fine to coarse; 20% gravel, fine, subangular. (CONFINING UNIT 1)
26									
27									
28									
29									
30				C	6				30.0 TO 90.0 feet: SANDSTONE (SS); yellowish brown; 20% fines, low plasticity; 50% sand, fine to coarse; 30% gravel, fine to medium, subangular; poorly cemented. (UPPER TROUTDALE SANDSTONE AQUIFER - SANDSTONE)
31									
32									
33									
34									
35				C	7				@ 30.0 feet: Added water to the hole.
36									
37									
38									
39									
40				C	8				@ 40.0 feet: SANDSTONE (SS); greenish black gray; <10% fines; 75% sand, medium to coarse; 15% gravel, fine, angular; poorly cemented.
41									
42									

NOTES: 1) Pilot hole was advanced from 0 to 12 feet below ground surface using a 18-inch O.D. tricone bit and a 16-inch O.D. steel casing was installed. 2) Borehole was drilled using a 12.75-inch under reaming bit system with 11.75-inch casing advanced. 3) C = Cuttings sample collected from the cyclone. 4) SS = Split Spoon sample 1.5-feet long x 2.0-inch O.D. driven using a 140-lb jar hammer. 5) A water-air mixture was used as a drilling fluid below 16-feet bgs. 6) White triangle = approximate depth at which water was encountered during drilling. Black triangle = water level in completed well. 7) Northing and Easting relative to NAD 27.

▽ Water level 50.0 feet (Borehole) ▼ Water level 94.6 feet (Well)

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Maul Foster & Alongi, Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
8076-001.001	EW-18	3 of 8

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
43									
44									
45				C	9				@ 45.0 feet: SANDSTONE (SS); greenish yellowish brown; <10% fines; 90% sand, fine to medium; poorly cemented.
46									
47									
48									
49									
50	▽			C	10	WL=50.0' 5/6/98 TD=50.0'			@ 50.0 feet: SANDSTONE (SS); black; <5% fines; yellowish brown; 80% sand, medium to coarse; 15% gravel, fine to medium, subrounded to subangular; basaltic. Hole producing water (approximately 5 gpm), but still adding water to the hole to facilitate drilling.
51									
52									
53									
54									
55									
56									
57									
58									
59									
60				C	11				@ 60.0 feet: SANDSTONE (SS); black; <10% yellowish brown fines ; 80% sand, fine to coarse; <10% gravel, fine subrounded to subangular; basaltic.
61									
62									
63									
64									
65									

NOTES: 1) Pilot hole was advanced from 0 to 12 feet below ground surface using a 18-inch O.D. tricone bit and a 16-inch O.D. steel casing was installed. 2) Borehole was drilled using a 12.75-inch under reaming bit system with 11.75-inch casing advanced. 3) C = Cuttings sample collected from the cyclone. 4) SS = Split Spoon sample 1.5-feet long x 2.0-inch O.D. driven using a 140-lb jar hammer. 5) A water-air mixture was used as a drilling fluid below 16-feet bgs. 6) White triangle = approximate depth at which water was encountered during drilling. Black triangle = water level in completed well. 7) Northing and Easting relative to NAD 27.

▽ Water level 50.0 feet (Borehole) ▼ Water level 94.6 feet (Well)

Maul Foster & Alongi, Inc.	Geologic Borehole Log/Well Construction		
	Project Number 8076-001.001	Well Number EW-18	Sheet 4 of 8

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
66				C	12				@ 65.0 feet: SANDSTONE (SS); black; 10% yellowish brown fines; 60% sand, fine to coarse; 30% gravel, fine to medium, subangular to subrounded; basaltic.
67									
68									
69									
70				C	13				@ 70.0 feet: SANDSTONE (SS); black; 10% yellowish brown fines; 90% sand, fine to coarse.
71									
72									
73									
74									
75				C	14				@ 75.0 feet: SANDSTONE; black; 10% yellowish brown fines; 90% sand, fine to coarse.
76									
77									@ 77.0 feet: Color change to greenish gray.
78									
79									
80				C	15				@ 80.0 feet: SANDSTONE (SS); greenish gray; 30% fines, low plasticity; 70% sand, fine to medium.
81									
82									
83									
84									
85				C	16				@ 85.0 feet: SANDSTONE (SS); greenish gray; 10% fines; 50% sand, fine to coarse; 40% gravel, fine to medium, subrounded to subangular.
86									
87									

TWPROJECTS\8076-001\001.GPJ 9/18/98

GBLWC C:\MF

NOTES: 1) Pilot hole was advanced from 0 to 12 feet below ground surface using a 18-inch O.D. tricone bit and a 16-inch O.D. steel casing was installed. 2) Borehole was drilled using a 12.75-inch under reaming bit system with 11.75-inch casing advanced. 3) C = Cuttings sample collected from the cyclone. 4) SS = Split Spoon sample 1.5-feet long x 2.0-inch O.D. driven using a 140-lb jar hammer. 5) A water-air mixture was used as a drilling fluid below 16-feet bgs. 6) White triangle = approximate depth at which water was encountered during drilling. Black triangle = water level in completed well. 7) Northing and Easting relative to NAD 27.

▽ Water level 50.0 feet (Borehole) ▼ Water level 94.6 feet (Well)

Maul Foster & Alongi, Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
8076-001.001	EW-18	5 of 8

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
88–94									
90				C	17				@ 90.0 feet: SANDSTONE (SS); greenish gray; 40% fines, low plasticity; 50% sand, fine to coarse; 10% gravel, fine, angular; basaltic.
95	▼			C	18	WL=94.6' 5/13/98 TD=149.5'			95.0 to 154.1 feet: SANDY GRAVEL (GW); greenish brown; 10% fines; 30% sand, medium to coarse; 60% gravel, fine to coarse, angular to subangular, composed of quartzite and basalt. (LOWER TROUTDALE SANDSTONE AQUIFER - CONGLOMERATE)
100				C	19				@ 100.0 feet: SANDY GRAVEL (GW); yellowish brown; 10% fines, 20% sand, fine to coarse; 70% gravel, fine to medium, angular to subangular; composed of basalt and quartzite.
105				C	20				@ 105.0 feet: SANDY GRAVEL (GW); yellowish brown; 10% fines; 30% sand, fine to coarse; 60% gravel, fine angular to subangular, composed of basalt and quartzite.
106–110									

NOTES: 1) Pilot hole was advanced from 0 to 12 feet below ground surface using a 18-inch O.D. tricone bit and a 16-inch O.D. steel casing was installed. 2) Borehole was drilled using a 12.75-inch under reaming bit system with 11.75-inch casing advanced. 3) C = Cuttings sample collected from the cyclone. 4) SS = Split Spoon sample 1.5-feet long x 2.0-inch O.D. driven using a 140-lb jar hammer. 5) A water-air mixture was used as a drilling fluid below 16-feet bgs. 6) White triangle = approximate depth at which water was encountered during drilling. Black triangle = water level in completed well. 7) Northing and Easting relative to NAD 27.

▽ Water level 50.0 feet (Borehole) ▼ Water level 94.6 feet (Well)

Maul Foster & Alongi, Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
8076-001.001	EW-18	6 of 8

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
111				C	21				@ 110.0 feet: SANDY GRAVEL (GW); yellowish brown; 10% fines; 20% sand, fine to coarse; 70% gravel, fine to medium, subangular to subrounded, composed of quartzite, basalt and other volcanics.
112									
113									
114									
115				C	22				@ 115.0 feet: GRAVEL (GP); yellowish brown; <5% fines; 10% sand, medium to coarse; 85% gravel, fine, subangular, slightly micaceous.
116									
117									
118									
119									
120				C	23				@ 120.0 feet: SANDY GRAVEL (GW); yellowish brown; <10% fines; 40% sand, fine to coarse, micaceous (large flakes); 50% gravel, fine to coarse, subangular, composed of quartzite and basalt.
121									
122									
123									
124									
125				C	24				@ 125.0 feet: GRAVEL (GP); yellowish brown; <10% fines, 20% sand, fine to medium, micaceous (large flakes); 70% gravel, medium to coarse, subrounded to subangular.
126									
127									
128									
129									
130				C	25				@ 130.0 feet: SANDY GRAVEL (GW); yellowish brown; <10% fines, 35% sand, fine to medium, micaceous (large flakes); 55% gravel, fine to medium, subangular.
131									
132									

NOTES: 1) Pilot hole was advanced from 0 to 12 feet below ground surface using a 18-inch O.D. tricone bit and a 16-inch O.D. steel casing was installed. 2) Borehole was drilled using a 12.75-inch under reaming bit system with 11.75-inch casing advanced. 3) C = Cuttings sample collected from the cyclone. 4) SS = Split Spoon sample 1.5-feet long x 2.0-inch O.D. driven using a 140-lb jar hammer. 5) A water-air mixture was used as a drilling fluid below 16-feet bgs. 6) White triangle = approximate depth at which water was encountered during drilling. Black triangle = water level in completed well. 7) Northing and Easting relative to NAD 27.

▽ Water level 50.0 feet (Borehole) ▼ Water level 94.6 feet (Well)

PROJECTS\8076-001\001.GPJ 9/18/98

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Maul Foster & Alongi, Inc.

Geologic Borehole Log/Well Construction

Project Number	Well Number	Sheet
8076-001.001	EW-18	7 of 8

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
133									
134									
135				C	26				@ 135.0 feet: GRAVEL (GP); yellowish brown; <5% fines; 15% sand; 80% gravel, fine to medium, composed of basalt and quartzite.
136									
137									
138									
139									
140				C	27				@ 140.0 feet: SANDY GRAVEL (GW); <10% fines, yellowish brown; 40% sand, fine to medium; 50% gravel, fine to medium, composed of quartzite and basalt; slightly micaceous.
141									@ 141.0 to 149.5 feet: SAND (SP); grayish, yellowish brown; <5% fines; 85% sand, fine to coarse, micaceous; 10% gravel, fine subangular.
142									
143									
144			10%	SS	28		6		
145							6		
146							6		
147			30%	SS	29		7		
148							9		
149							11		
150				C	30				@ 150.0 feet: SANDY GRAVEL (GW); yellowish brown; <10% fines; 35% sand, fine; 55% gravel, fine to medium, subangular, composed of quartzite, basalt and other volcanics.
151									
152				C	31				
153				C	32				@ 152.6 feet: Color change to greenish gray, with an increase in silt. (CONFINING UNIT 2 - WEATHERED HORIZON)
154				C	33				154.1 to 159.0 feet: SILT (ML); see description on following page.
155									

NOTES: 1) Pilot hole was advanced from 0 to 12 feet below ground surface using a 18-inch O.D. tricone bit and a 16-inch O.D. steel casing was installed. 2) Borehole was drilled using a 12.75-inch under reaming bit system with 11.75-inch casing advanced. 3) C = Cuttings sample collected from the cyclone. 4) SS = Split Spoon sample 1.5-feet long x 2.0-inch O.D. driven using a 140-lb jar hammer. 5) A water-air mixture was used as a drilling fluid below 16-feet bgs. 6) White triangle = approximate depth at which water was encountered during drilling. Black triangle = water level in completed well. 7) Northing and Easting relative to NAD 27.

▽ Water level 50.0 feet (Borehole) ▼ Water level 94.6 feet (Well)

W:\PROJECTS\8076-001\001.GPJ 9/18/98

Geologic Borehole Log/Well Construction

Maul Foster & Alongi, Inc.

Project Number	Well Number	Sheet
8076-001.001	EW-18	8 of 8

Depth (feet, BGS)	Well Details	Sample Data: Interval	Percent Recovery	Collection Method	Number	Name (Type)	Blows/6"	Lithologic Column	Soil Description
156			40%	SS	34		12 27 32		154.1 to 159.0 feet: SILT (ML); greenish gray; 90% fines, 10% sand, fine to medium; stiff; massive; competent; micaceous, no fractures. (CONFINING UNIT 2)
157									
158			90%	SS	35		50/5" 36 50/5"		
159									Total Depth = 159.0 feet below ground surface.

WELL CONSTRUCTION DETAILS

0 to 119.5 feet: 8.6-inch O.D. steel casing.
119.5 to 149.5 feet: 8.6-inch O.D. stainless steel wire-wrap screen with 0.040-inch slots.
149.5 to 151.5 feet: 8.6-inch O.D. steel sump.

0 to 2.0 feet: Morris flush mount set in concrete (temporary installation prior to conveyance line tie-in).
2.0 to 30.0 feet: 3/8-inch bentonite chips hydrated with potable water.
30 to 113.7 feet: bentonite grout.
113.7 to 116.5 feet: Filter pack seal composed of 20-40 Colorado Silica Sand.
116.5 to 152.6 feet: Filter pack composed of 8-12 Colorado Silica Sand.
152.6 to 159.0 feet: 3/8-inch bentonite chips.

NOTES: 1) Pilot hole was advanced from 0 to 12 feet below ground surface using a 18-inch O.D. tricone bit and a 16-inch O.D. steel casing was installed. 2) Borehole was drilled using a 12.75-inch under reaming bit system with 11.75-inch casing advanced. 3) C = Cuttings sample collected from the cyclone. 4) SS = Split Spoon sample 1.5-feet long x 2.0-inch O.D. driven using a 140-lb jar hammer. 5) A water-air mixture was used as a drilling fluid below 16-feet bgs. 6) White triangle = approximate depth at which water was encountered during drilling. Black triangle = water level in completed well. 7) Northing and Easting relative to NAD 27.

▽ Water level 50.0 feet (Borehole) ▼ Water level 94.6 feet (Well)

GBLWC C:\MFA\GINTW\PROJECTS\8076-001\001.GPJ 9/18/98

L17205

STATE OF OREGON
MONITORING WELL REPORT
(as required by ORS 537.765 & OAR 690-240-095)

Start Card # 110376

Instructions for completing this report are on the last page of this form.

(1) OWNER/PROJECT:
WELL NO. EW-18

Name [illegible] Corporation

Address P.O. Box 20187

City Portland State OR Zip 97220

(2) TYPE OF WORK:
☑ New construction ☐ Alteration (Repair/Recondition)
☐ Conversion ☐ Deepening ☐ Abandonment

(3) DRILLING METHOD
☑ Rotary Air ☐ Rotary Mud ☐ Cable
☐ Hollow Stem Auger ☐ Other

(4) BORE HOLE CONSTRUCTION
Special Standards ☐ Yes ☑ No Depth of completed well 151.6 ft.

Land surface

Vault ft. TO ft.

Seal 1 ft. TO 114.5 ft.

Filter pack 5 16' ft. TO 153.5 ft.

Water-tight cover
Surface flush vault
Locking cap

Casing diameter 8" in.
material steel
Welded ☑ Threaded ☐ Glued ☐

Liner diameter N/A in.
material ~~[illegible]~~
Welded ☐ Threaded ☐ Glued ☐

Well seal:
Material Volclay
Amount 750 lb
Grout weight 9.5
Borehole diameter 12 3/4 in.

~~Bentonite plug at least 3 ft. thick~~

Screen
material S.S
interval(s):
From 119.5 To 152.5
From ____ To ____
Slot size .040 in.

Filter pack:
Material sand
Size 8/12 in.

(5) WELL TEST:
☐ Pump ☐ Bailer ☑ Air ☐ Flowing Artesian
Permeability ____ Yield 20 GPM
Conductivity n/a PH n/a
Temperature of water 54 °F/C Depth artesian flow found ____ ft.
Was water analysis done? ☑ Yes ☐ No
By whom? Paul Foster
Depth of strata to be analyzed. From 114.5 ft. to 152.5 ft.
Remarks: ____
Name of supervising Geologist/Engineer [illegible]

(6) LOCATION OF WELL By legal description
Well Location: County Multnomah
Township 1N (N or S) Range 3E (E or W) Section 29
1. SE 1/4 of NW 1/4 of above section.
2. **Either** Street address of well location 2011 NE 201st Ave Gresham
or Tax lot number of well location 2300
3. ATTACH MAP WITH LOCATION IDENTIFIED. Map shall include approximate scale and north arrow.

(7) STATIC WATER LEVEL:
94 Ft. below land surface. Date 9-10-95
Artesian Pressure N/A lb/sq. in. Date ____

(8) WATER BEARING ZONES:
Depth at which water was first found 94

From	To	Est. Flow Rate	SWL
119.5	152.5	20 GPM	94

(9) WELL LOG:
Ground elevation ____

Material	From	To	SWL
Brown Soil	0	7	
Boulders	7	30	
sand stone	30	70	
Gravel & cobbles	70	152.5	
2'-20/40 sand			

Date started 5-5-95 Completed 5-8-95

(unbonded) Monitor Well Constructor Certification:
I certify that the work I performed on the construction, alteration, or abandonment of this well is in compliance with Oregon well construction standards. Materials used and information reported above are true to the best knowledge and belief.

Signed [signature] MWC Number 1045 Date 5-10-95

(bonded) Monitor Well Constructor Certification:
I accept responsibility for the construction, 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 well construction standards. This report is true to the best of my knowledge and belief.

Signed [signature] MWC Number 1026 Date 5-11-95

2063 ORIGINAL & FIRST COPY-WATER RESOURCES DEPARTMENT SECOND COPY-CONSTRUCTOR THIRD COPY-CUSTOMER

FOR WATER RESOURCES DEPARTMENT USE ONLY

Date Postmarked_____ W 110376

Date Hand-Delivered_____ WRD Receipt_____

Watermaster Initials_____ Date Fee Received_____

Check No._____

START CARD

NOTICE OF BEGINNING OF WELL CONSTRUCTION

(as required by ORS 537.762)

This form must be completed and the original copy mailed or delivered to the Water Resources Department, 158 12th St. NE, Salem, OR 97310, for all new well construction, or conversion of an existing hole not previously used to seek water. This original copy must be mailed or delivered no later than the day construction or conversion work begins. A $75 fee shall accompany the original copy for all new well construction and conversion (make checks payable to the Water Resources Department). Notices meeting the submittal requirements but received without the required fee will not be accepted as properly and timely filed. In addition, the constructor shall provide the "Watermaster Copy" of this notice to the office of the district watermaster within which the well is being constructed, altered, converted or abandoned using one of the following options: (a) by regular mail no later than three (3) calendar days (72 hours) prior to commencement of work; or, (b) by hand delivery, during regular office hours, no later than the day work is commenced; or, (c) by FAX no later than the day work is commenced. If method (c) is used, the original "Watermaster Copy" of this notice shall also be mailed or delivered to the office of the district watermaster no later than the day work is commenced. The Water Resources Commission has authority to impose civil penalties for failure to submit the required $75 fee with the start card and for failure to submit cards prior to beginning any construction, alteration, conversion or abandonment work.

Owner's name and mailing address: corporation c/o Prowell Env.

Home Phone: n/a — P.O. Box 20187 7231 SW 2nd Ave

Work Phone: 503/ 86 — Portland OR 97219

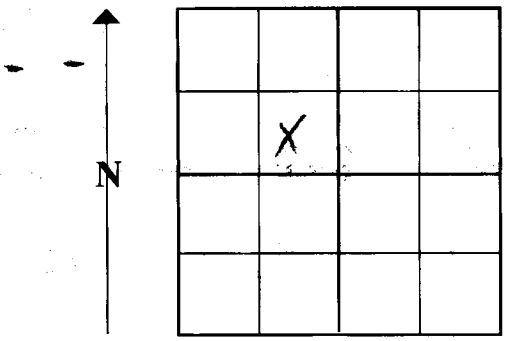
Check type of work: Fee Required: { ☑ New Construction ☐ Conversion } No Fee Required: { ☐ Alteration (Repair/Recondition) ☐ Deepening ☐ Abandonment } Original Start Card Number n/a

Proposed Commencement Date: 5-4-98

Existing or Proposed Well Depth: 15' Diameter: 8" Original Well I.D. Label Number: EW-15

Check Use: ☐ Domestic ☐ Public System (Community) ☐ Industrial ☐ Irrigation ☑ Monitoring ☐ Thermal ☐ Injection ☐ Other_____

Proposed Well Location: County Klamath Township: 1N (North or South) Range: 3E (East or West) Section: 29



1. SE 1/4 of NW 1/4 of above section.
2. Street Address of well location (or directions if not assigned). 3201 NE 20th Ave
3. Tax-lot number of well location: 2300
4. Attach map with location identified. (See reverse for approved maps)
5. Show well location within 1/4, 1/4 of section grid at left.

We hereby certify that we have read the back of this form and that the information provided is accurate to the best of our knowledge.

NIERMEIER — Owner/Agent

[signature] — Bonded Water/Monitor Well Constructor — License No._____

Date Signed

[illegible] — Company

4-3-98 — Date Signed

OWNER PLEASE NOTE: This is not a water right application. The owner is responsible for obtaining a water right through the Water Resources Department, if required. The Oregon Health Division requires plans to be submitted and approved prior to construction if the well is to be used as a public system.

ADDITIONAL IMPORTANT INFORMATION ON BACK.

THIS COPY TO CUSTOMER.

MULT 121635

AMENDED
01.27.16

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

1/11/2016

WELL I.D. LABEL# L 17205

START CARD # 1028788

(1) LAND OWNER

Owner Well I.D. EW-18

First Name _____ Last Name _____

Company CASCADE CORP

Address ~~7231 SW 2ND AVE~~ 2201 NE 201st Ave

City ~~PORTLAND~~ Fairview State OR Zip ~~97219~~ 97024

(2) TYPE OF WORK

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

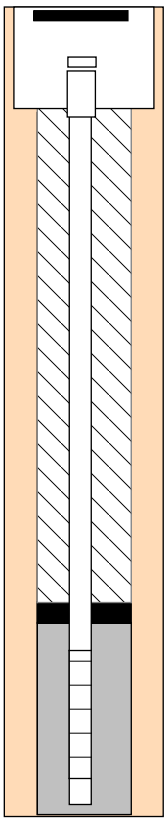
(3) DRILL METHOD

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

(4) CONSTRUCTION

Piezometer Well ☐

Depth of Completed Well 151.00 ft. Special Standard ☒



MONUMENT/VAULT
From _____ To _____

BORE HOLE
Diameter 12 From 0 To 151

CASING
Dia. 10 From ☐ 78 To 118
Gauge sch 40 Wld ☐ Thrd ☐
Material ◉ Steel ○ Plastic

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

SEAL
From 0 To 151
Material Bentonite Grout
Amount 56 Sacks Grout weight _____

SCREEN
Casing/Liner Casing Material ss
Diameter 8 From 118 To 151
Slot Size 0.040

FILTER
From _____ To _____ Material _____ Size of pack _____

(5) WELL TESTS

○ Pump ○ Bailer ○ Air ○ Flowing Artesian

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

Temperature _____ °F Lab analysis ☐ Yes By _____

Supervising Geologist/Engineer _____

Water quality concerns? ☐ Yes (describe below)

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 SE 1/4 of the ~~NW~~ NE 1/4 Tax Lot ~~2300~~ 1005
Tax Map Number _____ Lot _____
Lat ° ' " or _____ DMS or DD
Long ° ' " or _____ DMS or DD

◉ Street address of well ○ Nearest address

~~2201~~ NE 201ST AVE, ~~GRESHAM~~
2525 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
Bentonite Grout	0	151

Date Started 10/4/2015 Completed 10/12/2015

(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 806 Date 1/11/2016
Password : (if filing electronically) _____
Signed DAVID A DONNELLY (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 10306 Date 1/11/2016
Password : (if filing electronically) _____
Signed J TRENT CASTNER (E-filed)
Contact Info (optional) Cascade Drilling

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 121635

1/11/2016

WELL I.D. LABEL# L 17205

START CARD # 1028788

(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

While Abandoning the well by over drilling, Part of the casing & screen broke off. The well was grouted sealing in the pipe.

Certificate of Treatment/Disposal/Recycling

WasteXpress certifies that the items received from

CASCADE
2525 NE 201st Avenue
Fairview, OR

On a Non-Hazardous Manifest #23272 dated **11-16-15** have been properly treated/disposed/recycled at WasteXpress' affiliated facilities in compliance with all applicable regulatory standards as set forth by the Environmental Protection Agency (EPA) and the Oregon Department of Environmental Quality (DEQ)

Dated: *January 12, 2016*
Sworn and attested by
WasteXpress Environmental Services
By *B. Lengel*

APPENDIX E

SVE Data

Table E-1
Soil Vapor Extraction - 16 April 2015 through 31 December 2015
TSA Remedy - Gresham, Oregon

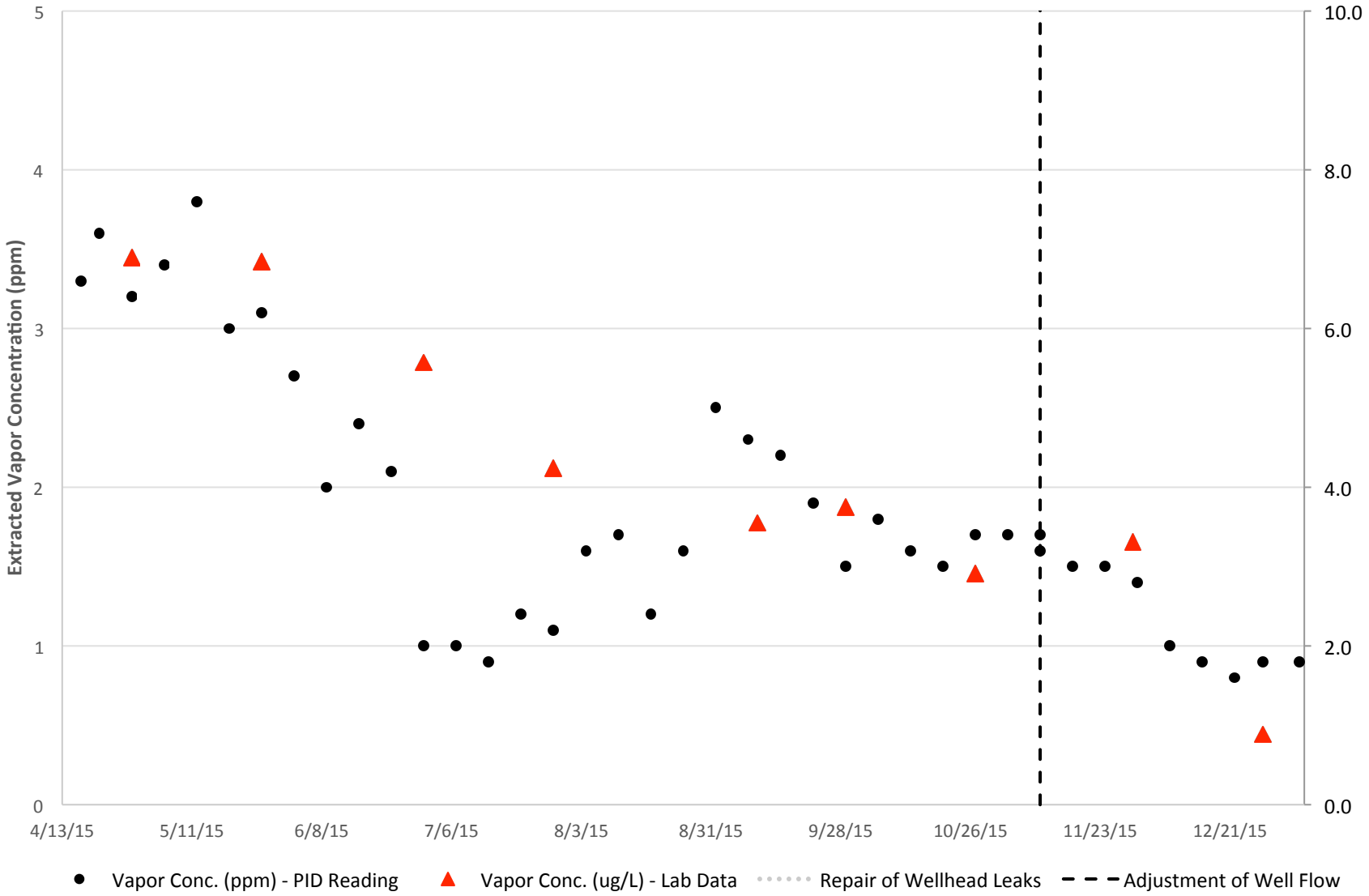
Well ID	Date	Time (hrs)	Temperature (degrees F)	Flow Rate (scfm)	PID Measurement (ppm)	Calculated VOC Concentration (ug/L)
Soil Vapor Extraction Outlet Well						
SVE System Outlet	4/16/15	12:30	126	165	--	--
SVE System Outlet	4/17/15	15:30	145	196	3.3	19.29
SVE System Outlet	4/21/15	10:00	140	191	3.6	21.04
SVE System Outlet	**4/28/15**	**11:45**	**119**	**197**	**3.2**	**18.71**
SVE System Outlet	5/5/15	16:00	118	199	3.4	19.88
SVE System Outlet	5/12/15	12:30	124	111	3.8	22.21
SVE System Outlet	5/19/15	13:30	180	133	3	17.54
SVE System Outlet	**5/26/15**	**12:30**	**148**	**129**	**3.1**	**18.12**
SVE System Outlet	6/2/15	13:20	180	131	2.7	15.78
SVE System Outlet	6/9/15	12:10	190	134	2	11.69
SVE System Outlet	6/16/15	10:10	185	128	2.4	14.03
SVE System Outlet	6/23/15	8:40	188	131	2.1	12.28
SVE System Outlet	**6/30/15**	**10:05**	**180**	**136**	**1**	**5.85**
SVE System Outlet	7/7/15	13:00	190	138	1	5.85
SVE System Outlet	7/14/15	11:30	138	130	0.9	5.26
SVE System Outlet	7/21/15	9:30	140	127	1.2	7.01
SVE System Outlet	**7/28/15**	**14:30**	**145**	**133**	**1.1**	**6.43**
SVE System Outlet	8/4/15	7:15	160	126	1.6	9.35
SVE System Outlet	8/11/15	12:00	150	134	1.7	9.94
SVE System Outlet	8/18/15	11:30	180	131	1.2	7.01
SVE System Outlet	8/25/15	14:40	185	130	1.6	9.35
SVE System Outlet	9/1/15	13:20	160	132	2.5	14.61
SVE System Outlet	**9/8/15**	**10:45**	**158**	**130**	**2.3**	**13.44**
SVE System Outlet	9/15/15	12:00	162	137	2.2	12.86
SVE System Outlet	9/22/15	14:00	184	131	1.9	11.11
SVE System Outlet	**9/29/15**	**9:00**	**160**	**129**	**1.5**	**8.77**
SVE System Outlet	10/6/15	11:55	170	128	1.8	10.52
SVE System Outlet	10/13/15	13:20	170	130	1.6	9.35
SVE System Outlet	10/20/15	8:05	135	127	1.5	8.77
SVE System Outlet	**10/27/15**	**8:00**	**128**	**131**	**1.7**	**9.94**
SVE System Outlet	11/3/15	10:00	170	135	1.7	9.94
SVE System Outlet	11/10/15	12:40	130	130	1.6	9.35
SVE System Outlet	11/10/15	13:55	148	152	1.7	9.94
SVE System Outlet	11/17/15	14:15	125	222	1.5	8.77
SVE System Outlet	**11/24/15**	**12:50**	**150**	**235**	**1.5**	**8.77**
SVE System Outlet	12/1/15	12:50	138	238	1.4	8.18
SVE System Outlet	12/8/15	8:15	130	227	1	5.85
SVE System Outlet	12/15/15	13:40	135	223	0.9	5.26
SVE System Outlet	12/22/15	12:40	135	223	0.8	4.68
SVE System Outlet	**12/28/15**	**12:40**	**138**	**234**	**0.9**	**5.26**

Notes:
ID = identification
hrs = hours
F = Fahrenheit
scfm = standard cubic feet per minute
ppm = parts per million
ug/L = micrograms per Liter
VOC = volatile organic compounds
Bold text indicates sampling dates for data shown on Table E-2.
Calculated VOC concentrations are based on PID readings.
Flow rates increased on 11/17/15 due to well flow adjusment.

Table E-2
Soil Vapor Extraction - Laboratory VOC results
TSA Remedy - Gresham, Oregon

Well ID	Date	cis-1,2-Dichloroethene (ug/m^3)	Trichloro-ethene (ug/m^3)	Tetrachloro-ethene (ug/m^3)	Total VOCs (ug/m^3)	Flow Rate (scfm)
System Outlet	4/28/15	520	6,000	370	6,890	197
	5/26/15	350	6,000	490	6,840	129
	6/30/15	310	4,900	360	5,570	136
	7/28/15	270	3,700	270	4,240	133
	9/10/15	220	3,100	230	3,550	130
	9/29/15	230	3,300	220	3,750	129
	10/27/15	200	2,500	210	2,910	131
	11/30/15	210	2,900	200	3,310	224
	12/28/15	200	2,800	200	3,200	234
Well VW17D-42.5	4/28/15	390	2,800	97	3,287	19
	7/28/15	150	1,200	54	1,404	21
	10/27/15	130	1,200	53	1,383	17
	11/30/15	4	31	1.9 U	35	25
Well VW17D-75	4/28/15	400	4,500	260	5,160	68
	7/28/15	150	950	140	1,240	68
	10/27/15	70	520	120	710	71
	11/30/15	53	710	120	883	95
Well VW17D-95.5	4/28/15	750	11,000	660	12,410	73
	7/28/15	180	2,500	200	2,880	75
	10/27/15	44	530	49	623	79
	11/30/15	140	2,000	150	2,290	102

Notes:
ID = identification
scfm = standard cubic feet per minute
ug/m^3 = micrograms per cubic meter
VOC = volatile organic compounds
Total VOCs are the calculated sum of the three VOCs shown.
Flow rates increased on 11/17/15 due to well flow adjusment.



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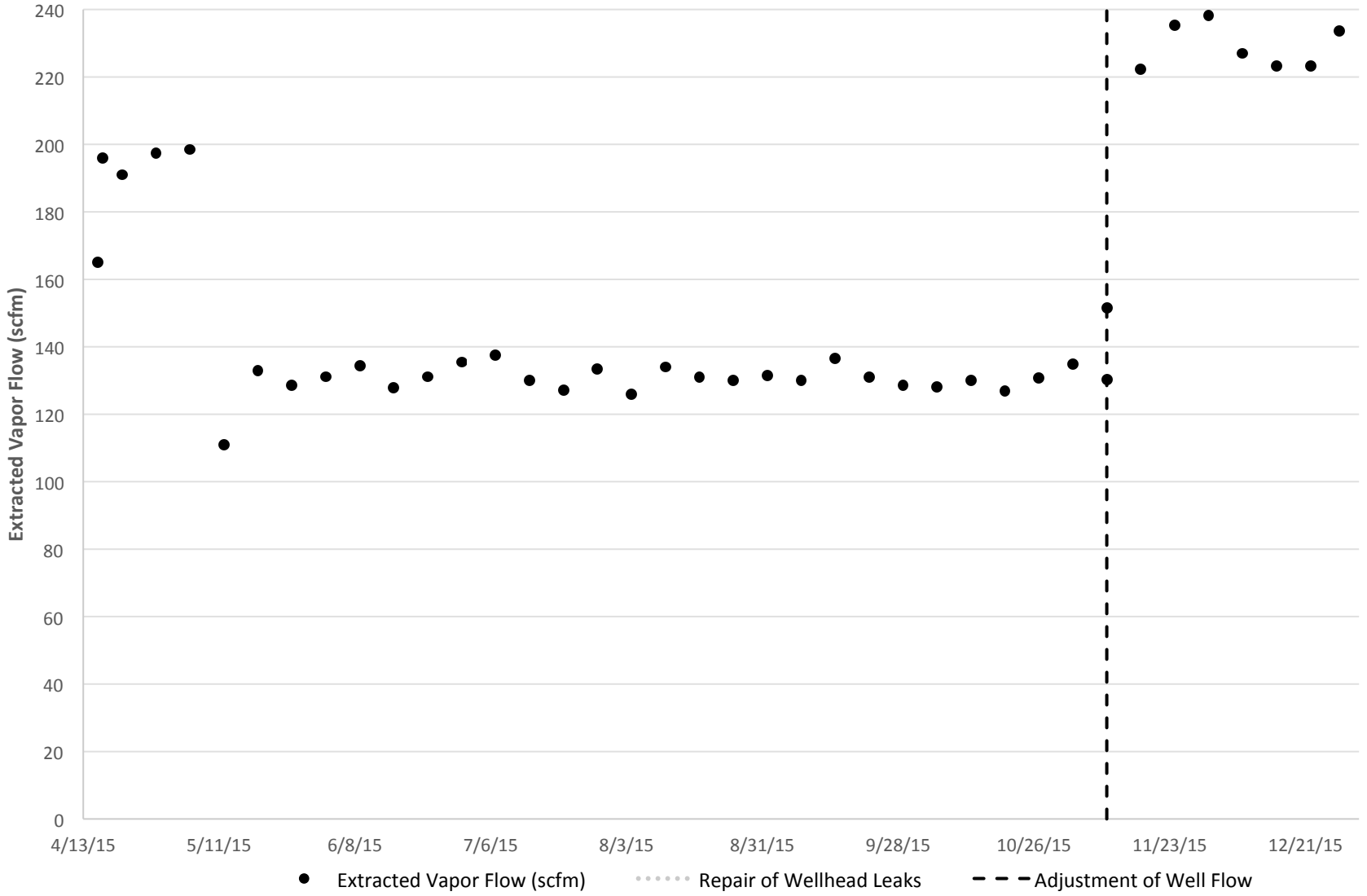
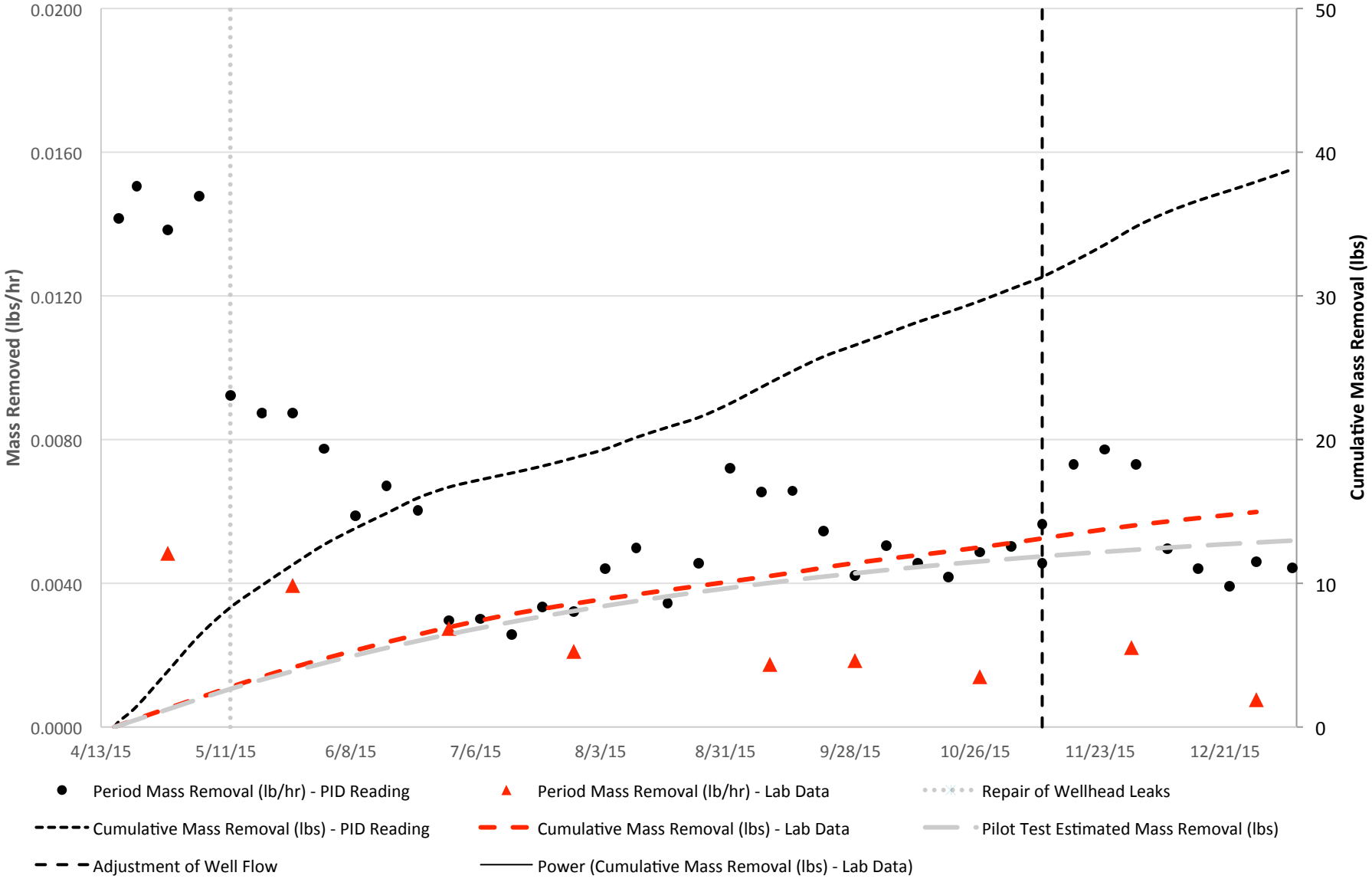
Cascade Corporation Gresham, Oregon	**SVE Extracted Vapor Concentration Weekly Average** **TSA Remedy**	Figure E-1



Geosyntec consultants

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



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Cascade Corporation Gresham, Oregon	**SVE Mass Removal Weekly Average** **TSA Remedy**	Figure E-3

APPENDIX F

Data Validation Memoranda Annual Reporting Period
Laboratory Reports (CD)
Historical Data Summary Tables – VOCs and Groundwater Elevations (CD)

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Memorandum

Date: 5 March 2015

To: Cindy Bartlett, RG, LG, Geosyntec Consultants, Portland, Oregon

From: Geosyntec Quality Assurance Group, Knoxville, Tennessee

Subject: Stage 2A Data Validation - Level II Data Deliverables – ESC Lab Sciences Work Orders: L747001 and L747024

SITE: Cascade Corp, Fairview, Oregon; Job No: PNG0564S14

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of twenty groundwater samples, one influent sample, one effluent sample, one field duplicate sample, one PDB blank, and two trip blanks collected on February 2, 2015, as part of the site investigation activities for the Cascade Corporation, Fairview, Oregon project. ESC Lab Sciences (ESC), Mt. Juliet, Tennessee provided the analytical services.

The samples were analyzed for the following test:

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

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Overall, based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data as qualified are usable for meeting project objectives, with the following exception. The non-detect values of 2-chloroethyl vinyl ether in the samples were rejected due to matrix spike/matrix spike duplicate (MS/MSD) recoveries less than 20% and technical and professional judgment.

The remaining data should be used within the limitations of the qualifications (if applicable).

The organic data were reviewed based on USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, June 2008 (USEPA-540-R-

08-01), as well as by the pertinent methods referenced by the data package and professional judgment.

The following samples were analyzed in the data set:

Laboratory ID	Sample ID
L747001-01	TS-C-INF-020215
L747001-02	TS-C-EFF-020215
L747001-03	TS-C-EFF-020215-DUP
L747001-04	TRIP BLANK
L747024-01	EW1-020215
L747024-02	EW2-020215
L747024-03	EW14-020215
L747024-04	EW23-020215
L747024-05	CMW17DS-020215
L747024-06	D17DS-020215
L747024-07	D17DG-020215
L747024-08	CMW18DS-020215
L747024-09	CMW14RDS-020215

Laboratory ID	Sample ID
L747024-10	EW12-020215-U
L747024-11	EW12-020215-L
L747024-12	CMW24DG-020215-U
L747024-13	CMW24DG-020215-L
L747024-14	CMW25DG-020215
L747024-15	CMW26DG-020215
L747024-16	CMW19DS-020215
L747024-17	CMW10DS-020215
L747024-18	EW16-020215
L747024-19	PBD BLANK-020215
L747024-20	EW8-020215-U
L747024-21	EW8-020215-L
L747024-22	TRIPBLANK

The samples were received at the laboratory at 3.9°C and 3.7°C, within the criteria 0-6°C.

No collection times were listed on the chain of custody (COC) forms for the trip blanks; the laboratory logged them in with collection times of 00:00. There was no impact on the data.

1.0 VOLATILE ORGANIC COMPOUNDS

Twenty groundwater samples, one influent sample, one effluent sample, one field duplicate sample, one PDB blank and two trip blanks 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 (Completeness)
✓ Holding Time
✓ Method Blank
⊗ Matrix Spike/Matrix Spike Duplicate
⊗ Laboratory Control Sample

- ✓ Surrogates
- ✓ Field Duplicate
- ✓ Trip Blank
- ✓ PDB Blank
- ✓ Sensitivity
- ⊗ Electronic Data Deliverables Review

1.1 Overall Assessment (Completeness)

The VOC data reported in this package are considered to be usable for meeting project objectives, with the following exception. The non-detect values of 2-chloroethyl vinyl ether in the samples were R qualified as rejected due to MS/MSD recoveries less than 20% (see section 1.4, below). Therefore, 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 analysis, for the project is 98.5%.

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). Three method blanks (batches WG768562, WG768563 and WG768564) were reported. VOCs were not detected in the method blanks above the detection limits (DLs).

1.4 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). Two sample set specific MS/MSD pairs were reported, using samples TS-C-INF-020215 and EW2-020215. The recovery and relative percent difference (RPD) results were within the laboratory specified acceptance, with the following exceptions.

The MS recoveries of 1,4-dichlorobenzene, hexachloro-1,3-butadiene, isopropylbenzene, n-butylbenzene, n-propylbenzene, p-isopropyltoluene and sec-butylbenzene were low and outside the laboratory specified acceptance in the MS/MSD pair using sample TS-C-INF-020215. In addition, there were no recoveries (0%) of 2-chloroethyl vinyl ether in the MS/MSD pair.

Therefore, the undetected values of 1,4-dichlorobenzene, 4hexachloro-1,3-butadiene, isopropylbenzene, n-butylbenzene, n-propylbenzene, p-isopropyltoluene and sec-butylbenzene in sample TS-C-INF-020215 were UJ qualified as estimated less than the DLs; based on sample preservation (the compound degrades under acid conditions), technical and professional judgment, and no MS/MSD recoveries, the undetected values of 2-chloroethyl vinyl ether in the associated samples were R qualified as rejected.

The MSD recoveries and/or the RPD results for the following compounds were high and outside the laboratory specified acceptance in the MS/MSD pair using sample TS-C-INF-020215. Since these compounds were not detected in sample TS-C-INF-020215, no qualifications were applied to the data.

1,1,1,2-Tetrachloroethane	1,4-Dichlorobenzene	n-Propylbenzene
1,1-dichloro-1-Propene	o-Chlorotoluene	p-Cymene
1,2,3-Trichlorobenzene	p-Chlorotoluene	sec-Butylbenzene
1,2,3-Trichloropropane	Bromobenzene	Styrene
1,2,3-Trimethylbenzene	Chlorobenzene	tert-Butylbenzene
1,2,4-Trichlorobenzene	Chlorodibromomethane	Tetrachloroethene (PCE)
1,2,4-Trimethylbenzene	Ethylbenzene	Toluene
1,2-Dichlorobenzene	Hexachlorobutadiene	Trichloroethene (TCE)
1,3,5-Trimethylbenzene	Isopropylbenzene	Xylenes, Total
1,3-Dichlorobenzene	Butylbenzene	Freon 11

The MSD recovery of 2-chloroethyl vinyl ether in the MS/MSD pair using sample EW2-020215 was low and outside the laboratory acceptance criteria; the recovery was 5%. In addition, the RPD was high and outside the laboratory acceptance criteria. Therefore, based on sample preservation (the compound degrades under acid conditions), technical and professional judgment and MSD recovery less than 20%, the undetected values of 2-chloroethyl vinyl ether in the associated samples were R qualified as rejected.

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

Sample ID	**Compound**	**Laboratory Result (mg/L)**	**Laboratory Flag**	**Validation Result (mg/L)**	**Validation Qualifier***	**Reason Code****
CMW10DS-020215	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
CMW14RDS-	Vinyl 2-Chloroethyl	0.050	U	0.050	R	4

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	Validation Result (mg/L)	Validation Qualifier*	Reason Code**
020215	ether					
CMW17DS-020215	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
CMW18DS-020215	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
CMW19DS-020215	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
CMW24DG-020215-L	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
CMW24DG-020215-U	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
CMW25DG-020215	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
CMW26DG-020215	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
D17DG-020215	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
D17DS-020215	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW1-020215	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW12-020215-L	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW12-020215-U	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW14-020215	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW16-020215	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW2-020215	Vinyl 2-Chloroethyl ether	0.050	U,J6, J3	0.050	R	4
EW23-020215	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW8-020215-L	Vinyl 2-Chloroethyl ether	0.050	U,J4	0.050	R	4
EW8-020215-U	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
TS-C-EFF-020215	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
TS-C-EFF-020215-DUP	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
TS-C-INF-020215	Vinyl 2-Chloroethyl ether	0.050	U,J6	0.050	R	4
TRIP BLANK	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	Validation Result (mg/L)	Validation Qualifier*	Reason Code**
PBD BLANK-020215	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
TRIPBLANK	Vinyl 2-Chloroethyl ether	0.050	U,J4	0.050	R	4
TS-C-INF-020215	1,4-Dichlorobenzene	0.001	U,J6, J3	0.001	UJ	4
TS-C-INF-020215	Isopropylbenzene	0.001	U,J6, J3	0.001	UJ	4
TS-C-INF-020215	Hexachlorobutadiene	0.001	U,J6, J3	0.001	UJ	4
TS-C-INF-020215	Butylbenzene	0.001	U,J6, J3	0.001	UJ	4
TS-C-INF-020215	n-Propylbenzene	0.001	U,J6, J3	0.001	UJ	4
TS-C-INF-020215	p-Cymene	0.001	U,J6, J3	0.001	UJ	4
TS-C-INF-020215	sec-Butylbenzene	0.001	U,J6, J3	0.001	UJ	4

mg/L-milligram per liter
U-not detected at the reported DL
J3- laboratory flag indicating the associated batch QC was outside the established quality control range for precision
J4-laboratory flag indicating the associated batch QC was outside the established quality control range for accuracy
J6- laboratory flag indicating the sample matrix interfered with the ability to make any accurate determination; spike value was low
*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

1.5 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 LCS/LCS duplicate (LCSD) pairs were reported. The recovery and RPD results were within the laboratory specified acceptance criteria, with the following exceptions.

The LCSD recoveries of 1,1,1,2-tetrachloroethane, 1,2,3-trichloropropane, 1,2-dibromoethane and the RPD for trichlorofluoromethane (Freon 11) in batch WG768562 were high and outside the laboratory specified acceptance criteria. Since 1,1,1,2-tetrachloroethane, 1,2,3-trichloropropane and 1,2-dibromoethane were not detected in the associated samples, no qualifications were applied to the data. In addition, the LCSD recovery of trichlorofluoromethane was low and outside the laboratory specified acceptance criteria. Therefore, the undetected values of trichlorofluoromethane in the associated samples were UJ qualified as estimated less than the DL, due to the low LCSD recovery.

The LCS/LCSD recoveries of 2-chloroethyl vinyl ether were low and outside the laboratory specified acceptance criteria in batch WG768564. Since the undetected values of 2-chloroethyl vinyl ether in the associated samples were R qualified as rejected due to the MS/MSD recoveries, no additional qualifications were applied to the data. In addition, the LCS/LCSD recoveries of chloroethane in batch WG768564 were high and outside the laboratory specified acceptance criteria. Since chloroethane was not detected in the associated samples, no qualifications were applied to the data.

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	Validation Result (mg/L)	Validation Qualifier	Reason Code
TS-C-EFF-020215	Freon 11	0.0050	U,J4, J3	0.0050	UJ	5
TS-C-EFF-020215-DUP	Freon 11	0.0050	U,J4, J3	0.0050	UJ	5
TS-C-INF-020215	Freon 11	0.0050	U,J4, J5	0.0050	UJ	5
TRIP BLANK	Freon 11	0.0050	U,J4, J3	0.0050	UJ	5

mg/L-milligram per liter
U-not detected at the reported DL
J4-laboratory flag indicating the associated batch QC was outside the established quality control range for accuracy
J3- laboratory flag indicating the associated batch QC was outside the established quality control range for precision

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Field Duplicate

One field duplicate sample, TS-C-EFF-020215-DUP, was collected. Acceptable precision (RPD ≤30%) was demonstrated between the field duplicate and the original sample, TS-C-EFF-020215-DUP. The RPDs between the results were 0%.

1.8 Trip Blank

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

1.9 PDB Blank

A PDB blank, PBD BLANK-020215, was collected with the sample set. VOCs were not detected in the PDB blank above the DLs.

1.10 Sensitivity

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

1.11 Electronic Data Deliverables (EDD) Review

Results and sample IDs in the EDDs 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 DLs in the hardcopy laboratory reports; both the DLs and the method detection limits (MDLs) were listed in the EDDs. It was also noted that the data were reported using the units parts per million (mg/L) in the EDDs, while the sample data were reported using the units parts per billion (µg/L) and the QC samples were reported using mg/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.

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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.

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.

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: 15 June 2015

To: Cindy Bartlett, RG, LG, Geosyntec Consultants, Portland, Oregon

From: Geosyntec Quality Assurance Group, Knoxville, Tennessee

Subject: Stage 2A Data Validation - Level II Data Deliverables – ESC Lab Sciences Work Orders: L763333 and L763338

SITE: Cascade Corp, Utah; Job No: PNG0564S14

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of fifteen groundwater samples, two field duplicates, and two trip blanks collected on May 5, 2015 as part of the site investigation activities for the Cascade Corp, Utah project. ESC Lab Sciences (ESC), Mt. Juliet, Tennessee provided the analytical services.

The samples were analyzed for the following test:

EPA Method 8260B - Volatile Organic Compounds (VOCs)

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Overall, based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data as qualified are usable for meeting project objectives, with the following exception. The non-detect values for 2-chloroethyl vinyl ether were rejected in the samples due to matrix/matrix spike (MS/MSD) recoveries less than 20%.

The organic data were reviewed based on USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, June 2008 (USEPA-540-R-08-01), as well as by the pertinent methods referenced by the data package and professional judgment.

The following samples were analyzed in the data set:

Laboratory ID	Sample ID
L763333-01	TS-C-EFF-050515
L763333-02	TS-C-EFF-050515-DUP
L763333-03	TS-C-INF-050515
L763333-04	TRIP BLANK LOT 342
L763338-01	EW1-050515
L763338-02	EW2-050515
L763338-03	EW14-050515
L763338-04	EW16-050515
L763338-05	D17DS-050515
L763338-06	EW12-050515-U

Laboratory ID	Sample ID
L763338-07	EW12-050515-L
L763338-08	CMW18DS-050515
L763338-09	CMW18DS-050515-DUP
L763338-10	CMW17DS-050515
L763338-11	CMW14RDS-050515
L763338-12	CMW19DS-050515
L763338-13	CMW26DG-050515
L763338-14	CMW10DS-050515
L763338-15	TRIP BLANK LOT 342

The samples were received at the laboratory at 3.4°C and 2.3°C, within the criteria 0-6°C.

No collection time was listed for the trip blanks; however, there was no impact on the data.

1.0 VOLATILE ORGANIC COMPOUNDS

Fifteen groundwater samples, two field duplicates, and two trip blanks 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 (Completeness)
✓ 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 (Completeness)

The VOC data reported in this package are considered to be usable for meeting project objectives, with the following exception. The non-detect values for 2-chloroethyl vinyl ether were R qualified as rejected in the samples due to MS/MSD recoveries less than 20% (see Section 1.4 below). Therefore, 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 analysis, for the project is 98.5%.

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). Three method blanks (batches WG787545, WG787559, and WG789033) were reported with the data sets. VOCs were not detected in the method blanks above the detection limits (DLs).

1.4 Matrix Spike/Matrix Spike Duplicate

An MS/MSD pair was not reported with batch WG787559. One sample set specific MS/MSD pair was reported using sample EW1-050515. The results for the sample set specific MS/MSD pair were within the laboratory specified acceptance criteria for recovery and relative percent difference (RPD), with the following exceptions.

The recoveries for 2-chloroethyl vinyl ether were less than 20% and outside of the laboratory specified acceptance criteria in the sample specific MS/MSD pair using sample EW1-050515 (1.50%/2.37%). In addition the RPD for 2-chloroethyl vinyl ether was high (47.1%) and outside the laboratory acceptance criteria in the MS/MSD pairs. Therefore, the nondetect value of 2-chloroethyl vinyl ether was R qualified as rejected in the samples, based on sample preservation (the compound degrades under acid conditions) and professional and technical judgment.

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

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier*	Reason Code**
TS-C-EFF-050515	Vinyl 2-Chloroethyl ether	50	U	50	R	4
TS-C-EFF-050515-DUP	Vinyl 2-Chloroethyl ether	50	U	50	R	4
TS-C-INF-050515	Vinyl 2-Chloroethyl ether	50	U	50	R	4
TRIP BLANK LOT 342	Vinyl 2-Chloroethyl ether	50	U	50	R	4
EW1-050515	Vinyl 2-Chloroethyl ether	50	U,J4, J6, J3	50	R	4
EW2-050515	Vinyl 2-Chloroethyl ether	50	U	50	R	4
EW14-050515	Vinyl 2-Chloroethyl ether	50	U	50	R	4
EW16-050515	Vinyl 2-Chloroethyl ether	50	U	50	R	4
D17DS-050515	Vinyl 2-Chloroethyl ether	50	U	50	R	4
EW12-050515-U	Vinyl 2-Chloroethyl ether	50	U,J4, J3	50	R	4
EW12-050515-L	Vinyl 2-Chloroethyl ether	50	U	50	R	4
CMW18DS-050515	Vinyl 2-Chloroethyl ether	50	U	50	R	4
CMW18DS-050515-DUP	Vinyl 2-Chloroethyl ether	50	U	50	R	4
CMW17DS-050515	Vinyl 2-Chloroethyl ether	50	U	50	R	4
CMW14RDS-050515	Vinyl 2-Chloroethyl ether	50	U	50	R	4
CMW19DS-050515	Vinyl 2-Chloroethyl ether	50	U	50	R	4
CMW26DG-050515	Vinyl 2-Chloroethyl ether	50	U	50	R	4
CMW10DS-050515	Vinyl 2-Chloroethyl ether	50	U	50	R	4
TRIP BLANK LOT 342	Vinyl 2-Chloroethyl ether	50	U	50	R	4

µg/L-microgram per liter
U-not detected at the reported DL
J3- laboratory flag defined as the associated batch QC was outside the established quality control range for precision
J4-laboratory flag defined as the associated batch QC was outside the established quality control range for accuracy
J6- laboratory flag defined as the sample matrix interfered with the ability to make any accurate determination; spike value is low
*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

1.5 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 LCS/LCS duplicate (LCSD) pairs were reported with the data sets. The results for the LCS/LCSD pairs were within the laboratory specified acceptance criteria for recovery and RPD, with the following exceptions.

In laboratory report L763338, the recoveries of 1,2-dibromo-3-chloropropane (61.1%/65%), 4-methyl-2-pentanone (MIBK) (63.7%/65%), and naphthalene (66.1%/68%) were low and outside

the laboratory specified acceptance criteria in the LCS/LCSD pair in batch WG787559. Therefore, the nondetect values of these compounds in the associated samples were UJ qualified as estimated less than the DL.

In laboratory report L763338, one or both the recoveries of 2-chloroethyl vinyl ether (161%) and acetone (178%/178%) and the RPD of 2-chloroethyl vinyl ether in the LCS in batch WG789033 were high and outside the laboratory specified acceptance criteria. Since 2-chloroethyl vinyl ether and acetone were not detected in the associated samples, no qualifications were applied to the data.

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	Validation Result (µg/L)	Validation Qualifier	Reason Code
CMW10DS-050515	Methyl Isobutyl Ketone (MIBK)	10	U,J4	10	UJ	5
CMW10DS-050515	Naphthalene	5.0	U,J4	5.0	UJ	5
CMW10DS-050515	1,2-Dibromo-3-Chloropropane	5.0	U,J4	5.0	UJ	5
TRIP BLANK LOT 342	Methyl Isobutyl Ketone (MIBK)	10	U,J4	10	UJ	5
TRIP BLANK LOT 342	Naphthalene	5.0	U,J4	5.0	UJ	5
TRIP BLANK LOT 342	1,2-Dibromo-3-Chloropropane	5.0	U,J4	5.0	UJ	5

µg/L-microgram per liter
U-not detected at the reported DL
J4-laboratory flag defined as the associated batch QC was outside the established quality control range for accuracy

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Field Duplicate

Two field duplicate samples, TS-C-EFF-050515-DUP and CMW18DS-050515-DUP, were analyzed with the data sets. Acceptable precision (RPD ≤30%) was demonstrated between the field duplicates and the original samples, TS-C-EFF-050515 and CMW18DS-050515, respectively.

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	RPD
TS-C-EFF-050515	The VOCs	ND	NA	0
TS-C-EFF-050515-DUP	The VOCs	ND	NA	
CMW18DS-050515	Tetrachloroethene (PCE)	1.1	NA	17

Sample ID	Compound	Laboratory Result (µg/L)	Laboratory Flag	RPD
CMW18DS-050515-DUP	Tetrachloroethene (PCE)	1.3	NA	
CMW18DS-050515	cis-1,2-Dichloroethene	8.5	NA	10
CMW18DS-050515-DUP	cis-1,2-Dichloroethene	9.4	NA	
CMW18DS-050515	Trichloroethene (TCE)	58	NA	3
CMW18DS-050515-DUP	Trichloroethene (TCE)	60	NA	
CMW18DS-050515	The other VOCs	ND	NA	0
CMW18DS-050515-DUP	The other VOCs	ND	NA	

µg/L-microgram per liter
ND-not detected at the DL
NA-not applicable

1.8 Trip Blank

Two trip blanks, both were identified as TRIP BLANK LOT 342, accompanied the sample shipments. VOCs were not detected in the trip blanks above the DLs.

1.9 Sensitivity

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

1.10 Electronic Data Deliverables (EDD) Review

Results and sample IDs in the EDDs 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 DLs in the hardcopy laboratory reports; both the DLs and the MDLs were listed in the EDDs. It was also noted that the data were reported using the units parts per million (mg/L) in the EDDs, while the sample data were reported using the units parts per billion (µg/L) and the QC samples to mg/L in the level II laboratory 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.

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.

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: 24 November 2015

To: Cindy Bartlett, RG, LG, Geosyntec Consultants, Portland, Oregon

From: Geosyntec Quality Assurance Group, Knoxville, Tennessee

Subject: Stage 2A Data Validation - Level II Data Deliverables – ESC Lab Sciences Work Orders: L797781, L797789, and L800041

SITE: Cascade Corp, Fairview, Oregon; Job No: PNG0564S14

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of eighteen water samples, three field duplicates, and two trip blanks, collected from October 29 - November 10, 2015, as part of the site investigation activities for the Cascade Corporation, Fairview, Oregon project. ESC Lab Sciences (ESC), Mt. Juliet, Tennessee provided the analytical services.

The samples were analyzed for the following test:

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

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Overall, based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data as qualified are usable for meeting project objectives, with the following exceptions. The non-detect values of 2-chloroethyl vinyl ether in the samples were R qualified as rejected due to matrix/matrix spike (MS/MSD) recoveries less than 20% and professional and technical judgment.

The remaining qualified data should be used within the limitations of the qualification.

The organic data were reviewed based on USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, August 2014 (USEPA-540-R-013-001), as well as by the pertinent methods referenced by the data package and professional and technical judgment.

The following samples were analyzed in the data set:

Laboratory ID	Sample ID
L797781-01	TS-C-EFF-102915
L797781-02	TS-C-EFF-102915-DUP
L797781-03	TS-C-INF-102915
L797781-04	TRIP BLANK
L797789-01	EW2-102915
L797789-02	EW1-102915
L797789-03	EW14-102915
L797789-04	EW16-102915
L797789-05	D17DS-102915
L797789-06	CMW17DS-102915
L797789-07	CMW17DS-102915-DUP
L797789-08	EW12-102915-U

Laboratory ID	Sample ID
L797789-09	EW12-102915-L
L797789-10	CMW18DS-102915
L797789-11	CMW18DS-102915-DUP
L797789-12	CMW14RDS-102915
L797789-13	CMW26-102915
L797789-14	CMW36DG-102915
L797789-15	CMW19DS-102915
L797789-16	CMW10DS-102915
L797789-17	TRIP BLANK
L800041-01	SOILBIN-20151110
L800041-02	MW99-20151110

The samples were received at the laboratory at 3.8°C, 3.8°C and 2.4°C, within the criteria 0-6°C.

The second sample transfers listed on the chain of custody (COC) forms in the three reports did not list the relinquishing signature, date, or time.

In addition, there were no times of collection listed on the COC for the trip blanks; the laboratory assigned collection times of 00:00. This did not have an impact on the data.

Laboratory reports L797789 and L800041 were revised on November 23, 2014. L797789 was revised to correct the sample collection time for sample EW14-102915, and L800041 was revised to correct the sample ID for sample SOILBIN-20151110.

1.0 VOLATILE ORGANIC COMPOUNDS

Eighteen water samples, three field duplicates, and two trip blanks 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 (Completeness)
✓ 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 (Completeness)

The VOC data reported in this package are considered to be usable for meeting project objectives, with the following exceptions. The non-detect values of 2-chloroethyl vinyl ether in the samples were R qualified as rejected due to MS/MSD recoveries less than 20% and professional and technical judgment (see Section 1.4 below). Therefore, 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 analysis, for the project is 98.5%.

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 WG825942, WG826003, WG825795, and WG828254). VOCs were not detected in the method blanks above the detection limits (DLs).

1.4 Matrix Spike/Matrix Spike Duplicate

Two sample set specific MS/MSD pairs were reported, using samples TS-C-EFF-102915 and EW2-102915. The recovery and relative percent difference (RPD) results were within the laboratory specified acceptance criteria, with the following exceptions.

The recoveries of 2-chloroethyl vinyl ether were less than 20% and outside of the laboratory specified acceptance criteria in both sample set specific MS/MSD pairs (1.27%/0.630% and 1.38%/0.626%).

In addition, the RPDs for 2-chloroethyl vinyl ether were high and outside the laboratory acceptance criteria in the MS/MSD pairs; no qualifications were applied to the data due to the high RPD result. However, due to recoveries less than 20%, the sample preservation (the compound degrades under acid conditions) and professional and technical judgment, the undetected values of 2-chloroethyl vinyl ether in the samples were R qualified as rejected.

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

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	Validation Result (mg/L)	Validation Qualifier*	Reason Code**
TS-C-EFF-102915	Vinyl 2-Chloroethyl ether	0.050	U,J6, J3	0.050	R	4
TS-C-EFF-102915-DUP	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
TS-C-INF-102915	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
TRIP BLANK (L797781)	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW2-102915	Vinyl 2-Chloroethyl ether	0.050	U,J6, J3	0.050	R	4
EW1-102915	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW14-102915	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW16-102915	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
D17DS-102915	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
CMW17DS-102915	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
CMW17DS-102915-DUP	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW12-102915-U	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW12-102915-L	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
CMW18DS-102915	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
CMW18DS-102915-DUP	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
CMW14RDS-102915	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
CMW26-102915	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
CMW36DG-102915	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
CMW19DS-102915	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	Validation Result (mg/L)	Validation Qualifier*	Reason Code**
CMW10DS-102915	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
TRIP BLANK (L797789)	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
SOILBIN-20151110	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
MW99-20151110	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4

mg/L-milligram per liter
U-not detected at the reported DL
J3- laboratory flag defined as the associated batch QC was outside the established quality control range for precision
J6- laboratory flag defined as the sample matrix interfered with the ability to make any accurate determination; spike value is low
*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

1.5 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 LCS/LCS duplicate (LCSD) pairs were reported. The recovery and RPD results were within the laboratory specified acceptance criteria, with the following exceptions.

The recovery of 1,1,1,2-tetrachloroethane (76.0%, 78.5-125%) was low and outside the laboratory specified acceptance criteria in the LCSD in batch WG825942. Therefore, the nondetect value of 1,1,1,2-tetrachloroethane in the associated sample was UJ qualified as estimated less than the DL.

The recovery of 1,3-dichlorobenzene (128%, 77.6-127%) was high and outside the laboratory specified acceptance criteria in the LCS in batch WG828254. Since 1,3-dichlorobenzene was not detected in the associated samples, no qualifications were applied to the data.

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	Validation Result (mg/L)	Validation Qualifier	Reason Code
TS-C-EFF-102915	1,1,1,2-Tetrachloroethane	0.00100	U,J4	0.00100	UJ	5

mg/L-milligram per liter
U-not detected at the reported DL
J4-laboratory flag defined as the associated batch QC was outside the established quality control range for accuracy

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Field Duplicate

Three field duplicate samples, TS-C-EFF-102915-DUP, CMW17DS-102915-DUP, and CMW18DS-102915-DUP, were collected. Acceptable precision (RPD ≤30%) was demonstrated between the field duplicates and the original samples, TS-C-EFF-102915, CMW17DS-102915, and CMW18DS-102915, respectively, with the following exception.

Methyl ethyl ketone was detected in the original sample CMW17DS-102915 and was not detected in the field duplicate CMW17DS-102915-DUP, resulting in a non-calculable RPD between the results. Therefore, the concentration of methyl ethyl ketone was J qualified as estimated and the nondetect value was UJ qualified as estimated less than the RL in the field duplicate pair.

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	RPD	Validation Result (mg/L)	Validation Qualifier	Reason Code
CMW17DS-102915	cis-1,2-Dichloroethene	0.0067	NA	6	NA	NA	NA
CMW17DS-102915-DUP	cis-1,2-Dichloroethene	0.0063	NA		NA	NA	NA
CMW17DS-102915	Methyl ethyl ketone	0.0108	NA	NC	0.0108	J	7
CMW17DS-102915-DUP	Methyl ethyl ketone	0.0100	U		0.0100	UJ	7
CMW17DS-102915	Tetrachloroethene (PCE)	0.00194	NA	2	NA	NA	NA
CMW17DS-102915-DUP	Tetrachloroethene (PCE)	0.00191	NA		NA	NA	NA
CMW17DS-102915	Trichloroethene (TCE)	0.0421	NA	5	NA	NA	NA
CMW17DS-102915-DUP	Trichloroethene (TCE)	0.0402	NA		NA	NA	NA
CMW17DS-102915	The other VOCs	ND	NA	0	NA	NA	NA
CMW17DS-102915-DUP	The other VOCs	ND	NA		NA	NA	NA
CMW18DS-	cis-1,2-	0.0111	NA	2	NA	NA	NA

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	RPD	Validation Result (mg/L)	Validation Qualifier	Reason Code
102915	Dichloroethene						
CMW18DS-102915-DUP	cis-1,2-Dichloroethene	0.0113	NA		NA	NA	NA
CMW18DS-102915	Tetrachloroethene (PCE)	0.00252	NA	9	NA	NA	NA
CMW18DS-102915-DUP	Tetrachloroethene (PCE)	0.00276	NA		NA	NA	NA
CMW18DS-102915	Trichloroethene (TCE)	0.0757	NA	5	NA	NA	NA
CMW18DS-102915-DUP	Trichloroethene (TCE)	0.0792	NA		NA	NA	NA
CMW18DS-102915	The other VOCs	ND	NA	0	NA	NA	NA
CMW18DS-102915-DUP	The other VOCs	ND	NA		NA	NA	NA
TS-C-EFF-102915	The VOCs	ND	NA	0	NA	NA	NA
TS-C-EFF-102915-DUP	The VOCs	ND	NA		NA	NA	NA

mg/L-milligram per liter
ND-not detected at the DL
NA-not applicable
NC-not calculable

1.8 Trip Blank

Two trip blanks, both identified as TRIPBLANK, accompanied the sample shipments. VOCs were not detected in the trip blanks above the DLs.

1.9 Sensitivity

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

1.10 Electronic Data Deliverables (EDD) Review

Results and sample IDs in the EDDs 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 DLs in the hardcopy laboratory reports; both the DLs and the method detection limits (MDLs) were listed in the EDDs. It was also noted that the data were reported in the units parts per million (mg/L) in the EDDs, while the sample data were reported in the units parts per billion (µg/L) and the QC samples were reported in the units mg/L

in the level II laboratory 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.

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.

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: 30 September 2015

To: Cindy Bartlett, RG, LG, Geosyntec Consultants, Portland, Oregon

From: Geosyntec Quality Assurance Group, Knoxville, Tennessee

Subject: Stage 2A Data Validation - Level II Data Deliverables – ESC Lab Sciences Work Orders: L780902, L780963, and L781472

SITE: Cascade Corp, Fairview, Oregon; Job No: PNG0564S14

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of thirty-seven water samples, four field duplicates, and three trip blanks, collected from August 3, 4, and 5, 2015, as part of the site investigation activities for the Cascade Corporation, Fairview, Oregon project. ESC Lab Sciences (ESC), Mt. Juliet, Tennessee provided the analytical services.

The samples were analyzed for the following test:

EPA Method 8260B - Volatile Organic Compounds (VOCs)

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Overall, based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data as qualified are usable for meeting project objectives, with the following exceptions. The non-detect values of 2-chloroethyl vinyl ether in the samples were R qualified as rejected due to matrix/matrix spike (MS/MSD) recoveries less than 20% and professional and technical judgment.

The remaining qualified data should be used within the limitations of the qualification.

The organic data were reviewed based on USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, August 2014 (USEPA-540-R-013-001), as well as by the pertinent methods referenced by the data package and professional and technical judgment.

The following samples were analyzed in the data set:

Laboratory ID	Sample ID
L780902-01	EW-1-080315
L780902-02	EW-2-080315
L780902-03	EW-14-080315
L780902-04	EW-14-080315-DUP
L780902-05	EW-16-080315
L780902-06	EW-23-080315
L780902-07	EW-12-080315-U
L780902-08	EW-12-080315-L
L780902-09	D-17DG-080315
L780902-10	D-17DS-080315
L780902-11	MW-14RDS-080315
L780902-12	MW-17DS-080315
L780902-13	MW-18DS-080315
L780902-14	MW-22DG-080315
L780902-15	MW-36DG-080315
L780902-16	EW-11-080415-U
L780902-17	EW-11-080415-L
L780902-18	EW-15-080415-U
L780902-19	EW-15-080415-L
L780902-20	D-16DS-080415
L780902-21	EW-8-080415-U
L780902-22	EW-8-080415-L

Laboratory ID	Sample ID
L780902-23	BOP-44DG-080415
L780902-24	BOP-44DS-080415
L780902-25	D-18DS-080415
L780902-26	D-18DS-080415-DUP
L780902-27	MW-24DG-080415-U
L780902-28	MW-24DG-080415-L
L780902-29	MW-25DG-080415
L780902-30	MW-26DG-080415
L780902-31	MW-26DG-080415-DUP
L780902-32	TRIPBLANK
L780963-01	TS-C-EFF-080315
L780963-02	TS-C-EFF-080315-DUP
L780963-03	TS-C-INF-080315
L780963-04	TRIP BLANK LOT #342
L781472-01	MW-19DS-080515
L781472-02	MW-10DG-080515
L781472-03	MW-10DS-080515
L781472-04	MW-8DG-080515
L781472-05	PWB-1UTS-080515
L781472-06	PWB-1LTS-080515
L781472-07	MW-20DS-080515
L781472-08	TRIP BLANK LOT 345

The samples were received at the laboratory at 2.4°C, 3.7°C, and 3.1°C, within the criteria 0-6°C.

The second sample transfers listed on the chain of custody (COC) forms in the three reports did not list the relinquishing signature, date or time.

In addition, there were no times of collection listed on the COC for the trip blanks; the laboratory assigned collection times of 00:00. This did not have an impact on the data.

Report L780902 was revised to correct the client ID for sample L780902-10. The COC lists the client ID as D-17DG-080315; information was sent from the client to the laboratory requesting the sample ID change to D-17DS-080315, based on the field notes. The laboratory report did not indicate it was a revision.

1.0 VOLATILE ORGANIC COMPOUNDS

Thirty-seven water samples, four field duplicates, and three trip blanks 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 (Completeness)
✓ 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 (Completeness)

The VOC data reported in this package are considered to be usable for meeting project objectives, with the following exceptions. The non-detect values of 2-chloroethyl vinyl ether in the samples were R qualified as rejected due to MS/MSD recoveries less than 20% and professional and technical judgment (see Section 1.4 below). Therefore, 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 analysis, for the project is 98.5%.

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 WG807268, WG807270, WG807271, WG807773, and WG 808211). VOCs were not detected in the method blanks above the detection limits (DLs).

1.4 Matrix Spike/Matrix Spike Duplicate

MS/MSD pairs were analyzed at the proper frequency for the number and types of samples analyzed (one pair per batch of 20 samples). Two sample set specific MS/MSD pairs were reported, using samples D-17DS-080315 and MW-26DG-080415. The recovery and relative percent difference (RPD) results were within the laboratory specified acceptance criteria, with the following exceptions.

The recoveries of 2-chloroethyl vinyl ether were less than 20% and outside of the laboratory specified acceptance criteria in both sample set specific MS/MSD pairs (0%/0% and 12%/0%). In addition, the RPD for 2-chloroethyl vinyl ether was high and outside the laboratory acceptance criteria in the MS/MSD pair using sample MW-26DG-080415; no qualifications were applied to the data due to the high RPD result. However, due to recoveries less than 20%, the sample preservation (the compound degrades under acid conditions) and professional and technical judgment, the undetected values of 2-chloroethyl vinyl ether in the samples were R qualified as rejected.

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

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	Validation Result (mg/L)	Validation Qualifier*	Reason Code**
TS-C-INF-080315	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW-15-080415-L	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
TS-C-EFF-080315	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW-8-080415-U	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW-14-080315	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW-12-080315-L	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW-14-080315-DUP	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	Validation Result (mg/L)	Validation Qualifier*	Reason Code**
EW-16-080315	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW-23-080315	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW-15-080415-U	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
D-17DG-080315	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW-2-080315	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
D-17DS-080315	Vinyl 2-Chloroethyl ether	0.050	U, J6	0.050	R	4
D-16DS-080415	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW-11-080415-L	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
MW-36DG-080315	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
MW-22DG-080315	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
MW-18DS-080315	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
MW-17DS-080315	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
MW-14RDS-080315	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW-12-080315-U	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
TS-C-EFF-080315-DUP	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
MW-26DG-080415-DUP	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
BOP-44DG-080415	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
BOP-44DS-080415	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
D-18DS-080415-DUP	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
MW-24DG-080415-U	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
MW-24DG-080415-L	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
MW-25DG-080415	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW-1-080315	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	Validation Result (mg/L)	Validation Qualifier*	Reason Code**
D-18DS-080415	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
PWB-1LTS-080515	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
MW-19DS-080515	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
MW-10DG-080515	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
MW-10DS-080515	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
PWB-1UTS-080515	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
MW-20DS-080515	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW-8-080415-L	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
EW-11-080415-U	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
MW-8DG-080515	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
MW-26DG-080415	Vinyl 2-Chloroethyl ether	0.050	U, J6 J3	0.050	R	4
TRIP BLANK LOT 345	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
TRIPBLANK	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
TRIP BLANK LOT #342	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4

mg/L-milligram per liter
U-not detected at the reported DL
J3- laboratory flag defined as the associated batch QC was outside the established quality control range for precision
J6- laboratory flag defined as the sample matrix interfered with the ability to make any accurate determination; spike value is low
*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

1.5 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). Five LCS/LCS duplicate (LCSD) pairs were reported. The recovery and RPD results were within the laboratory specified acceptance criteria, with the following exceptions.

The LCS recoveries of 1,2-dichlorobenzene (119%, limits 85-118%) and 1,4-dichlorobenzene (115%, limits 82-114%) were high and outside the laboratory specified acceptance criteria in batch WG808211 (laboratory report L781472). Since 1,2-dichlorobenzene and 1,4-dichlorobenzene were not detected in the associated samples, no qualifications were applied to the data. In addition, the LCS/LCSD recoveries of acrolein (23%/25%, limits 40-172%) were low and outside the laboratory specified acceptance criteria in batch WG808211. Therefore, the nondetect value of acrolein in the associated sample was UJ qualified as estimated less than the DL.

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	Validation Result (mg/L)	Validation Qualifier	Reason Code
MW-10DG-080515	Acrolein	0.050	U, J4	0.050	UJ	5

mg/L-milligram per liter
U-not detected at the reported DL
J4-laboratory flag defined as the associated batch QC was outside the established quality control range for accuracy

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses, with the following exceptions.

The recoveries of dibromofluoromethane in the following samples were high and outside the laboratory specified acceptance criteria: MW-18DS-080315, MW-36DG-080315, EW-11-080415-U, EW-15-080415-U, EW-15-080415-L, BOP-44DS-080415, D-18DS-080415 and MW-24DG-080415-L. Since the other two surrogates had acceptable recoveries, no qualifications were applied to the data, based on professional and technical judgment.

1.7 Field Duplicate

Four field duplicate samples, EW-14-080315-DUP, D-18DS-080415-DUP, MW-26DG-080415-DUP, and TS-C-EFF-080315-DUP were collected. Acceptable precision (RPD $\leq$30%) was demonstrated between the field duplicates and the original samples, EW-14-080315, D-18DS-080415, MW-26DG-080415, and TS-C-EFF-080315, respectively.

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	RPD
D-18DS-080415	The VOCs	ND	NA	0
D-18DS-080415-DUP	The VOCs	ND	NA	
EW-14-080315-DUP	Trichloroethene (TCE)	0.00711	NA	5

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	RPD
EW-14-080315	Trichloroethene (TCE)	0.00679	NA	
EW-14-080315-DUP	The other VOCs	ND	NA	0
EW-14-080315	The other VOCs	ND	NA	
MW-26DG-080415	Trichloroethene (TCE)	0.00234	NA	25
MW-26DG-080415-DUP	Trichloroethene (TCE)	0.00301	NA	
MW-26DG-080415	The other VOCs	ND	NA	0
MW-26DG-080415-DUP	The other VOCs	ND	NA	
TS-C-EFF-080315	The VOCs	ND	NA	0
TS-C-EFF-080315-DUP	The VOCs	ND	NA	

mg/L-milligram per liter
ND-not detected at the DL
NA-not applicable

1.8 Trip Blank

Three trip blanks, TRIPBLANK, TRIP BLANK LOT #342, and TRIP BLANK LOT 345, accompanied the sample shipments. VOCs were not detected in the trip blanks above the DLs.

1.9 Sensitivity

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

1.10 Electronic Data Deliverables (EDD) Review

Results and sample IDs in the EDDs 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 DLs in the hardcopy laboratory reports; both the DLs and the method detection limits (MDLs) were listed in the EDDs. It was also noted that the data were reported in the units parts per million (mg/L) in the EDDs, while the sample data were reported in the units parts per billion (µg/L) and the QC samples were reported in the units mg/L in the level II laboratory reports. This did not affect the quality of the data. No other discrepancies were identified between the level II reports and the EDDs.

* * * * *

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.

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.

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

TECHNICAL MEMORANDUM

LANDAU ASSOCIATES
ENVIRONMENTAL | GEOTECHNICAL | NATURAL RESOURCES

TO: Chris Kimmel, Project Manager

FROM: Anne Halvorsen

DATE: June 17, 2015

RE: BOEING PORTLAND (TSA)
FIRST QUARTER 2015 GROUNDWATER QUALITY SAMPLING
LABORATORY DATA QUALITY EVALUATION

This technical memorandum provides the results of a focused data validation associated with 10 groundwater samples, 1 field duplicate and 2 trip blanks, collected during the first quarter 2015 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 packages 1537307, 1536519, and 1538085. Samples submitted to LLI were analyzed for volatile organic compounds [(VOCs) U.S. 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 1999, 2008) and the *National Functional Guidelines for Inorganic Data Review* (EPA 2004, 2010). The verification and validation check for each laboratory data package 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. No qualification of the data was deemed necessary.

CHAIN-OF-CUSTODY RECORDS

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

Upon receipt by LLI, the sample container information was compared to the associated chain-of-custody and the cooler temperature was recorded. The coolers associated with these data packages were received with temperatures meeting the EPA-recommended limit of <0.6°(ranging from 0.9°C to 2.9°C). Data were not qualified based upon the cooler temperature.

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 is necessary.

BLANK RESULTS

Laboratory Method Blanks

At least one method blank was analyzed with this batch of samples for VOCs analysis. No contamination was detected in the method blank. No qualification of the data is necessary.

Field Trip Blanks and Field Equipment Blanks

Trip blanks were submitted to the laboratory for VOC analysis with data packages 1537307 and 1538085. No contamination was detected in the trip blanks. No qualification of the data is necessary. No field equipment blanks were submitted for analysis with this batch of samples.

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 is necessary.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) AND LABORATORY REPLICATE RESULTS

No matrix spike or laboratory duplicate samples were analyzed with these data packages.

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 relative percent differences

(RPDs) for the laboratory control samples and associated duplicates were within the current laboratory-specified control limits.

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-0215/BOP-13ds-0215] was submitted for analysis with data package 1536519.

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 this case, 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.

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 these sample batches.

Continuing calibration verification (CCV) recovery results are provided with all data packages. In data packages 1537307 and 1536519, the CCV was high for bromoform and/or vinyl acetate for several samples. Since the associated samples are not detected, no qualification of the data is 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 and field duplicates. Data accuracy was evaluated through laboratory control samples and surrogate spikes. No data were rejected.

REFERENCES

EPA. 2010. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review.* USEPA-540-R-10-011. U.S. Environmental Protection Agency. Office of Superfund Remediation and Technology Innovation. Washington, D.C. January.

EPA. 2008. *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review.* USEPA-540-R-08-01. U.S. Environmental Protection Agency. Office of Superfund Remediation and Technology Innovation. Washington, D.C. June.

EPA. 2004. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.* EPA 540-R-04-004. U.S. Environmental Protection Agency. Office of Superfund Remediation and Technology Innovation. October.

EPA. 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review.* EPA-540/R-99-008. U.S. Environmental Protection Agency. Office of Emergency and Remedial Response. Washington, D.C. October.

TECHNICAL MEMORANDUM

LANDAU ASSOCIATES
ENVIRONMENTAL | GEOTECHNICAL | NATURAL RESOURCES

TO: Chris Kimmel, Project Manager

FROM: Erin Waibel and Anne Halvorsen

DATE: August 13, 2015

RE: BOEING PORTLAND (TSA)
SECOND QUARTER 2015 GROUNDWATER QUALITY SAMPLING
LABORATORY DATA QUALITY EVALUATION

This technical memorandum provides the results of a focused data validation associated with 2 groundwater samples and 1 trip blank collected during the second quarter 2015 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 1558826. Samples submitted to LLI were analyzed for volatile organic compounds [(VOCs) U.S. 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 1999, 2008) and the *National Functional Guidelines for Inorganic Data Review* (EPA 2004, 2010). The verification and validation check for each laboratory data package 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. No qualification of the data was deemed necessary.

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 temperature was recorded. The cooler was received with a temperature 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 is necessary.

BLANK RESULTS

Laboratory Method Blanks

At least one method blank was analyzed with this batch of samples for VOCs analysis. No contamination was detected in the method blank. No qualification of the data is necessary.

Field Trip Blanks and Field Equipment Blanks

One trip blank was submitted to the laboratory for VOC analysis with data package 1558826. No contamination was detected in the trip blank. No qualification of the data is necessary. No field equipment blanks were submitted for analysis with this batch of samples.

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 is necessary.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) AND LABORATORY REPLICATE RESULTS

No matrix spike or laboratory duplicate samples were analyzed with these data packages.

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 this batch of samples for VOCs analysis. Recoveries and relative percent differences

(RPDs) for the laboratory control samples and associated duplicates were within the current laboratory-specified control limits.

BLIND FIELD DUPLICATE RESULTS

No blind field duplicates were submitted for analysis with this batch of samples.

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 these sample batches.

Continuing calibration verification (CCV) recovery results all acceptable.

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 not evaluated. Data accuracy was evaluated through laboratory control samples and surrogate spikes. No data were rejected.

REFERENCES

EPA. 2010. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review.* USEPA-540-R-10-011. U.S. Environmental Protection Agency. Office of Superfund Remediation and Technology Innovation. Washington, D.C. January.

EPA. 2008. *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review.* USEPA-540-R-08-01. U.S. Environmental Protection Agency. Office of Superfund Remediation and Technology Innovation. Washington, D.C. June.

EPA. 2004. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.* EPA 540-R-04-004. U.S. Environmental Protection Agency. Office of Superfund Remediation and Technology Innovation. October.

EPA. 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review.* EPA-540/R-99-008. U.S. Environmental Protection Agency. Office of Emergency and Remedial Response. Washington, D.C. October.

Technical Memorandum

TO: Chris Kimmel, Project Manager

FROM: Kristi Schultz and Anne Halvorsen

DATE: October 27, 2015

RE: **Boeing Portland (TSA)**
Third Quarter 2015 Groundwater Quality Sampling
Laboratory Data Quality Evaluation

This technical memorandum provides the results of a focused data validation associated with 23 groundwater samples and 2 trip blanks collected during the third quarter 2015 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 packages 1583267 and 1589697. Samples submitted to LLI were analyzed for volatile organic compounds ([VOCs] U.S. 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 1999, 2008). The verification and validation check for each laboratory data package included the following:

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

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

Chain-of-Custody Records

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

Upon receipt by 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. No contamination was detected in the method blanks. No qualification of the data was necessary.

Field Trip Blanks and Field Equipment Blanks

Two trip blanks were submitted to the laboratory for VOC analysis with the sample batches. No contamination was detected in the trip blanks. No qualification of the data was necessary. No field equipment blanks were submitted for analysis with these sample batches.

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 spike or laboratory duplicate samples were analyzed with these data packages.

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 relative percent differences (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

Two pairs of blind field duplicate samples were submitted for VOC analysis with samples in data package 1583267: BOP-Z-0815 / BOP-20ds-0815 and BOP-Y-0815 / BOP-60(dg)-0815.

A project-specified control limit of 20 percent was used to evaluate the RPDs between the duplicate water 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 these sample batches.

Continuing calibration verification (CCV) recovery results were within laboratory-specified control limits with the following exception:

- The CCV was low for acetone in data package 1583267. 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 and blind field duplicates. Data accuracy was evaluated through laboratory control samples and surrogate spikes. No data were rejected.

LANDAU ASSOCIATES, INC.

Kristi Schultz
Assistant Scientist

Anne Halvorsen
Senior Project Scientist

ASH/kes
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References

EPA. 2008. *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review.* USEPA-540-R-08-01. U.S. Environmental Protection Agency. Office of Superfund Remediation and Technology Innovation. Washington, D.C. June.

EPA. 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review.* EPA-540/R-99-008. U.S. Environmental Protection Agency. Office of Emergency and Remedial Response. Washington, D.C. October.

Table 1
Summary of Data Qualifiers
Boeing Portland TSA Phase I

Data Package	Analyte	Result	Qualifier	Sample Number	Reason
1583267	Acetone	5.0 U	UJ	BOP-31ds-0815	Low continuing calibration recovery
1583267	Acetone	53	J	BOP-23dg-0815	Low continuing calibration recovery
1583267	Acetone	56	J	BOP-31dg-0815	Low continuing calibration recovery
1583267	Acetone	5.0 U	UJ	BOP-13ds-0815	Low continuing calibration recovery
1583267	Acetone	59	J	BOP-13dg-0815	Low continuing calibration recovery
1583267	Acetone	5.0 U	UJ	BOP-62ds-0815	Low continuing calibration recovery
1583267	Acetone	66	J	BOP-61dg-0815	Low continuing calibration recovery
1583267	Acetone	5.0 U	UJ	BOP-61ds-0815	Low continuing calibration recovery
1583267	Acetone	5.0 U	UJ	BOP-66ds-0815	Low continuing calibration recovery
1583267	Acetone	34	J	BOP-60R(ds)-0815	Low continuing calibration recovery
1583267	Acetone	50	J	BOP-Y-0815	Low continuing calibration recovery
1583267	Acetone	52	J	BOP-60(dg)-0815	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.

U = Indicates the compound was undetected at the reported concentration.

TECHNICAL MEMORANDUM

LANDAU ASSOCIATES
ENVIRONMENTAL | GEOTECHNICAL | NATURAL RESOURCES

TO: Chris Kimmel, Project Manager

FROM: Terry McGourty and Anne Halvorsen

DATE: December 29, 2014

RE: BOEING PORTLAND (TSA)
FOURTH QUARTER 2014 GROUNDWATER QUALITY SAMPLING
LABORATORY DATA QUALITY EVALUATION

This technical memorandum provides the results of a focused data validation associated with 2 groundwater samples collected during the fourth quarter 2014 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 1517225. Samples submitted to LLI were analyzed for volatile organic compounds [(VOCs) U.S. 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 1999, 2008) and the *National Functional Guidelines for Inorganic Data Review* (EPA 2004, 2010). The verification and validation check for each laboratory data package 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. No qualification of the data was deemed necessary.

CHAIN-OF-CUSTODY RECORDS

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

Upon receipt by LLI, the sample container information was compared to the associated chain-of-custody and the cooler temperature was recorded. The cooler associated with this data package was received with a temperature below the EPA-recommended limit of 4°C±2°C (1.4°C). Data were not qualified based upon the cooler temperature.

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 is necessary.

BLANK RESULTS

Laboratory Method Blanks

At least one method blank was analyzed with this batch of samples for VOCs analysis. No contamination was detected in the method blank. No qualification of the data is necessary.

Field Trip Blanks and Field Equipment Blanks

No trip blanks or field equipment blanks were submitted for analysis with this batch of samples.

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 is necessary.

MATRIX SPIKE/MATRIX SPIKE DUPLICATE (MS/MSD) AND LABORATORY REPLICATE RESULTS

No matrix spike or laboratory duplicate samples were analyzed with this data package.

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 this batch of samples for VOCs analysis. Recoveries and relative percent differences

(RPDs) for the laboratory control samples and associated duplicates were within the current laboratory-specified control limits with the following exception:

- The percent recovery value for the LCS associated with the VOC analysis for vinyl acetate in this data package exceeded the laboratory-specified control limits. Since the associated samples are not detected, no qualification of the data is necessary.

BLIND FIELD DUPLICATE RESULTS

No blind field duplicates were submitted for analysis with this batch of samples.

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 these sample batches.

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.

REFERENCES

EPA. 2010. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review.* USEPA-540-R-10-011. U.S. Environmental Protection Agency. Office of Superfund Remediation and Technology Innovation. Washington, D.C. January.

EPA. 2008. *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review.* USEPA-540-R-08-01. U.S. Environmental Protection Agency. Office of Superfund Remediation and Technology Innovation. Washington, D.C. June.

EPA. 2004. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.* EPA 540-R-04-004. U.S. Environmental Protection Agency. Office of Superfund Remediation and Technology Innovation. October.

EPA. 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review.* EPA-540/R-99-008. U.S. Environmental Protection Agency. Office of Emergency and Remedial Response. Washington, D.C. October.

Technical Memorandum

TO: Chris Kimmel, Project Manager

FROM: Kristi Schultz and Anne Halvorsen

DATE: December 21, 2015

RE: **Boeing Portland (TSA)**
Fourth Quarter 2015 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 fourth quarter 2015 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 1607519. Samples submitted to LLI were analyzed for volatile organic compounds ([VOCs] U.S. 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 1999, 2008). The verification and validation check for each laboratory data package 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 temperature was recorded. The cooler was received with a temperature 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. No contamination was detected in the 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 the sample batch. No contamination was detected in the trip blank. 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 spike or laboratory duplicate samples were analyzed with this data package.

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 relative percent differences (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

One pair of blind field duplicate samples was submitted for VOC analysis: BOP-Z-1115 / BOP-60dg-1115.

A project-specified control limit of 20 percent was used to evaluate the RPDs between the duplicate water 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 pair 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. Continuing calibration verification (CCV) recovery results were within laboratory-specified control limits.

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

LANDAU ASSOCIATES, INC.

Kristi Schultz
Assistant Scientist

Anne Halvorsen
Senior Project Scientist

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References

EPA. 2008. *USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review.* USEPA-540-R-08-01. U.S. Environmental Protection Agency. Office of Superfund Remediation and Technology Innovation. Washington, D.C. June.

EPA. 1999. *USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review.* EPA-540/R-99-008. U.S. Environmental Protection Agency. Office of Emergency and Remedial Response. Washington, D.C. October.

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Memorandum

Date: 15 June 2015

To: Cindy Bartlett, RG, LG, Geosyntec Consultants, Portland, Oregon

From: Geosyntec Quality Assurance Group, Knoxville, Tennessee

Subject: Stage 2A Data Validation - Level II Data Deliverables – ALS Environmental: P1502164

SITE: Cascade Corp, Fairview, Oregon; Job No: PNG0564S14

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of one air sample collected on May 26, 2015 as part of the site investigation activities for the Cascade Corporation, Fairview, Oregon project. ALS Environmental, Simi Valley, California provided the analytical services.

The sample was analyzed for the following test:

- EPA Method TO-15 - Volatile Organic Compounds (VOCs).

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

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

The organic data were reviewed based on USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, June 2008 (USEPA-540-R-08-01), as well as by the pertinent methods referenced by the data package and professional judgment.

The following was analyzed in the data set:

Laboratory ID	Sample ID
P1502164-001	SVE EFF-052615

1.0 VOLATILE ORGANIC COMPOUNDS

One air sample was analyzed for VOCs per EPA Method TO-15.

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 (Completeness)
- ✓ Holding Time
- ✓ Method Blank
- ✓ Laboratory Control Sample
- ✓ Surrogates
- ✓ Trip Blank
- ✓ Field Blank
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverables Review

1.1 Overall Assessment

The VOC data reported in this package are considered to be 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 analysis, for the project is 100%.

1.2 Holding Time

The holding time for the VOC analysis of a SUMMA canister air sample 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). One method blank (batch P150602) was reported with the data sets. VOCs were not detected in the method blank 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). One LCS was reported with the data sets. The results for the LCS were within the laboratory specified acceptance criteria for recovery.

1.5 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.6 Trip Blank

A trip blank was not shipped with the sample set.

1.7 Field Blank

Field blanks were not collected with the sample set.

1.8 Field Duplicate

Field duplicates were not collected with the sample set.

1.9 Sensitivity

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

1.10 Electronic Data Deliverables (EDD) 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. No discrepancies were identified between the level II report and the EDD.

* * * * *

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.

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.

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: 15 June 2015

To: Cindy Bartlett, RG, LG, Geosyntec Consultants, Portland, Oregon

From: Geosyntec Quality Assurance Group, Knoxville, Tennessee

Subject: Stage 2A Data Validation - Level II Data Deliverables – ALS Environmental: P1501779

SITE: Cascade Corp, Fairview, Oregon; Job No: PNG0564S14

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of four air samples collected on April 28, 2015 as part of the site investigation activities for the Cascade Corporation, Fairview, Oregon project. ALS Environmental, Simi Valley, California provided the analytical services.

The samples were analyzed for the following test:

- EPA Method TO-15 - Volatile Organic Compounds (VOCs).

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

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

The organic data were reviewed based on USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, June 2008 (USEPA-540-R-08-01), as well as by the pertinent methods referenced by the data package and professional judgment.

The following samples were analyzed in the data set:

Laboratory ID	Sample ID
P1501779-001	VW17D-42.5-042815

Laboratory ID	Sample ID
P1501779-002	VW17D-75.0-042815

Laboratory ID	Sample ID
P1501779-003	VW17D-95.5-042815

Laboratory ID	Sample ID
P1501779-004	OUT-042815

1.0 VOLATILE ORGANIC COMPOUNDS

Four air samples were analyzed for VOCs per EPA Method TO-15.

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 (Completeness)
- ✓ Holding Time
- ✓ Method Blank
- ✓ Laboratory Control Sample
- ✓ Surrogates
- ✓ Trip Blank
- ✓ Field Blank
- ✓ Field Duplicate
- ✓ Sensitivity
- ✓ Electronic Data Deliverables Review

1.1 Overall Assessment

The VOC data reported in this package are considered to be 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 analysis, for the project is 100%.

1.2 Holding Time

The holding time for the VOC analysis of a SUMMA canister air sample 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). One method blank (batch P150506) was reported with the data sets VOCs were not detected in the method blank 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). One LCS was reported with the data sets. The results for the LCS were within the laboratory specified acceptance criteria for recovery.

1.5 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.6 Trip Blank

A trip blank was not shipped with the sample set.

1.7 Field Blank

Field blanks were not collected with the sample set.

1.8 Field Duplicate

Field duplicates were not collected with the sample set.

1.9 Sensitivity

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

1.10 Electronic Data Deliverables (EDD) 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. No discrepancies were identified between the level II report and the EDD.

* * * * *

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.

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.

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: 28 January 2016

To: Cindy Bartlett, RG, LG, Geosyntec Consultants, Portland, Oregon

From: Geosyntec Quality Assurance Group, Knoxville, Tennessee

Subject: **Stage 2A Data Validation - Level II Data Deliverables – ESC Lab Sciences Work Orders L804094 and L809265 and ALS Environmental Service Request Numbers P1502696, P1503097, P1503827, P1504111, P1504626, and P1505203**

SITE: Cascade Corp, Fairview, Oregon; Job No: PNG0564S15

INTRODUCTION

This report summarizes the findings of the Stage 2A data validation of two groundwater samples, fifteen air samples, and two trip blanks, collected from June 30 through December 28, 2015, as part of the site investigation activities for the Cascade Corp, Fairview, Oregon project. ESC Lab Sciences (ESC), Mt. Juliet, Tennessee, and ALS Environmental, Simi Valley, California, provided the analytical services.

The samples were analyzed for the following tests:

- EPA Method 8260B - Volatile Organic Compounds (VOCs)
- EPA Method TO-15 – Selected Volatile Organic Compounds (1,1-Dichloroethene, cis-1,2-Dichlroethene, Trichloroethene, Tetrachloroethene, and Vinyl Chloride)

EXECUTIVE SUMMARY

The samples were handled, prepared, and measured in the same manner under similar prescribed conditions.

Overall, based on this Stage 2A data validation covering the quality control (QC) parameters listed below, the data as qualified are usable for meeting project objectives, with the following exceptions. The non-detect values of 2-chloroethyl vinyl ether in the water samples were R qualified as rejected due to historical matrix spike/matrix spike duplicate (MS/MSD) results, sample preservation (2-chloroethyl vinyl ether degrades in acidic conditions), and professional and technical judgment.

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The remaining qualified data should be used within the limitations of the qualification.

The organic data were reviewed based on USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, August 2014 (USEPA-540-R-013-001), as well as by the pertinent methods referenced by the data package and professional and technical judgment.

The following samples were analyzed in the data set:

Laboratory ID	Client ID
L804094-01	CMW17DS-113015
L804094-02	TRIP BLANK
L809265-01	CMW17DS-122815
L809265-02	TRIP BLANK
P1502696-001	SVE EFF-063015
P1503097-001	VW17D-95.5-072815
P1503097-002	VW17D-75.0-072815
P1503097-003	VW17D-42.5-072815
P1503097-004	SVE EFF-072815
P1503827-001	SVE EFF-091015

Laboratory ID	Client ID
P1504111-001	SVEEFF-092915
P1504626-001	VW17d-42.5-102715
P1504626-002	VW17d-75-102715
P1504626-003	VW17d-95.5-102715
P1504626-004	SVE EFF-102715
P1505203-001	VW 17d 95.5 - 113015
P1505203-002	VW 17d 75.0 - 113015
P1505203-003	VW 17d 42.5 - 113015
P1505203-004	SVE EFF - 113015

The water samples were received at the laboratory at 3.1^{o}C, within the criteria 0-6^{o}C.

The second sample transfers listed on the chain of custody (COC) forms in reports L804094 and L809265 did not list the relinquishing signature, date, or time.

The transfers on the COC forms in reports P1503097, P1503827, and P1504626 did not list the relinquishing time.

1.0 VOLATILE ORGANIC COMPOUNDS BY EPA METHOD 8260B

Two water samples and two trip blanks 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 (Completeness)
✓ 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 (Completeness)

The VOC data reported in this package are considered to be usable for meeting project objectives, with the following exceptions. The non-detect values of 2-chloroethyl vinyl ether in the samples were R qualified as rejected due to historical MS/MSD results, sample preservation (2-chloroethyl vinyl ether degrades in acidic conditions), and professional and technical judgment (see Section 1.4 below). Therefore, 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 analysis, for the project is 98.5%.

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). Two method blanks were reported (batches WG833298 and WG839297). VOCs were not detected in the method blanks above the reported detection limits (RDLs).

1.4 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). Two batch MS/MSD pairs were reported. Since these are batch QC, the results do not affect the samples in this data set and qualifications were not applied to the data based on these results.

Based on historical data, sample preservation (2-chloroethyl vinyl ether degrades in acidic conditions), and professional and technical judgment the nondetect values of 2-chloroethyl vinyl ether were R qualified as rejected.

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	Validation Result (mg/L)	Validation Qualifier*	Reason Code**
CMW17DS-113015	Vinyl 2-Chloroethyl ether	0.050	U, J3	0.050	R	4
TRIP BLANK (L804094)	Vinyl 2-Chloroethyl ether	0.050	U, J3	0.050	R	4
CMW17DS-122815	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4
TRIP BLANK (L809265)	Vinyl 2-Chloroethyl ether	0.050	U	0.050	R	4

mg/L-milligram per liter
U-not detected at the reported RDL
J3- laboratory flag defined as the associated batch QC was outside the established quality control range for precision
*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

1.5 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). Two LCS/LCS duplicate (LCSD) pairs were reported. The recovery and RPD results were within the laboratory specified acceptance criteria, with the following exceptions.

The RPD of 2-chloroethyl vinyl ether (28.8%, limit 23.5%) was high and outside the laboratory specified acceptance criteria in the LCS/LCSD in batch WG833298; however since 2-chloroethyl vinyl ether was rejected based on the sample preservation and sample degradation, no further qualifications were applied to the data.

The LCS recoveries of 1,2-dichlorobenzene, 1,2,3-trimethylbenzene, and methyl tert-butyl ether were low and the RPD of 1,2,3-trimethylbenzene was high all outside the laboratory specified acceptance criteria. Therefore, the nondetect values of these compounds in the associated samples were UJ qualified as estimated less than the RDLs. Also, the RPDs of 1,2,3-trichlorobenzene, 1,2,4-trichlorobenzene, 1,2-dibromo-3-chloropropane, 1,4-dichlorobenzene, hexachloro-1,3-butadiene, and naphthalene were high and outside the laboratory specified acceptance criteria. Since these compounds were not detected in the associated samples, no qualifications were applied to the data.

Sample ID	Compound	Laboratory Result (mg/L)	Laboratory Flag	Validation Result (mg/L)	Validation Qualifier	Reason Code
CMW17DS-122815	Methyl tert-Butyl Ether	0.0010	U, J4	0.0010	UJ	5
CMW17DS-122815	1,2-Dichlorobenzene	0.0010	U, J4	0.0010	UJ	5
CMW17DS-122815	1,2,3-Trimethylbenzene	0.0010	U, J4, J3	0.0010	UJ	5
TRIP BLANK	1,2-Dichlorobenzene	0.0010	U, J4	0.0010	UJ	5
TRIP BLANK	Methyl tert-Butyl Ether	0.0010	U, J4	0.0010	UJ	5
TRIP BLANK	1,2,3-Trimethylbenzene	0.0010	U, J4, J3	0.0010	UJ	5

mg/L-milligram per liter
U-not detected at the reported RDL
J3- laboratory flag defined as the associated batch QC was outside the established quality control range for precision
J4-laboratory flag defined as the associated batch QC was outside the established quality control range for accuracy

1.6 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

1.7 Field Duplicate

Field duplicates were not collected with the sample set.

1.8 Trip Blank

Two trip blanks, both identified as TRIPBLANK, accompanied the sample shipments. VOCs were not detected in the trip blanks above the RDLs.

1.9 Sensitivity

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

1.10 Electronic Data Deliverables (EDDs) Review

Results and sample IDs in the EDDs 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 RDLs in the hardcopy laboratory reports; both the DLs and the method detection limits (MDLs) were listed in the EDDs. It was also noted that the data were reported in the units parts per million (mg/L) in the EDDs, while the sample data were reported in the units parts per billion (µg/L) and the QC samples were reported in the units mg/L

in the level II laboratory 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

Fifteen air samples were analyzed for VOCs per EPA Method TO-15.

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

2.1 Overall Assessment (Completeness)

The selected VOC data reported in this package are considered to be 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 analysis, for the project is 100%.

2.2 Holding Time

The holding time for the VOC analysis of a SUMMA Canister sample is 30 days from collection to analysis. The holding times were met for the sample analyses.

2.3 Method Blank

Method blanks were analyzed at the proper frequency for the number and types of samples analyzed (one per batch of 20 samples). Six method blanks were reported (batches P150707,

P150807, P150917, P151002, P151109, and P151204). VOCs were not detected in the method blanks above the method reporting limits (MRLs).

2.4 Matrix Spike/Matrix Spike Duplicate

MS/MSD pairs were not reported.

2.5 Laboratory Control Sample

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

2.6 Laboratory Duplicate

Two laboratory duplicates were reported using samples VW17d-42.5-102715 and VW17d 95.5-113015. The RPD results were within the laboratory specified acceptance criteria.

2.7 Surrogates

Acceptable surrogate recoveries were reported for the sample analyses.

2.8 Field Duplicate

Field duplicates were not collected with the sample set.

2.9 Trip Blank

Trip blanks were not shipped with the sample set.

2.10 Sensitivity

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

2.11 Electronic Data Deliverables Review

Results and sample IDs in the EDDs 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 hardcopy laboratory 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

micrograms per cubic meter ($\mu g/m^3$) and parts per billion by volume (ppbv). 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.

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.

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

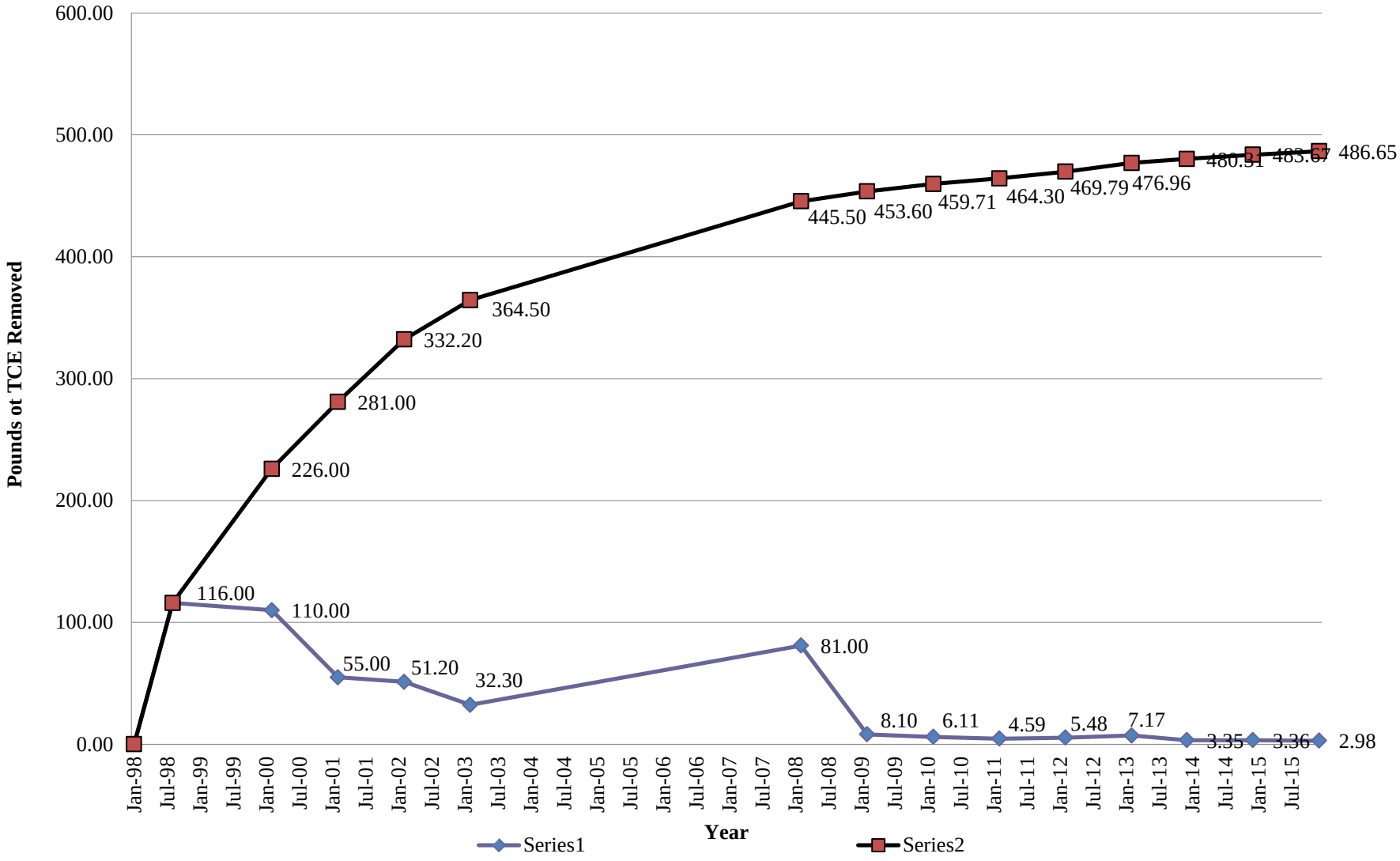
Valid Value	Description
1	Preservation requirement not met
2	Analysis holding time exceeded
3	Blank contamination (i.e., method, trip, equipment, etc.)
4	Matrix spike/matrix spike duplicate recovery or RPD outside limits
5	LCS recovery outside limits and RPD outside limits (LCS/LCSD)
6	Surrogate recovery 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

APPENDIX G
TCE Mass Removal Estimates

Table G-1
TCE Mass Removal - January 1998 through December 2015
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	3.35	480.31
Dec-14	3.36	483.67
Dec-15	2.98	486.65



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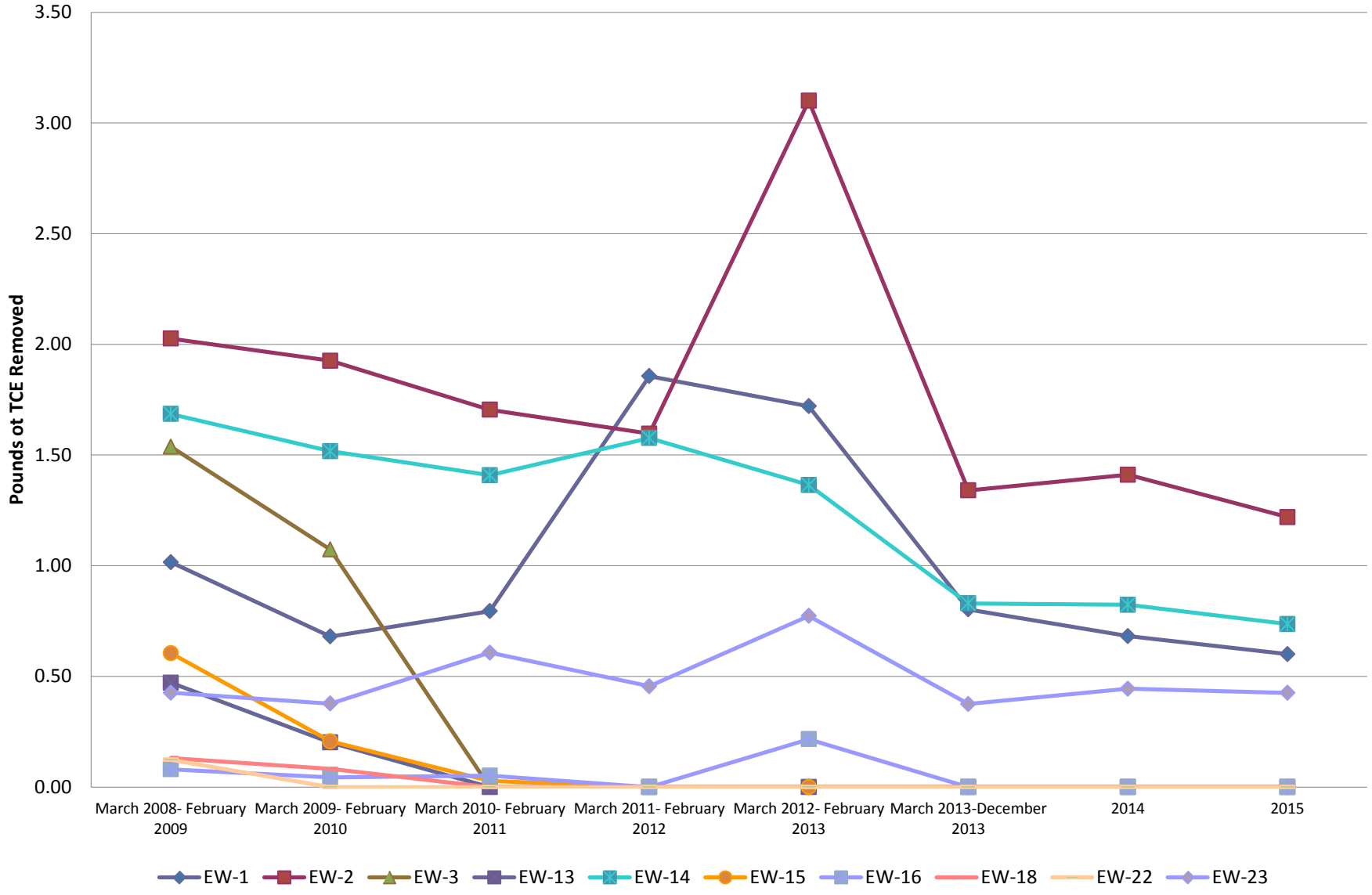
Cascade Corporation Gresham, Oregon	**TCE Mass Removal** **TSA Remedy**	Figure G-1

Table G-2
TCE Mass Removal Per Extraction Well
TSA Remedy - East Multnomah County

Date	Pounds of TCE Removed Per Well									
	EW-1	EW-2	EW-3	EW-13	EW-14	EW-15	EW-16	EW-18	EW-22	EW-23
March 2008- February 2009	1.02	2.03	1.54	0.47	1.69	0.60	0.08	0.13	0.12	0.43
March 2009- February 2010	0.68	1.93	1.07	0.20	1.52	0.21	0.04	0.08	0.00	0.38
March 2010- February 2011	0.79	1.70	0.00	0.00	1.41	0.03	0.05	0.00	0.00	0.61
March 2011- February 2012	1.86	1.60	0.00	0.00	1.58	0.00	0.00	0.00	0.00	0.46
March 2012- February 2013	1.72	3.10	0.00	0.00	1.36	0.00	0.22	0.00	0.00	0.77
March 2013-December 2013	0.80	1.34	0.00	0.00	0.83	0.00	0.00	0.00	0.00	0.37
2014	0.68	1.41	0.00	0.00	0.82	0.00	0.00	0.00	0.00	0.44
2015	0.60	1.22	0.00	0.00	0.74	0.00	0.00	0.00	0.00	0.43

Notes

The amount of TCE removed by the extraction wells in the remedial systems was calculated by multiplying average monthly flow rates at each extraction well by estimated TCE concentration at the extraction wells at the mid-point of each month. The mid-monthly TCE concentrations were calculated by linear interpolation from the two near sampling dates.



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Cascade Corporation Gresham, Oregon	**TCE Mass Removal per Extraction Well TSA Remedy**	Figure G-2