2013 Progress and Performance Evaluation
Troutdale Gravel Aquifer
Boeing Portland Facility
Gresham, Oregon

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Prepared for

The Boeing Company

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LIST OF ABBREVIATIONS AND ACRONYMS

1,1DCE	dichloroethene
Boeing	The Boeing Company
BGS	below ground surface
CAOs	corrective action objectives
CMI	corrective measures implementation
CMS	corrective measures study
COPC	constituents of potential concern
DEQ	Department of Environmental Quality
EPA	Environmental Protection Agency
FOG	fats, oil, and grease
GAC	granular activated carbon
GWTS	groundwater treatment system
ICP	Institutional Controls Plan
ICAs	interim corrective actions
IRAM	interim remedial action measure
MCLs	maximum contaminant levels
NPDES	National Pollutant Discharge Elimination System
O&M	operations and maintenance
PCE	tetrachloroethene
PRB	permeable reactive barrier
ppm	parts per million
psi	per square inch
RCRA	Resource Conservation and Recovery Act
RBC	risk-based cleanup levels
RFI	RCRA facilities investigation
ROI	radii of injection
STS	Sump Treatment System
SVE	soil vapor extraction
TCA	trichloroethane
TCE	trichloroethene
TGA	Troutdale Gravel Aquifer
TOC	total organic carbon
TSA	Troutdale Sandstone Aquifer
VC	vinyl chloride
VOCs	volatile organic compounds

1.0 INTRODUCTION

This corrective measures progress and performance evaluation report documents performance of the Troutdale Gravel Aquifer (TGA) remedy currently being conducted by The Boeing Company (Boeing) at the Boeing Portland facility in Gresham, Oregon (Figure 1). This report covers activities conducted from July 1 through December 31, 2013 and provides a summary of TGA corrective measures implementation, treatment system(s) operation, remedial progress, performance evaluation, and recommendations for modifications to the existing monitoring plan and/or remedy actions. Activities during the first half of the year (January 1 through June 30) were reported the Semiannual Data Report (Landau Associates 2013a).

This report is submitted as required under Order on Consent No. LQSR-NWR-04-12 issued to Boeing by the Oregon Department of Environmental Quality (DEQ 2008a). The DEQ Order on Consent requires Boeing to continue to perform the site remedial actions included within the final remedy specified in the U.S. Environmental Protection Agency (EPA) Order on Consent (EPA 1994), the Decision and Response to Comments (Final Decision; EPA 1997a), and the Statement of Basis (EPA 1997b). In addition to the consent order driven corrective measures, additional measures such as bioremediation, have been implemented to improve remedy performance and decrease the projected remedy timeframe.

2.0 REMEDY BACKGROUND

Boeing has conducted investigations and implemented corrective measures relative to volatile organic compounds (VOCs) in soil and groundwater at the Boeing facility since 1986. Corrective measures consist of interim corrective actions (ICAs), consent order driven corrective measures, and additional measures, such as bioremediation, implemented to improve remedy performance and decrease the projected remedy timeframe.

ICAs were the earliest corrective measure undertaken by Boeing and began in 1986 to stabilize VOCs in the soil and groundwater at the Boeing Portland facility and to address protection of human health and the environment. These actions included: providing an alternate water supply to owners of impacted wells; decommissioning supply wells; excavation of impacted soil; installation and expansion of the ICA groundwater extraction and treatment system; and installation and testing of a soil vapor extraction (SVE) system and a dual-phase extraction system. These ICAs were previously documented in the interim measures evaluation report (Landau Associates 1995a) and summarized in the Phase 2 corrective measures study (CMS; Landau Associates 1996).

2.1 CONSENT ORDER CORRECTIVE MEASURE OBJECTIVES AND CLEANUP LEVELS

Subsequent to implementation of ICAs, the Phase 2 CMS, the EPA Final Decision, and the EPA Statement of Basis identified areas of the Boeing Facility where corrective measures were to be implemented. These corrective action areas were based on the known or potential presence of VOCs in soil and groundwater, and on the evaluation of the source areas identified in the Phase III Resource Conservation and Recovery Act (RCRA) facility investigation report (RFI; Landau Associates 1995b). These corrective action areas are shown on Figure 2, and are described in detail in the Phase 2 CMS and the TGA corrective measures implementation (CMI) work plan (Landau Associates 1997).

Consent Order corrective measures have been implemented at the Boeing Facility to address VOC contamination in the TGA, specifically to provide protection of human health and the environment from exposure to the TGA VOC plume through ingestion, dermal contact, or inhalation pathways. These objectives were confirmed in the EPA Final Decision (EPA 1997a) and provided the basis for corrective action implementation (Landau Associates 1997). The Corrective Action Objections (CAOs) to be achieved by the corrective measures for the TGA, as presented in the Final Decision, are as follows:

CAO-a. Decrease VOC concentrations (i.e., mass removal) throughout the site to achieve maximum contaminant levels (MCLs). If this is not feasible, then minimize the areal extent of groundwater contamination that exceeds MCLs and provide long-term containment for those areas with concentrations above MCLs.

CAO-b. Prevent exposure to TGA groundwater that contains VOCs at concentrations above MCLs.

CAO-c. Protect environmental receptors by preventing discharge of TGA groundwater to surface water at VOC contaminant concentrations that may exceed ambient water quality criteria.

CAO-d. Prevent further spread of contamination in the TGA (i.e., prevent the migration of groundwater containing VOCs above MCLs).

CAO-e. Protect groundwater quality in the Troutdale Sandstone Aquifer (TSA).

CAO-f. Facilitate existing uses of groundwater resources in eastern Multnomah County.

CAO-g. Reduce concentrations of VOCs and minimize migration of VOCs from vadose zone soil to the TGA that could compromise satisfying CAO-a for groundwater.

The EPA Final Decision and Statement of Basis establish constituents of potential concern (COPC) and target groundwater cleanup levels for the TGA corrective measures based on MCLs as follows:

Constituent	Cleanup Level [micrograms per liter (µg/L)]
1,1-Dichloroethene (1,1-DCE)	7
cis-1,2-Dichloroethene (cDCE)	70
Trichloroethane (TCA)	200
Trichloroethene (TCE)	5
Tetrachloroethene (PCE)	5
Vinyl chloride (VC)	2

2.2 CONSENT ORDER CORRECTIVE MEASURES

TGA consent order corrective measures consisted of several components: dual-phase extraction, soil vapor extraction, groundwater pump and treat, performance monitoring, well decommissioning to reduce liability and potential pathways, and the implementation of the Institutional Controls Plan (ICP; Landau Associates 2005). These components are discussed in the following sections.

2.2.1 DUAL-PHASE AND SOIL VAPOR EXTRACTION

Dual-phase extraction system pilot tests were conducted during the late 1990s and the results indicated that TGA soil was not conductive to this type of system. Therefore, well DP-1 was converted from dual-phase extraction to groundwater extraction and well DP-4 was incorporated into the Central and West Corrective Action Areas SVE system. The Central and West Corrective Action Areas SVE system consisted of 8 vapor extraction wells, DP-4, and 14 shallow and deep vapor observation wells. The SVE system operated between 1994 and 2009 and removed approximately 3,750 pounds of VOCs from the unsaturated zone. SVE system mass recovery declined with time and, in 2009, DEQ approved the decommissioning of the system because VOC mass removal rates were below the shutoff criterion of 0.1 lbs/day (DEQ 2009a). Three vapor observations wells [VOW-4(s,d), VOW-6(s,d), and VOW-9(s,d)] were decommissioned in March 2010. A total of 7 vapor observation wells [VOW-5(s,d), VOW-7(s,d),

VOW-8(s,d), VOW-10(s,d), VOW-11(s,d), VOW-12(s,d), and VOW-14(s,d)] and 2 vapor extraction wells (VE-6 and VE-7) were decommissioned in March 2011.

2.2.2 GROUNDWATER PUMP AND TREAT SYSTEM

The groundwater treatment system (GWTS), which expanded upon the former ICA groundwater extraction and treatment system, began operation in 1989 and has operated full-time with only minor shutdowns for maintenance or construction modifications. The locations of the extraction wells and the conveyance piping system are shown on Figure 3. In 2000, the pumping at E-1 was suspended due to compliant groundwater (Landau Associates 2000). Extraction well E-1 was subsequently decommissioned in June 2004.

The operational shutdown of extraction wells E-5 through E-9 was recommended in the 2000 TGA annual performance evaluation report due to low mass removal rates (Landau Associates 2001). The operational shutdown of E-5 through E-9 was approved by EPA and conducted in October 2002 (Landau Associates 2002); since the start of the shutdown period, the wells have operated periodically for maintenance and monitoring purposes. To compensate for the changes in the TGA groundwater capture, the pump rates at E-11 (West Corrective Action Area) and E-12 (Downgradient Corrective Action Area) were increased (Landau Associates 2003).

Extraction wells E-10, E-11, E-14, E-15, and E-16 were shut down to facilitate bioremediation injection activities in late 2008 (Landau Associates 2009a). Extraction wells E-10 and E-14 were decommissioned with DEQ approval (DEQ 2008b) during the first quarter of 2010 in preparation for the Building 85-001 expansion project. Extraction wells E-15 and E-16 resumed pumping on December 20, 2012 after 4 years of pilot shutdown following utilization of these wells as donor injection wells during the 2008 bioremediation injection program within the West Corrective Action Area.

Currently, the following wells are actively pumping as part of the TGA groundwater extraction and treatment system:

- E-2, E-3, E-4, E-12, and E-13 (located in the Downgradient Corrective Action Area)
- E-15 and E-16 (located in the West Corrective Action Area)
- DP-1 (located in the Central Correct Action Area).

2.2.3 GROUNDWATER PERFORMANCE MONITORING PLAN

The groundwater performance monitoring plan consists of groundwater level measurements, collection of representative groundwater quality samples, and collection of influent and effluent samples from the GWTS. The current groundwater monitoring plan is summarized in Table 1.

The groundwater performance monitoring plan is evaluated yearly and modified based on the continued remedy of the dissolved VOC plume and with DEQ's approval. Criteria for modification to the

monitoring program have been established (Landau Associates 2010b) to standardize the process for current and future monitoring frequency modification:

Criteria for Increasing Sampling Frequency:

- If COPC concentrations increase to detectable levels for two consecutive sampling events, after having been below detection limits for 2 or more years.
- If COPC concentrations increase to above the respective MCLs for two consecutive sampling events, after having been below the MCL for 2 or more years.

Criteria for Reducing Sampling Frequency:

- If COPC concentrations have been consistently below detection limits for the prior 2 consecutive years. A well that meets this criterion could also be recommended for removal from the monitoring program.
- If COPC concentrations have been stable to declining for the prior 2 years.

Criteria for Discontinued Monitoring

- COPC 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 progress of aquifer restoration.
- The location of the well duplicates another well better suited to evaluate hydraulic control and progress of aquifer restoration.

Confirmation Sampling Event

- Wells that meet the above criteria for discontinued monitoring and have been removed from the Monitoring Program will have a confirmation sample collected one year later for evaluation of possible decommissioning.

2.2.4 WELL DECOMMISSIONING

Well decommissioning activities are proposed to DEQ if criteria for the removal of the well from the monitoring program have been met (Section 2.2.3) or if the well is no longer utilized as a bioremediation injection location or as either a groundwater or vapor extraction well. A review of the utilization of wells are evaluated yearly and modified based on the continued remedy of the dissolved VOC plume and with DEQ's approval. No well decommissioning activities requested to DEQ during this semiannual reporting period.

2.2.5 INSTITUTIONAL CONTROLS PLAN

The Institutional Controls Plan (ICP; Landau Associates 2005) was developed as part of the selected corrective measures for the TGA. The plan provides measures to restrict the potential ingestion of TGA groundwater exceeding the MCLs, provides a worker protection institutional control to restrict the potential exposure of works during surface/subsurface disturbances within certain areas of the site which are referred to as Source Areas, and provides a restrictive covenant for the facility. The

groundwater use institutional control regulates groundwater use in the area by granting agency the authority to review any proposed actions involving the installation of wells or modifications of existing well water use within the dissolved VOC plume. The worker protection institutional control provides procedures for notification to the lead agency of proposed worker activities within the source areas. Workers shall conduct activities under guidance of an approved health and safety plan and disposal criteria will be coordinated with the lead agency.

2.3 ADDITIONAL CORRECTIVE MEASURES

Additional corrective measures have been incorporated into the TGA remedy to decrease the remedy timeframe and to improve the remedy performance. The GWTS system continues to provide hydraulic capture and remedy of the saturated zone of the TGA. Additional corrective measures currently being utilized at the Site are discussed in the following sections.

2.3.1 COOLANT RELEASE REMEDY AREA

In 2006, coolant material was discovered in the 85-105 building footing drain sump (sump). The sump is a collection location for both building footing drain water and shallow perched groundwater. The accumulated water is routed to the GWTS for treatment prior to discharge to the Storm Drain Creek and the city of Gresham stormwater facility. Upon discovery of the coolant release, Boeing immediately disconnected the sump discharge from the GWTS and routed the accumulated water to temporary storage tanks for batch testing and processing through the facility treatment system for disposal to the sanitary sewer. An investigation was conducted to evaluate the vertical and horizontal extent of the release to the TGA by monitoring existing nearby wells and installing eight monitoring wells (LAI-1 through LAI-8). The results of the investigation indicated that the petroleum-based coolant, which floated on the water table, did not migrate substantially because the building footing drain and sump acted as a collection system for the released coolant. The investigation also confirmed that nearby Upper Troutdale Sandstone Aquifer (TSA) wells did not show evidence of impacts due to the coolant release (Landau Associates 2007a).

To address the isolated coolant impacts to the shallow TGA, five injection wells (IW-1 through IW-5) were installed directly upgradient of the release area to allow for stimulation of aerobic biodegradation as an interim remedial action measure (IRAM; Landau Associates 2007b). The DEQ-approved (DEQ 2007) interim remedial action plan detailed the process and procedures for using an oxygen releasing compound (EHC-O^{TM}) injected as a slurry with water to enhance the aerobic biodegradation of the petroleum-based contaminant. In 2008, two EHC-O^{TM} injections events were conducted. Annual EHC-O^{TM} injections were conducted in 2010, 2011, 2012, and 2013 (April).

Between August 2007 and August 2012, water collected in the 85-105 building footing sump was recovered and treated using the Sump Treatment System (STS). The STS consisted of a conveyance line that transports the accumulated water from the sump vault to Building 85-124, where the water is routed through an oil/water separator, then monitored by an in-line fats, oil, and grease (FOG) monitor. If FOG concentrations were below 75 parts per million (ppm), water was directed to the sanitary sewer. If FOG concentrations were above 75 ppm, water was automatically routed through a granular activated carbon (GAC) vessel prior to discharge. Groundwater samples and operation and maintenance (O&M) system compliance samples, were collected quarterly to verify that the system operated below the sanitary sewer discharge permit limits. Based on compliant system O&M data, the shutdown of the STS was recommended (Landau Associates 2012b) and approved by DEQ (DEQ 2012a). The STS was subsequently shut down in August 2012. Water accumulating in the sump has been re-routed to the GWTS (pre-2006 coolant release occurrence treatment method) and the STS system was decontaminated and stored for potential future use at Boeing facilities (as needed).

2.3.2 SOURCE AREA INVESTIGATIONS

In 1995, six potential source areas to the TGA contamination were identified based on earlier investigations and either current or past site uses (Landau Associates 1995a). These source areas were identified as West Source Area, Central Source Area, Southwest Source Area, Former Vapor Degreaser Source Area, East Yard Source Area, and East Source Area. The source areas are shown on Figure 4. Restrictions on intrusive activities within the source areas and the use of groundwater are provided in the ICP.

Investigations have been conducted within some of the source areas and based on these investigation results, DEQ has either approved of additional corrective actions or the removal of the source area from the ICP. The following sections provide a description of the four source area investigations that have been completed. At the time of this report, source area investigations have not been completed in the East Yard Source Area and the East Source Area.

2.3.2.1 West Source Area Investigation

In preparation for the Building 85-001 expansion project, a series of subsurface environmental investigations were conducted in 2008 to evaluate the potential presence and extent of soil contamination within the West Source Area. The phased investigations were conducted by advancing a total of 34 borings to depths ranging from 5 to 40 ft below ground surface (BGS) using roto-sonic drill methods. Representative soil samples were collected for laboratory analysis. A total of 13 samples contained TCE above the reporting limit, with concentrations ranging from 1.0 to 120.0 micrograms per kilogram

(µg/kg). TCE results were below the risk-based cleanup levels (RBCs) with the exception of two samples located near the southwestern portion of the existing 85-001 building (Landau Associates 2011a).

Based on the results of the investigations, a remedial excavation was conducted to remove the impacted soil. Approximately 520 cubic yards (yd^3; 779 tons) of TCE-impacted soil were removed and transported offsite to the Hillsboro Landfill for disposal. Soil samples were collected to determine the extent of the excavation and final confirmation soil samples documented the condition of soil remaining in the bottom and sidewalls of the excavation (Landau Associates 2011a).

The results of the investigations and the remedial excavation demonstrated no unacceptable exposure risk to construction workers. Based on this demonstration, DEQ approved the removal of the West Source Area from the ICP (DEQ 2011).

2.3.2.2 Central Source Area Investigation

A review of historical data indicates the Central Source Area was first identified as a potential source area based on hydrogeologic field evidence, reviews of historical aerial photographs, and interviews with former employees. It was determined that this area may have been used for occasional liquid waste disposal between 1964 through 1967. In 1991, Boeing extended Building 85-105 to the west over the southeastern portion of the Central Source Area and associated subsurface activities expansion exposed stained soil and three 55-gallon drums (one of which was intact and contained a mixture of approximately 50 percent TCE and 50 percent PCE), as well as drum lids, paint sludge, demolition debris, wood waste, and miscellaneous waste in the Central Source Area. Approximately 6,300 tons of VOC-contaminated soil and debris were removed during the 1991 building expansion (Landau Associates 2012a).

Pilot testing for SVE and dual-phase extraction systems were conducted in the Central Source Area in the early 1990s. The results of the pilot tests indicated that the area subsurface permeability was generally too low for effective SVE treatment with the exception of an isolated area in the area near well DP-4. Well DP-4 was connected to the SVE for the West Corrective Action Area and operated as an SVE extraction well from 1994 through 2009 and removed approximately 631 pounds of VOCs from the vadose soil before being shutdown due to vapor removal rates being below the 0.1 lbs/day target rate. The results of the early 1994 dual-phase extraction well indicated well DP-1 would most likely not provide adequate soil vapor extraction due to low permeable soil conditions; therefore, the well was converted to a groundwater extraction well and continues to operate through this semiannual reporting period.

Historical investigations in the source area indicated that TCE and PCE were only detected in a limited number of soil samples and concentrations were low [0.0007 to 0.0016 milligrams per kilogram (mg/kg)]. This does not include soil samples from the area of VOC contamination that were removed

during the 1991 expansion of Building 85-105. Based on the data collected to date, no further investigation of the southwestern half of the Central Source Area was determined to be needed; however, additional soil vapor sampling was recommended for the northern portion of the source area (Landau Associates 2012a).

During November 2011, a total of 35 sub-slab vapor samples were collected primarily in the northern portion of the Central Source Area to address the need for additional soil vapor sampling. The analytical results were all below the Oregon DEQ RBCs. Based on the analytical results, it was concluded that the Central Source Area did not pose a VOC exposure risk to workers, and it was recommended that the area be removed from the ICP. DEQ agreed with the recommendation and the institutional controls within the Central Source Area has been removed (DEQ 2012b).

2.3.2.3 Southwest Source Area Investigation

The Southwest Source Area was identified as a potential source area in the Phase 2 CMS (Landau Associates 1996). Historical groundwater samples collected and analyzed for VOCs from this area did not indicate that a significant source was present; however, additional data was needed to further characterize the potential source area.

Between April 17 and 18, 2013 a sub-slab vapor investigation was conducted in the Southwest Source Control Area using procedures presented in the DEQ-approved work plan (Landau Associates 2011b). A total of seventeen sub-slab vapor samples were collected and submitted to the laboratory for VOC analysis. Results for the TGA COPCs were all below the laboratory reporting limits. The results of this investigation were documented in a summary report and submitted to DEQ with the conclusion that there is no VOC exposure risk to workers, and recommended that the area be removed from the ICP (Landau Associates 2013b). DEQ agreed with the recommendations and the institutional controls within the Southwest Source Area have been removed (DEQ 2014).

2.3.2.4 Former Vapor Degreaser Source Area Investigations

Historical releases of TCE from two former vapor degreasers inside Building 85-001 constitute a primary source of TCE contamination in the TGA. The location of the Former Vapor Degreaser Source Area is shown on Figure 4. Prior to 2009, the area of the former degreasers was deemed inaccessible for soil and groundwater investigation due to limited access for drilling inside the active manufacturing building and due to difficult geologic conditions (dense to very dense soil with cobbles and boulders) that require specialized drilling equipment. Recent advancement in limited access roto-sonic drilling techniques allowed for investigation to occur, with three phased investigations conducted within the area between 2009 and 2011. The results of the three phased investigations were presented in summary investigation reports (Landau Associates 2010a, 2011c, and 2012d).

The degreaser source area investigations consisted of collecting representative samples of soil vapor and groundwater. Soil vapor samples were collected sub-slab and from variable depths in the vadose zone. Groundwater samples were collected at various depths from wells that were installed through the TGA to terminate in the upper 2 ft of the confining layer between the TGA and the underlying TSA [i.e., of the second siltstone unit in confining layer (SU1b)]. In 2009, a total of 3 wells [BOP-72(i) through BOP-74(i)] were installed. In 2010, 3 additional wells [BOP-75(i) through BOP-77(i)] were installed and in 2011 an additional 14 wells [BOP-78(i) through BOP-88(i), and VOW-16 through VOW-18)] were installed. Seven wells installed in 2011 [BOP-78(i), BOP-79(i), and BOP-84(i) through BOP-88(i)] are multiple purpose sampling and remediation wells with a well screen section in the vadose zone and a screen section below the water table. The multiple purpose wells are utilized for SVE operation, groundwater quality monitoring, and aquifer injection for *in situ* bioremediation. Well locations are shown on Figure 5.

Based upon the findings of the investigations and aquifer testing conducted at the Former Vapor Degreaser Source Area, two additional corrective actions have been installed and are under way to achieve source remediation. These corrective actions, enhanced *in situ* bioremediation and SVE, are described in the following sections.

2.3.3 ENHANCED *IN SITU* BIOREMEDIATION

Enhanced *in situ* bioremediation is currently being utilized in conjunction with the GWTS (provides hydraulic capture of dissolved plume) to remediate the more persistent areas of the remedy. *Aerobic* biodegradation is being utilized to treat the petroleum-based coolant material release at the 85-105 building. *Anaerobic* bioremediation is being utilized for reductive dechlorination of TCE and its breakdown products (cDCE and VC) in the Former Vapor Degreaser Source Area (Landau Associates 2012c, 2013c) and in the Downgradient Corrective Action Area (Landau Associates 2009a). The appropriate method for *in situ* bioremediation depends on aquifer conditions and type of contaminant.

2.3.4 SOIL VAPOR EXTRACTION TREATMENT

To address soil vapor in the Former Vapor Degreaser Source Area, the SVE system previously utilized in the Central and West Corrective Action Areas was modified and installed between August and September 2012 (Landau Associates 2011e). The multiple purpose wells [BOP-78(i), BOP-79(i), and BOP-84(i) through BOP-88(i)] and three vapor observation wells (VOW-16 through VOW-18) were installed around of the former vapor degreaser, as access would allow. The multiple purpose wells were connected to the above grade SVE system through a series of subgrade conveyance piping to minimize disruption of facility operations. The SVE system consists of a control panel, rotron blower, condensate pump, knockout tank, and two 2,000-pound GAC vessels for vapor treatment. Exhaust piping was routed

from the GAC vessels to a roof stack for venting. Vapor samples are collected from the SVE system, extraction wells, and vapor observation wells on a quarterly basis and discussed in Section 4.3.1 of this report.

In April 2013, nine semi-permanent sub-slab vapor pins (VP-1 through VP-9) were installed around the Former Vapor Degreaser Source Area to monitor changes in the sub-slab interval as the SVE system continues to operate. Sub-slab vapor samples are collected from the nine vapor pins on a quarterly basis and results are discussed in Section 5.3.1 of this report.

3.0 SIGNIFICANT ISSUES, EVENTS, AND ACTIONS

This section of the report summarizes significant issues, events, and action taken during the semiannual reporting period.

3.1 GROUNDWATER EXTRACTION WELL OPERATION

The groundwater extraction wells were operated during the semiannual reporting period with the following exceptions:

- Extraction well E-3 was shutdown between September 20 and October 7, 2013 due to a malfunctioned pump. The replacement pump was installed and operations at E-3 resumed on October 7, 2013.
- Extraction well E-2 was shut down between October 25 and November 11, 2013 due a plugged pump which resulted in reduced extraction pump rates. The extraction well was cleaned using sonar techniques and aggressively redeveloped to remove solids by removing approximately 12,000 gallons prior to replacement of the extraction pump. Redevelopment water was transferred by a vacuum truck to a temporary storage tank to allow solids to settle prior to decanting the clear water to the GWTS. Solids generated from the redevelopment activities were transferred to 55-gallon drums and disposed by Boeing.

3.2 FORMER VAPOR DEGREASER BIOREMEDIATION

A bioremediation injection was conducted at the Former Vapor Degreaser Source Area between June 21 and July 9, 2013. The injection was conducted in general accordance with the work plan (Landau Associates 2013c) as approved by DEQ (DEQ 2013). Approximately 10,150 gallons of electron donor injection mixture, which consisted of approximately 9,600 gallons of potable water and 550 gallons of LactOil donor substrate was injected. The LactOil concentrate was composed of ethyl lactate [36 percent by volume (%vol)] and vegetable oil (41 %vol) donor with the balance consisting of surfactants and water. The donor injection mixture was gravity fed to source area wells [BOP-78(i), BOP79(i), and BOP-84(i) through BOP-88(i)] that were designed and constructed for both SVE and aquifer injection. To minimize the potential for donor material to spread to the upper SVE screened portions of the wells, the SVE system was shutdown (SVE shutdown between June 21 and July 22, 2013). Packers were installed in the blank section of well casing between the two screen intervals and inflated to approximately 40 pounds per square inch (psi) to seal off the lower aquifer injection interval from the SVE screen above. Each of the seven wells received between 1,300 gallons [BOP-88(i)] to 1,700 gallons [BOP-86(i)] of donor mixture. Average injection rates across the seven injection wells ranged from 4.8 to 11.7 gallons per minute (gpm).

3.2.1 FORMER VAPOR DEGREASER SVE

The SVE system installed within the Former Vapor Degreaser Source Area operated during this semiannual reporting period with the following exception. The SVE system was shutdown between June 21 and July 22, 2013 to facilitate the source area bioremediation injection. Upon completion of the injection, the SVE system was restarted with no complications.

4.0 REMEDY PROGRESS DATA

This section of the report presents a summary of remedy progress monitoring data collected during this reporting period (July 1 through December 31, 2013), including TGA and Upper TSA groundwater quality data, groundwater level data, groundwater extraction well performance data, and GWTS effluent and influent water quality data. Activities during the first half of the year (January 1 through June 30) were reported the Semiannual Data Report (Landau Associates 2013a).

Laboratory reports and data validation memorandums for data collected during this semiannual reporting period are provided in Appendix A. Historical TGA and select Upper TSA data is presented in Appendix B.

4.1 TGA GROUNDWATER QUALITY

Groundwater quality monitoring for TGA wells and select Upper TSA monitoring wells was conducted in accordance with the Groundwater Performance Monitoring Plan (Table 1). In addition, sampling and analysis of the discharge from actively operated groundwater extraction wells was performed on a quarterly basis, while shutdown extraction wells (non-pumping) were sampled on an annual basis. Groundwater samples from each sampling event were analyzed for VOCs. Select wells were additionally analyzed for bioremediation monitoring parameters [total organic carbon (TOC), nitrate, sulfate, and dissolved gasses] or diesel-range petroleum hydrocarbons (TPH-Dx). The analytical results for the VOC COPCs at each TGA monitoring well and extraction well, select Upper TSA wells, and the GWTS are presented in Table 2. The interpreted extent of the dissolved VOC plume in the TGA, based on the results from the August 2013 (more inclusive annual event), are shown on Figure 5. TCE continues to be the predominant COPC in the TGA and will continue to be used to benchmark remediation progress.

The TGA dissolved VOC plume continues to exhibit decreasing concentrations and aerial extent. Analytical results for the TGA wells indicate TCE concentrations have steadily decreased since operation of the GWTS began in March 1989. However, a few persistent areas have been slow to respond to the GWTS corrective measure. The progress of the remedy was discussed in the latest Five-Year Evaluation Report (Landau Associates 2012b); Groundwater quality for each of the Corrective Action Areas is discussed below.

4.1.1 EAST YARD CORRECTIVE ACTION AREA

Extraction well E-8 was originally installed to assist with remediation within the East Area; however, active operation of the extraction well was discontinued in 2002 and, since the shutdown, the

well operated intermittently for groundwater quality monitoring and maintenance purposes only. Analytical results for the August 2013 sampling event indicate TCE concentrations have decreased from 140 µg/L (December 1991) to 5.3 µg/L., which is slightly above the MCL (5 µg/L). All other COPC concentrations at E-8 are below the respective MCLs. Based on TCE concentrations remaining above the MCL, continued monitoring at East Corrective Action Area is warranted.

The groundwater quality data in the East Yard Corrective Action Area are currently evaluated at monitoring well BOP-48(i) and extraction well E-9. Extraction well E-9 was shut down in 2002 due to low mass removal rates and has operated intermittently for groundwater quality sampling and maintenance purposes only. TCE concentrations at both wells have consistently been below the MCL since November 2007 for E-9 and February 2006 for BOP-48(i). Other COPC concentrations are either below the respective MCLs or the laboratory reporting limits. Groundwater quality data continues to indicate remediation has been completed in this area and both wells qualify for discontinued monitoring per the performance monitoring plan. However, Boeing has elected to continue monitoring until the East Yard Source Area has been investigated for shallow impacts and l removed from the ICP.

4.1.2 CENTRAL CORRECTIVE ACTION AREA

August 2013 groundwater quality data within the Central Corrective Action Area indicate TCE, PCE, and cDCE above MCL cleanup levels, as follows:

- TCE concentrations at all wells [BOP-10(i), BOP-56(i), BOP-59(i), E-6, E-7, and DP-1] were above the MCL with concentrations ranging from 7.0 to 38 µg/L during the August 2013 event. TCE concentrations in the Central Corrective Action Area wells were highest at E-7 (38 µg/L); however, concentrations have decreased over time from the maximum concentrations (5,800 µg/L) in September 1990.
- PCE was above the MCL (5 µg/L) at BOP-10(i) at 6.5 µg/L, BOP-56(i) at 5.7 µg/L, and extractions wells E-6 at 21 µg/L, E-7 at 23 µg/L, and DP-1 at 20 µg/L. PCE concentration trends continue to decrease within the Central Corrective Action Area with the exception of DP-1. PCE concentrations at DP-1 showed a steady decrease from the pretreatment concentrations of 20 µg/L through August 2011 and then an increase from 4.0 to 21 µg/L, where it has remained steady.
- The analytical results for cDCE at DP-1 have decreased from the highest concentration of 850 µg/L (pre-treatment) to 98 µg/L during the August 2013 sampling event; however, cDCE remains above the MCL (70 µg/L).

All other COPC concentrations are below the respective MCL cleanup levels. Continued monitoring within the Central Corrective Action Area is warranted. Extraction pumping at DP-1 continues to operate for groundwater remediation within the Central Corrective Action Area. The Central Corrective Action Area continues to be an area of the site where VOC concentration reduction has been slow and PCE at DP-1 persists at pre-treatment levels.

4.1.3 WEST CORRECTIVE ACTION AREA

The groundwater remedy for the West Corrective Action Area is monitored at well BOP-16(i), BOP-56(i), BOP-57(ia, ib), and extraction wells E-5, E-11, E-15, and E-16. Specific findings of the August 2013 sampling event are as follows:

- TCE concentrations were reported below the MCL at BOP-16(i), E-5, E-11, and E-15. TCE concentrations at the remaining wells ranged from 12 to 13 µg/L at wells BOP-57(ia) and E-16, and 25 µg/L at BOP-57(ib). VC concentrations were above the MCL (2 µg/L) at BOP-16(i) with concentrations ranging from 4.5 to 4.8 µg/L (August and November events); BOP-57(ib) at 7.1 µg/L (August event); and extraction well E-15 ranging from 5.1 to 2.4 µg/L (August and November events). 1,1DCE was detected at 34 µg/L at BOP-57(ib), above the MCL (7 µg/L).

All other COPC concentrations were either below the laboratory reporting limits or detected at low levels (below the respective MCLs). Due to exceedances of the MCLs as indicated, continued groundwater monitoring of the area is warranted.

Well pair BOP-57(ia) (screened at the base of the TGA) and BOP-57(ib) (screened in the first layer of the siltstone unit: SU1) are located near former supply well A-2, which was screened within the TGA and the underlying TSA before being decommissioned in 1988. The well A-2 investigation and decommissioning activities are summarized in the RFI (Landau Associates 1995b). Data from the well A-2 investigation suggested the former supply well was a conduit for contamination to migrate from the TGA to the underlying Upper TSA (i.e., contaminant source to the TSA) prior to well decommissioning. August 2013 TCE data from wells BOP-57(ia) (13 µg/L) and BOP-57(ib) (25 µg/L) continue to show a steady decrease from prior maximum 1,400 µg/L [August 1994, BOP-57(ia)] 380 µg/L [August 2006, BOP57(ib)].

4.1.4 SOUTHWEST CORRECTIVE ACTION AREA

Groundwater quality in the Southwest Corrective Action Area is characterized at monitoring well BOP-9(i). The August 2013 sample for BOP-9(i) indicates a TCE concentration of 62 µg/L, which increased from February 2013 (33 µg/L) but which remains significantly lower than the maximum concentrations (1,600 µg/L) in January 1989. All other COPCs were either non-detect at the reporting limit or reported at low concentrations below the respective MCLs.

4.1.5 DOWNGRADIENT CORRECTIVE ACTION AREA

The groundwater remedy for the Downgradient Corrective Action Area is monitored at wells BOP-7(i), D-7(i), D-8(i), D-11(i), D-12(i), and extraction wells E-2, E-3, E-4, E-12, and E-13. Specific findings of the August 2013 sampling event are as follows:

- TCE concentrations at D-8(i) have steadily decreased from 570 µg/L (November 1988) to 30 µg/L in August 2013. TCE concentrations at extraction wells E-3, E-4, E-12, and E-13 ranged from 7.8 µg/L (E-13) to 35 µg/L (E-4) during this reporting period. BOP-7(i) is located between extraction wells E-12 (northwest of well) and E-2 (southeast of well); however, like BOP-57(ib), the well is partially screened in the low-permeable first layer of the SU1. The August and November 2013 TCE results for BOP-7(i) were 310 to 220 µg/L, respectively. TCE has decreased at BOP-7(i) from the maximum concentration of 1,500 µg/L reported from the June 1990 sampling event; however, concentrations remain well above the MCL. PCE concentrations at BOP-7(i) ranged from 4.9 to 5.6 µg/L (August and November sampling events), which are near the MCL (5 µg/L).
- VC concentrations at E-3 were above the MCL (2 µg/L) at 4.0 µg/L during the August event and below the MCL at 1.8 µg/L during the November event. VC has been consistently reported at concentrations above the laboratory reporting limit since February 2010 (upon completion of the 2008 bioremediation injection in the area); however, VC concentrations have decreased from 8.2 µg/L during the February 2013 sampling event.
- 1,1DCE concentrations at BOP-7(i) ranged from 17 to 24 µg/L during this semiannual reporting period, which are above the MCL (7 µg/L).

4.1.6 FORMER VAPOR DEGREASER SOURCE AREA

TCE concentrations at 7 wells [BOP-73(i), BOP-76(i), BOP-78(i), BOP-82(i), and BOP-86(i) through BOP-88(i)] were above the MCL with concentrations ranging from 5.5 to 17,000 µg/L, as shown on Figure 6. The highest TCE concentration was from the sample collected at BOP-73(i) (17,000 µg/L) during November 2013. TCE concentrations at the remaining source area wells were below the MCL during the November sampling event.

cDCE concentrations were above the MCL (70 µg/L) at four wells [BOP-76(i), BOP-78(i), BOP-88(i), and BOP-73(i)]. Concentrations ranged from 85 [BOP-88(i)] to 7,800 µg/L [BOP-73(i)].

Groundwater quality data from this reporting period also indicate that VC concentrations above the MCL (2 µg/L) were reported at all 12 wells source area wells with the exception of BOP-87(i). VC concentrations above the MCL ranged from 2.1 µg/L at BOP-85(i) to 250 µg/L at BOP-73(i).

Well BOP-72(i) received electron donor during November 2010 pilot testing (Landau Associates 2011c) and BOP-74(i) has been injected in December 2011 and August 2012 to establish and maintain a permeable reactive barrier (PRB) for bioremediation at the downgradient edge of the source. Wells BOP-73(i) [located 30 ft north of the former degreasers] and BOP-77(i) [located 50 ft northwest of the former degreasers] have not received electron donor, these wells provide aquifer monitoring between injection wells. TCE concentrations at BOP-73(i) have increased from 110 µg/L (pretreatment) to 17,000 µg/L (November 2013), which indicates that VOC mass from the lower permeable siltstone layer underlying the TGA continues to be desorbed. The increase in concentrations of breakdown compounds cDCE, from 5.3 to 7,800 µg/L, 11DCE from 2.2 to 14 µg/L, VC from non-detect at the reporting limit to 250 µg/L,

and ethane from non-detect at the reporting limit to 30 µg/L, indicate that aquifer treatment is being achieved.

TCE concentrations at BOP-77(i) have decreased from 690 µg/L (February 2011) to concentrations below the laboratory reporting limit in November 2013. cDCE concentrations have increased from 2.5 to 9.5 µg/L and methane concentrations have increased from 5,480 to 20,000 µg/L. In addition ethane has increased from non-detect at the reporting limit to 8.6 µg/L (August 2013). Enhanced dechlorination, evidenced by decreasing concentrations of TCE concurrent with increasing concentrations of breakdown products, is observed at most wells in the source area.

4.1.7 COOLANT RELEASE AREA

The analytical results for COPC (petroleum hydrocarbons and VOCs) concentrations were either below the respective MCLs or the laboratory reporting limits. Monitoring well LAI-8 was dry and therefore not sampled during this reporting period.

To monitor the extent of the coolant release and to monitor the effects of the EHC-O™ injections, groundwater samples were collected semiannually in 2013 from three TGA coolant release monitoring wells (LAI-4, LAI-7, and LAI-8), and annually from eight monitoring wells (LAI-1 through LAI-8). Groundwater results for total TPH-Dx from these wells are summarized in Table 4, and shown on Figure 8. Historical total TPH-Dx concentrations are summarized in Appendix B. TGA COPCs are summarized in Table 2 and TCE concentrations are shown on Figure 5. Historical COPC concentrations are summarized in Appendix B.

4.2 PERTINENT TSA GROUNDWATER QUALITY MONITORING DATA

TSA groundwater quality data at six wells [BOP-22R(ds), BOP-60R(ds), BOP-61(ds), BOP-62(ds), BOP-65(ds), and BOP-66(ds)] were reviewed to evaluate possible downward migration of groundwater from the TGA migrating downward through the confining layer (CU1) to the underlying Upper TSA, per the Consent Order. The VOC analytical results from the August 2013 event for the TSA wells are summarized in Table 2. TCE concentrations for the Upper TSA wells are shown on Figure 5. Historical TSA water quality data for the above mentioned wells are summarized in Appendix B, Table B-1.

TCE concentrations at the six TSA wells were below the reporting limit or below the MCL, with the exception of BOP-61(ds). The TCE concentration at BOP-61(ds) was just above the MCL at 5.6 µg/L during the August 2013 sampling event, which is within the normal range for the past 2 years (see historical data in Appendix B). TGA wells upgradient of TSA well BOP-61(ds) include E-9 and BOP-48(i), where TCE results are near the reporting limit and do not indicate a source for the TSA

concentrations. TSA extraction well EW-23, located 330 ft northeast of BOP-61(ds), is operated to capture and remediate groundwater in the vicinity of BOP-61(ds) as part of the East Multnomah County Cleanup project.

4.3 TGA GROUNDWATER LEVEL MONITORING

Groundwater levels in the TGA monitoring wells measured during the August and November 2013 sampling events are presented in Table 3. The more inclusive August 2013 sampling event data was utilized to develop water level contours are presented on Figure 7. The TGA groundwater flow continues to be observed toward the northwest.

Groundwater contour data indicate that the active pumping at extraction wells in the Downgradient Corrective Action Area (E-2, E-3, E-4, E-12, and E-13), Central Corrective Action Area (DP-1), and West Corrective Action Area (E-15 and E-16) has been effective in maintaining an inward hydraulic gradient and capture of the TGA plume.

5.0 PERFORMANCE EVALUATION

This section evaluates the performance of the various corrective measures.

5.1 GROUNDWATER EXTRACTION SYSTEM

Groundwater extraction system monitoring data includes VOC analytical data from sampling the discharge of each TGA extraction well and extraction well flow rate data. The actively operated extraction wells (E-2, E-3, E-4, E-12, E-13, E-15, E-16, and DP-1) along with shutdown well E-11 were sampled quarterly throughout the reporting period and flow rate data were collected monthly. The shutdown extraction wells (E-5 through E-9) are sampled on an annual basis. These data are presented and evaluated in this section in terms of an average daily mass removal rate in pounds per day (lbs/day), total gallons extracted at each extraction well, and the average yield in gallons per minute (gpm) for each extraction well.

Average total mass removal rates (lbs/day) of VOCs [TCE; PCE; TCA; 1,1DCE, and 1,1,2-trichloro-1,2,2-trifluoroethane (Freon-TF)] from each TGA groundwater extraction well for 2013 are presented on Figure 9. The mass removed for other COPCs is not presented because the constituents contributed less than 10 percent of the total VOC mass removed. Extraction well E-13, located in the Downgradient Corrective Action Area, continue to provide the highest average mass removal rate (0.00173 pounds per day; lbs/day), compared to the other TGA extraction wells which range from 0.005 lbs/day (E-4) 0.0057 lbs/day (DP-1).

Data from each extraction well is provided for evaluation of GWTS operation. The average pump rates are based on the total gallons removed during each measurement period divided by the number of minutes in the measurement period that the well was actively pumping. Well E-15 had the lowest average pump rate during this reporting period (between 0.20 and 0.35 gpm), while E-13 continues to pump at the highest average rate (between 121 and 125 gpm). Extraction wells E-5 through E-9 have been shut down since 2002, with the exception of brief operation for sample collection and maintenance. Extraction well E-11 was utilized in the 2008 *in situ* bioremediation injection activities and continues to indicate elevated TOC concentrations (27.5 mg/L in November 2013) and is recommended to remain shut down. The approximate average extraction rate (gallons/minute) at each extraction well for this reporting period (July through December 2013) is summarized in Table 5.

Per DEQ approvals (DEQ 2009b), TSA extraction wells EW-3 and EW-13 were shut down in 2009. Upper TSA extraction well EW-3 was shut down to minimize downward vertical gradients from the TGA to the Upper TSA near BOP-60(ds). Lower extraction well EW-13 was shut down to minimize the hydraulic divide produced when EW-13 and nearby EW-23 were both operated. Lower TSA

extraction well EW-23, which is monitored and reported in the East Multnomah Cleanup Project reports, will remain operational to enhance treatment/containment along the eastern portion of the Boeing property.

In compliance with Boeing Portland's National Pollutant Discharge Elimination System (NPDES) permit (NPDES number 101761), quarterly samples of the GWTS effluent were collected for chemical analysis. The NPDES permit effluent water quality requirements and the analytical results for the August and November 2013 events are summarized in Table 2. TCE concentrations for the system influent ranged from 7.5 to 8.1 µg/L during this reporting period, while the system effluent remained below the reporting limits. All the NPDES permit requirements were met during this semiannual reporting period.

5.2 COOLANT RELEASE-AEROBIC BIOREMEDIATION

With the exception of well LAI-4, TPH-Dx is below the cleanup level (1.35 mg/L) or not detected at the other coolant release monitoring wells. Prior to treatment, the TPH-Dx cleanup level was exceeded at wells LAI-1, LAI-4, LAI-5, LAI-6, LAI-7, and LAI-8. However, wells LAI-1 and LAI-6 have been below the cleanup level since 2007, LAI-5 since 2006, and LAI-7 since 2008, as summarized in Appendix B, Table B-2. August 2013 data is presented in Table 4.

Total TPH-Dx concentrations at LAI-8 have frequently been above the cleanup level since injections began; however, dry conditions at this well since November 2011 have prevented the collection of data from this well. Although TPH-Dx remains above the cleanup level at LAI-4, where TPH impacts have been most persistent, concentrations have decreased substantially from 31,800 mg/L (September 2006) to 1.9 mg/L (August 2013). Data collected during and prior to treatment of the released coolant indicates that the coolant material was isolated to a relatively small area of the TGA due to capture by the building footing drain and sump (Section 2.3.1) and did not migrate downward to the TSA.

A total of six EHC-O™ injections have been completed in 2008 (February and October), June 2010, June 2011, April 2012, and April 2013 to stimulate bioremediation of coolant-impacted TGA groundwater (Landau Associates 2010b). During each injection event, EHC-O slurry was injected to wells IW-1 through IW-5. Low dissolved oxygen and ORP, combined with rebounding TPH-Dx concentrations are indicators that additional injection of EHC-O™ is required to maintain optimum treatment conditions. Based on the current data, monitoring of coolant release monitoring wells will continue, but no additional injection is planned for the next reporting period.

5.3 FORMER VAPOR DEGREASER SOURCE CONTROL AREA

The additional corrective measure utilized in at the Former Vapor Degreaser Source Area includes the operation of a SVE system to address deeper vadose zone and sub-slab soil vapor and the utilization of *in situ* bioremediation to address VOC concentrations in the groundwater.

5.3.1 SVE SYSTEM

Analytical data for the SVE wells are summarized in Table 6. Baseline data and data for the reporting period are shown on Figure 10. The SVE system mass removal rates for this semiannual reporting period are included in Table 7. Historical vapor data for the source area wells is included in Appendix B; Table B-3.

SVE system influent analytical results since system startup in September 2012 indicate that the majority of the TCE mass removal (0.74 lbs) occurred within the first 2 months of operation. During this semiannual reporting period, the removal rate ranged from 0.005 to 0.008 lbs/day; approximately 0.64 lbs of VOC was removed during this semiannual reporting period. To date, a cumulative mass of 3.481 lbs has been removed from the vadose zone.

The sub-slab analytical results indicate the SVE system has effectively removed TCE vapors from the sub-slab interval. Baseline sub-slab TCE concentrations ranged from below the reporting limit to 850,000 µg/m^3. Nine vapor pins (VP-1 through VP-9) were installed in the source area prior to SVE startup to monitor the sub-slab interval. Sub-slab vapor pin data during this reporting period ranged from below the laboratory reporting limit to 570 µg/m^3; all results are below the screening level (2,900 µg/m^3). The vapor pin analytical results for this semiannual reporting period are summarized in Table 8 and shown on Figure 11. Historical sub-slab results are included in Appendix B, Table B-4.

Deeper TCE soil vapor concentrations have also decreased substantially following system startup. Baseline TCE concentrations ranged from 340 to 230,000 µg/m^3, with 9 of 16 monitoring wells having TCE concentrations greater than the cleanup level of 2,900 µg/m^3 After 1 month of operation only one well [BOP-86(i)] had TCE concentrations in soil vapor above the cleanup level. During this semiannual reporting period, all TCE vapor concentrations were below the cleanup level for all at-depth vapor samples. The most substantial decrease occurred at well BOP-88(i) with a baseline concentration of 230,000 µg/m^3 and a November 2013 result of 63 µg/m^3. The highest TCE concentration measured during the reporting period was610 µg/m^3 at BOP-84(i) in August.

Operational parameters indicate the SVE system was operating as intended. During this reporting period the SVE system operating parameters consisted of the following:

- System air flow velocity measured at the discharge stack - 251 to 265 standard cubic feet per minute (scfm)

- Vacuum at observation wells - 24 to 34 inches of water (in. H2O)
- Pressure between the blower and the GAC treatment vessels - consistently 1.4 psi
- Temperature at the discharge stack - 28.5 to 57.0 degrees celsius (C)
- Air flow velocity measured the seven SVE wells - 17.8 to 130.5 scfm; BOP-88(i) and BOP-79(i) had lowest and highest flow rates, respectively
- Vacuum at the seven extraction wells - 17.0 to 22 in. H2O; BOP-78(i) and BOP-87(i) recording the lowest vacuum and BOP-79(i)and BOP-86(i) the highest.

5.3.2 AQUIFER BIOREMEDIATION

Source area bioremediation consists of a PRB created through electron donor injection to well BOP-74(i) and donor injection to the 7 multi-purpose wells [BOP-78(i), BOP-79(i), and BOP-84(i) through BOP-88(i)] located closer to the former degreasers. PRB injections occurred in 2011 and 2012. Injection of the 7 multi-purpose wells was first performed in 2013. Injections utilized a combination of fast-release lactate and slow-release vegetable oil electron donors to achieve optimal aquifer redux conditions and treatment longevity, while minimizing reduction of aquifer hydraulic conductivity within the treatment zone. Well locations and estimated radii of injection (ROI) are shown on Figure 12.

Well BOP-74(i) is located downgradient of the former vapor degreasers and the area of maximum TCE concentrations in groundwater. Injection flow rates for BOP-74(i) indicate the well is located in a preferential flow path of higher hydraulic conductivity and groundwater flux from the source. Donor injection to BOP-74(i) results in a bioremediation PRB ideally located to intercept and treat contaminate flux emanating from the source area. Electron donor was injected to BOP-74(i) in December 2011 and in September 2012 in accordance with the respective DEQ-approved work plans (Landau Associates 2011d, 2012c). Changes in TOC and aquifer redox conditions that occurred at wells BOP-80(i) and BOP-81(i), located approximately 230 ft downgradient of source area, following PRB injections confirm that these wells are hydraulically downgradient of the source and appropriately located to monitor the effects of source treatment.

In July 2013, the 7 multiple purpose wells, were injected with approximately 10,150 gallons of electron donor substrates and a potable water mixture. The 7 wells are located upgradient of PRB injection well BOP-74(i) at locations near the former degreasers and on the upgradient edge of the highest TCE concentrations in groundwater. Each well received 1,300 to 1,700 gallons of donor injection fluid.

The PRB injections and injection of the 7 multiple purpose wells have resulted in a comingled treatment zone. Elevated TOC observed at nearby wells during and following injection of BOP-74(i) indicated a approximate ROI of 40 ft following the first injection (15,000 gallons) and of 70 ft following the second injection (30,000 gallons). The ROI of the second PRB injection extends to upgradient multiple purpose injection wells and overlaps with ROI from the injection of those 7 wells. The

combined treatment zone is approximately 140 ft wide (north to south) and 150 to 160 ft thick (east to west).

The progress of the bioremediation remedy within the treatment zone is primarily demonstrated by the decrease in TCE concentrations and the increase in breakdown daughter products (cDCE and VC) and in non-toxic end products ethane and ethane. Donor and enhanced aquifer redox conditions for bioremediation are indicated by increasing TOC, ferrous iron, and methane; and decreasing sulfate. Enhanced dechlorination, evidenced by decreasing concentrations of TCE concurrent with increasing concentrations of breakdown products, is observed at most wells. Two exceptions are wellsBOP-73(i) and BOP-76(i), both of which are used for monitoring only (not injection). TCE at BOP-73(i) has increased from 900 µg/L (February 2010) to 17,000 µg/L (November 2013). At BOP-76(i), TCE increased from 26 µg/L (June 2013, prior to injection of the 7 multiple purpose wells) to 140 µg/L in November 2013. These increases in aqueous phase TCE indicate enhanced desorption of TCE from the lower permeabilty portions of the aquifer and aquitard and dissolution of potential residual DNAPL. Enhanced desorption/dissolution is an essential mechanism for remediation, as it brings contaminant mass into the aqueous phase where mass destruction through biodegradation can occur. Substantial increases in breakdown products cDCE and VC are also observed at wells BOP-73(i) and BOP-76(i), indicating enhanced reductive dechlorination is occurring concurrent with enhanced desorption. End products ethane and/or ethane were detected at half of the 12 wells where analyzed during the reporting period, including BOP-73(i) with the highest and increasing TCE concentration; occurrence of ethene/ethane confirms complete reductive dechlorination through to innocuous end products. Bioremediation monitoring data results for the Former Vapor Degreaser Source Area are summarized in Table 9.

Periodic injections of donor substrates will be required to maintain adequate electron donor and the required reduced aquifer redox conditions for continued treatment of TCE and breakdown products in the source area. Based on empirical data from this and other sites, it is anticipated that the longevity of the first injection would be in the range of 4 to 12 months, dependant on the flux of groundwater and contaminants through the source area. TCE has diffused into the low-permeability confining layer between the TGA and the underlying TSA due to DNAPL historically extending to the base of the TGA. Treatment of this TCE mass within the low permeability aquitard will require an extended period of treatment and aquifer treatment occurring immediately above and extending into the confining layer (Landau Associates 2011b). Bioremediation of the TGA will substantially decrease levels of TCE in groundwater immediately above the confining layer, resulting in enhanced desorption/diffusion of TCE from the confining layer.

5.4 DOWNGRADIENT PLUME AREA – ANAEROBIC BIOREMEDIATION

Groundwater in the West Corrective Action Area (Figure 2) has historically contained the highest dissolved VOC concentrations within the TGA plume, with maximum historical TCE concentrations ranging from 1,200 to 10,000 µg/L. In preparation for the 85-001 building expansion and resulting decommissioning of wells in the area, an electron donor (vegetable oil) injection program was performed to stimulate *in situ* anaerobic bioremediation of the aquifer in this area. Bioremediation activities were documented in the completion report (Landau Associates 2009a) and summarized in the last Five-Year Report (Landau Associates 2012b).

As a result of the vegetable oil donor injection, anaerobic reductive dechlorination of TCE and breakdown products was stimulated over a large treatment area within the West and Downgradient Corrective Action Areas. The extent of the treatment zone was based on the presence of TOC above 10 mg/L. Elevated TOC extended to downgradient extraction wells E-2, E-3, and E-4, which marked the downgradient extent of the treatment zone. Within the treatment zone, monitoring data showed a transition of aquifer conditions from aerobic baseline conditions to the highly reducing (i.e., sulfate-reducing to methanogenic) aquifer redox conditions required for complete reductive dechlorination of TCE and breakdown products.

Bioremediation effects continue to be observed in November 2013 data, 59 months after injection. TOC, indicative of electron donor, has decreased substantially in the nearly 5 years since donor injection and treatment effects are waning. PCE is below the MCL at all monitored wells. TOC continues to persist at injected well E-11 with a November 2013 result of 27.5 mg/L. Historical groundwater data for the Downgradient and West Corrective Action Areas are summarized in Appendix B, Table B-1.

- At E-2, the downgradient extraction well most affected by donor injection, TCE and breakdown products remain below MCLs. Concentrations have been below MCLs since October 2011.
- At downgradient extraction wells E-3 and E-4, affected more slowly and to a lesser degree by donor injection than E-2, TCE concentrations have decreased from baseline, but remain above the MCL. TCE at E-3 is at 18 µg/L, compared to an October 2008 baseline concentration of 89 µg/L; VC (1.8 µg/L) is detected below the MCL. At E-4, TCE (35 µg/L) is well below the baseline concentration of 180 µg/L; breakdown products remain below MCLs.
- At extraction well E-16 (not injected with electron donor), injection resulted in bioremediation and complete degradation of TCE to VC and ethene. Treatment is waning, as indicated by TOC and ethene not being detected and TCE concentrations steadily increasing, reported at 13 µg/L in November 2013.

6.0 RECOMMENDATIONS

This section presents recommendations based on the data and evaluations presented in prior sections. Recommendations include:

- Continued water quality and soil vapor monitoring.
- Continued operation of the groundwater extraction system.
- Potential additional EHC-O injections in the Coolant Release Area, if indicated by substantial rebound in TPH-Dx concentrations. However, based on the current data, additional injection is not needed during the next reporting period.
- Pilot shut down of the SVE system in the Former Vapor Degreaser Source Area is recommended, as described in Section 6.2.
- Periodic electron donor injections will be needed to maintain enhanced bioremediation in the Former Vapor Degreaser Source Area. It is anticipated that PRB injection well BOP-74(i) and the 7 multiple purpose injection wells will be injected concurrently during future injection events. Data evaluation will determine the timing of future injection events. Any modifications to the prior electron donor injection approach and quantities will be detailed in a subsequent work plan addendum.

6.1 PERFORMANCE MONITORING PROGRAM

No modifications are recommended to the existing performance and monitoring program (Table 1).

6.2 LONG-TERM CORRECTIVE MEASURES OPERATION PLAN MODIFICATION

Boeing will continue to evaluate changes to the groundwater extraction and treatment system based on the most current operational data. As appropriate and as requested by the authorizing agency, Boeing will also continue to evaluate new technologies for possible implementation.

The installation of the SVE system as an additional corrective measure within the Former Vapor Degreaser Area has successfully decreased VOC concentrations not only in the sub-slab interval but also deeper in the vadose zone. Vapor analytical results for the sub-slab and deeper vadose zone intervals were below the cleanup levels for samples collected during this reporting period. The system mass removal rate is currently 0.008 lbs/day; which is below the established shutdown criteria of 0.1 lbs/day. Based on the low mass removal rates, we recommend the SVE system be pilot shutdown beginning in April 2014. If quarterly vapor sample results from the sub-slab vapor pins or the deeper vapor wells indicate VOC concentrations are increasing to above the cleanup levels, then the SVE system will resume operation until the mass removal rate is again below the shutdown criteria. Depending on results of the pilot shut down, a strategy of intermittent SVE system operation may be recommended.

7.0 USE OF THIS REPORT

This report has been prepared for the exclusive use of Boeing for specific application to the TGA remedy at the Portland facility. No other party is entitled to rely on the information, conclusions, and recommendations included in this document without the express written consent of Landau Associates. Further, the reuse of information, conclusions, and recommendations provided herein for extensions of the project or for any other project, without review and authorization by Landau Associates, shall be at the user's sole risk. Landau Associates warrants that within the limitations of scope, schedule, and budget, our services have been provided in a manner consistent with that level of care and skill ordinarily exercised by members of the profession currently practicing in the same locality under similar conditions as this project. We make no other warranty, either express or implied.

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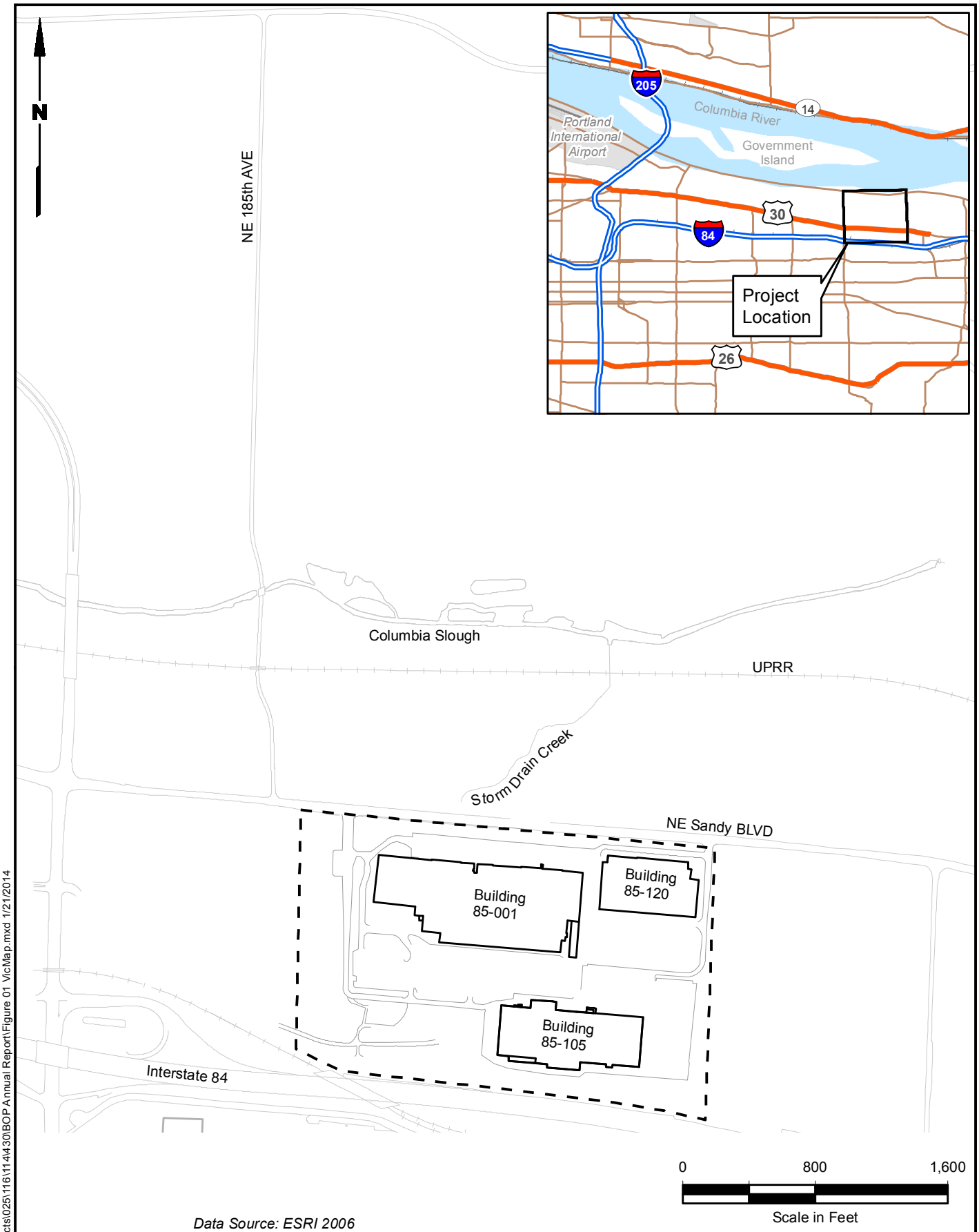

Data Source: ESRI 2006

G:\Projects\025\116\114430\BOP Annual Report\Figure 01 VicMap.mxd 1/21/2014

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Boeing Portland Gresham, Oregon	**Boeing Portland Site Map**	Figure 1

G:\Projects\025\116\114\430\BOP Annual Report\Figure 02 TGA GW Locations and Action Areas.mxd 2/25/2014

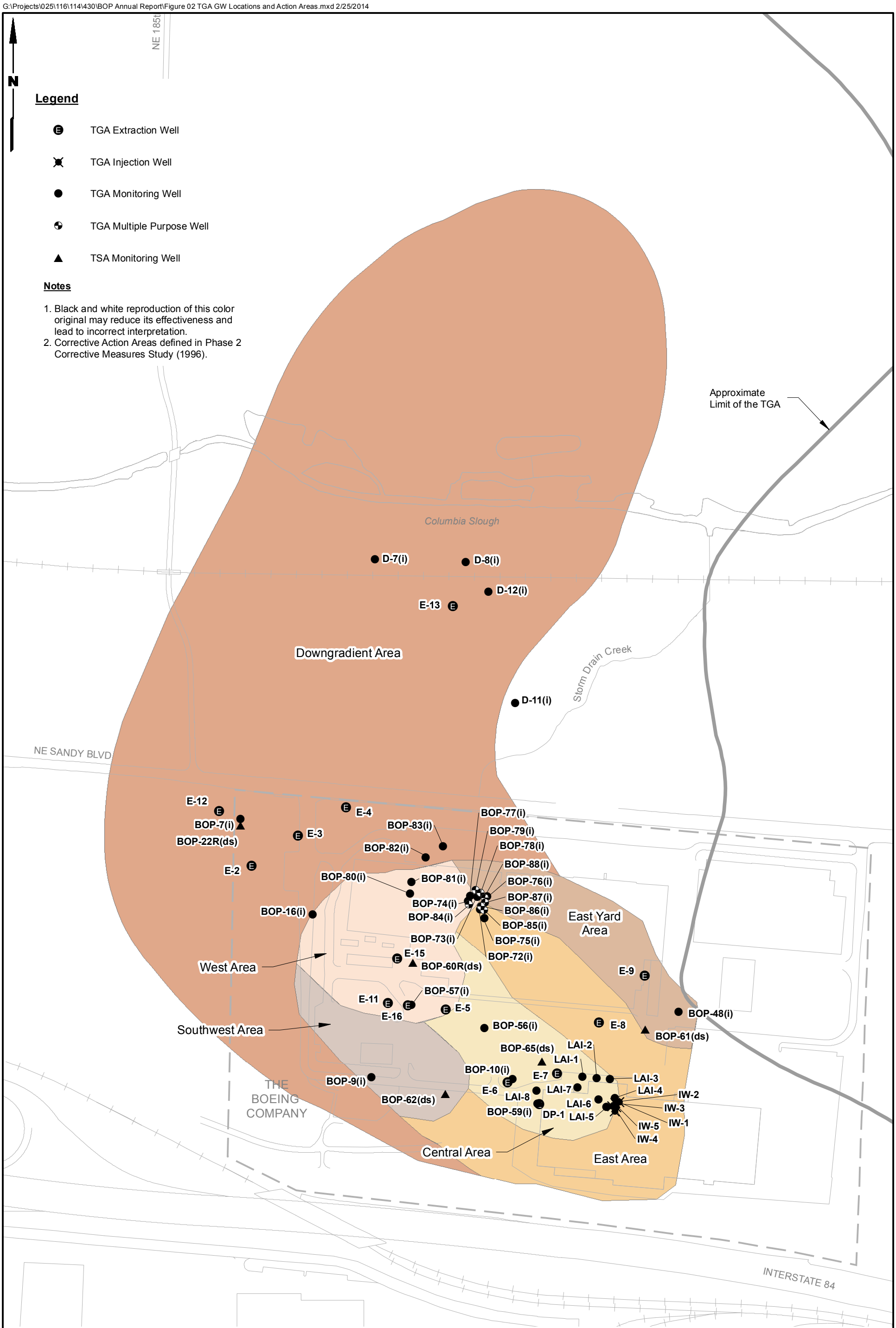
N

Legend

- TGA Extraction Well
- TGA Injection Well
- TGA Monitoring Well
- TGA Multiple Purpose Well
- TSA Monitoring Well

Notes

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.
2. Corrective Action Areas defined in Phase 2 Corrective Measures Study (1996).

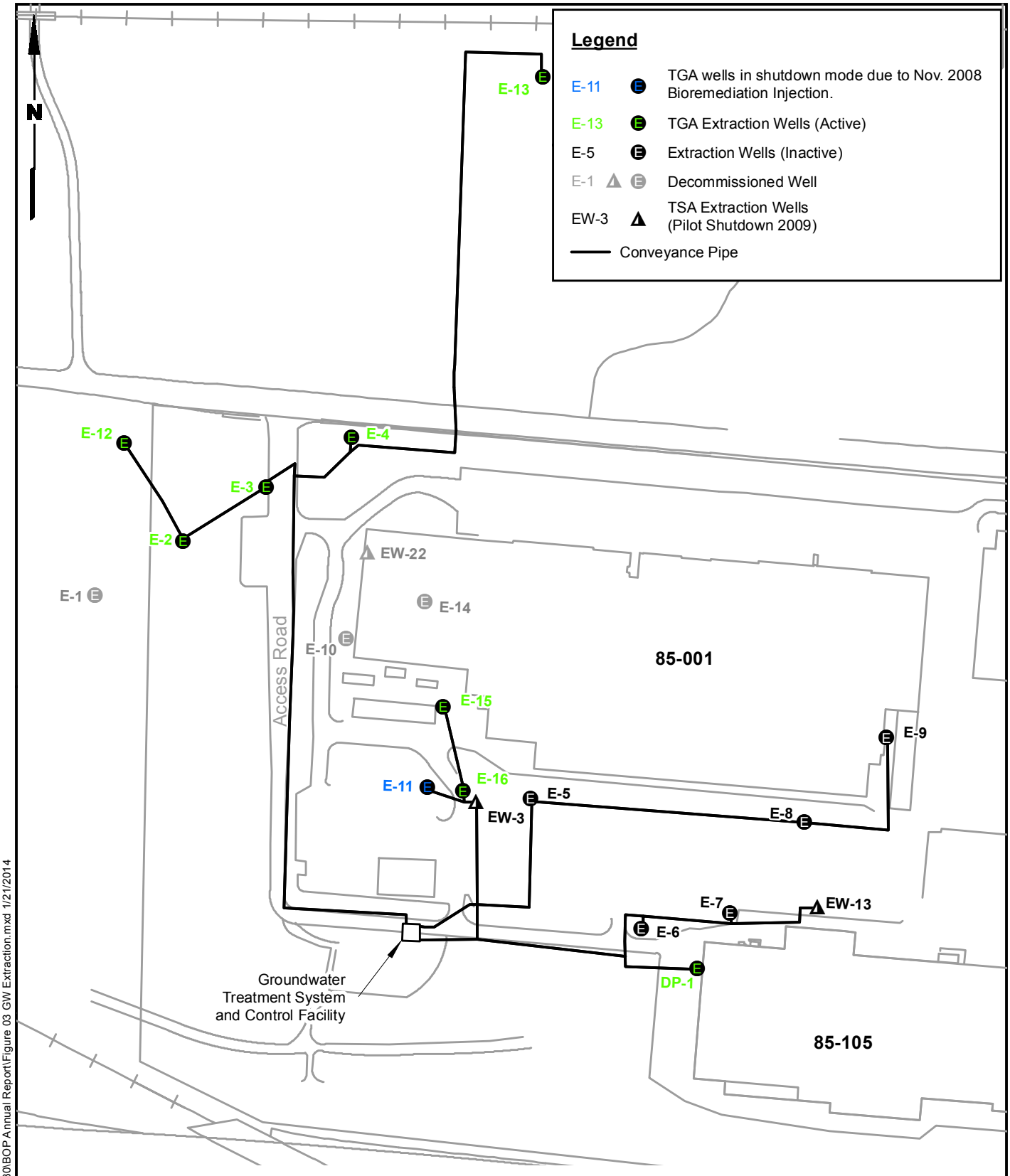


0 350 700

Scale in Feet

LANDAU ASSOCIATES

Boeing Portland Gresham, Oregon	**TGA Groundwater Performance Monitoring Locations**	Figure 2



Notes
1. E-1 decommissioned June 2004.
2. E-10, E-14, and EW-22 decommissoned February 2010.

0 300 600
Scale in Feet

G:\Projects\025\116\11443\0\BOP Annual Report\Figure 03 GW Extraction.mxd 1/21/2014

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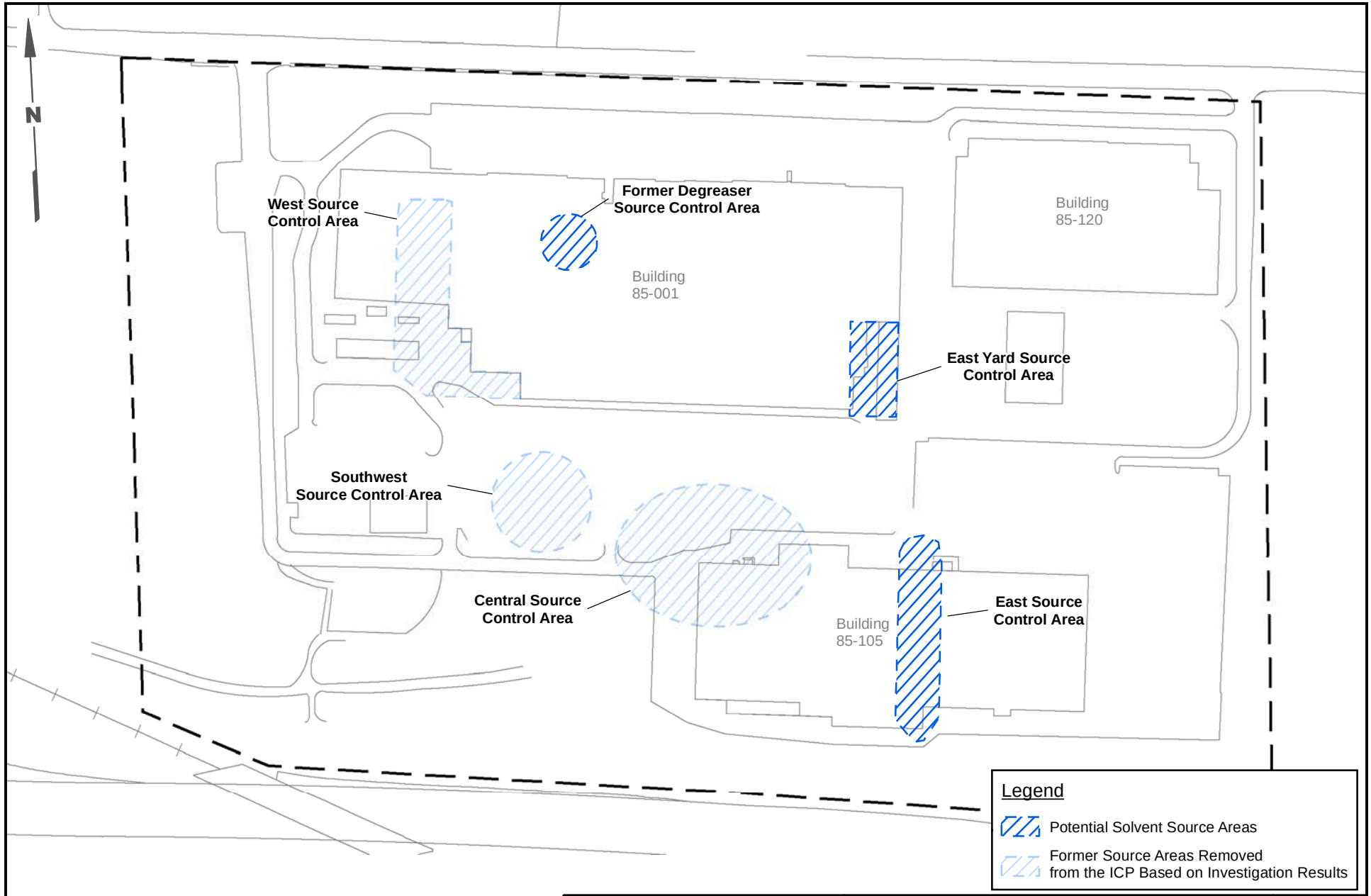
Boeing Portland
Gresham, Oregon

Groundwater Extraction and Treatment System Configuration

Figure 3

G:\Projects\025\116\114\430\BOP Annual Report\Figure 04 ICP Source.mxd 2/3/2014



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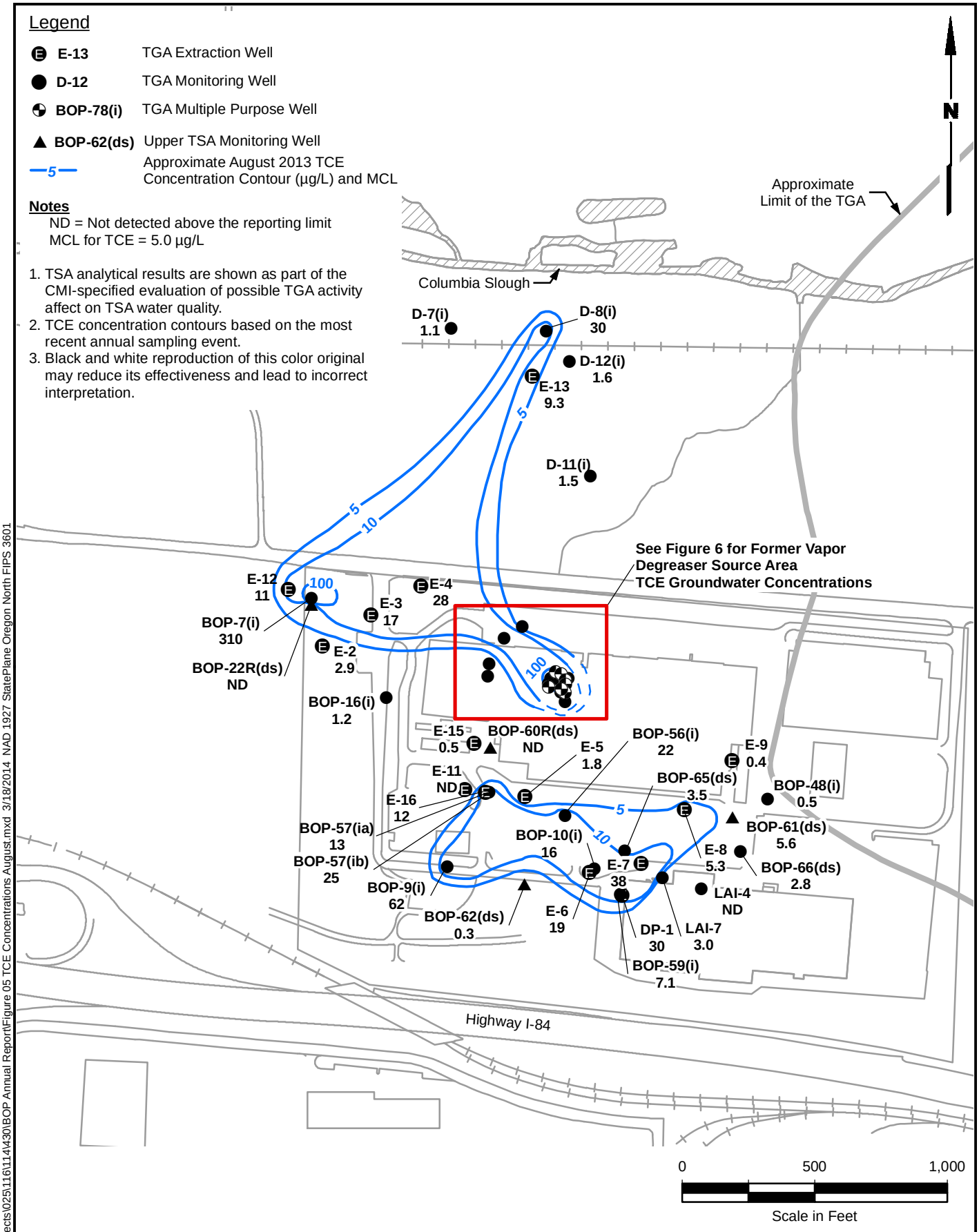
Boeing Portland
Gresham, Oregon

ICP: Source Control Areas

Figure
4



G:\Projects\025\116\114\430\BOP Annual Report\Figure 05 TCE Concentrations August.mxd 3/18/2014 NAD 1927 StatePlane Oregon North FIPS 3601

LANDAU ASSOCIATES

Boeing Portland
Gresham, Oregon

TCE Groundwater Results in TGA August 2013

Figure 5

Legend

BOP-80(i) TGA Monitoring Well Location

BOP-84(i) Multi-Purpose Well Location

VOW-16 Vapor Observation Well Location

Approximate Location of Former Degreaser

BOP- 78(i)	
Date	69.5
08/2013	5.5

Sample Depth (Feet Below Ground Surface)
Collection Date and TCE Concentration (µg/L)

ND Not Detected at Reporting Limit

N

BOP-83(i)	
Date	79.5
08/2013	3.4
11/2013	2.4

BOP-82(i)	
Date	72.5
08/0213	19
11/2013	17

BOP-81(i)	
Date	98.5
08/2013	ND
11/2013	ND

85-001 Building Expansion

BOP-80(i)	
Date	102.5
08/2013	ND
11/2013	ND

BOP-78(i)	
Date	69.5
08/2013	5.5
11/2013	ND

Vitra Deburr Machinery Area

BOP-79(i)	
Date	69.5
08/2013	1.0
11/2013	1.9

BOP-73(i)	
Date	78
08/2013	1,800
11/2013	17,000

BOP-76(i)	
Date	68.7
08/2013	1.0
11/2013	140

VOW-16

100

1,000

BOP-77(i)	
Date	78.7
08/2013	0.7
11/2013	ND

BOP-88(i)	
Date	70.5
08/2013	7.8
11/2013	0.2

VOW-17

BOP-74(i)	
Date	71
08/2013	0.6
11/2013	ND

BOP-87(i)	
Date	73.5
08/2013	21
11/2013	0.6

Location of Former Degreasers

BOP-84(i)	
Date	75
08/2013	2.2
11/2013	0.7

VOW-18

BOP-86(i)	
Date	69
08/2013	9.1
11/2013	1.4

85-001 Building

BOP-72(i)	
Date	67
08/2013	ND
11/2013	ND

BOP-85(i)	
Date	68.5
08/2013	1.5
11/2013	0.2

BOP-75(i)	
Date	68.7
08/2013	1.3
11/2013	2.2

Notes

1. Values shown in RED are above the MCL (5 µg/L)
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 40 80
Scale in Feet

Data Source: The Boeing Company

LANDAU ASSOCIATES

Boeing Portland Gresham, Oregon	**TCE Groundwater Results Former Degreaser Source Area**	Figure 6

Landau Associates, Inc. | G:\Projects\025\116\114430\BOP Annual Report\Figure 06 GW TCE.dwg (A) "Figure 6" 3/18/2014

G:\Projects\025\116\114\430\BOP Annual Report\Figure 07 TGA Groundwater Contours - August.mxd 2/3/2014

Legend

E	E-3 17.90	TGA Extraction Well and Groundwater Elevation August 2013
●	BOP-7(i) 20.81	TGA Monitoring Well and Groundwater Elevation August 2013
▲	BOP-22R(ds) 11.91	Upper TSA Monitoring Well and Groundwater Elevation August 2013
◒	BOP-84(i)	TGA Multiple-Purpose Wells
—5—		Approximate Groundwater Elevation Contour (ft. MSL)

N

Note

1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Approximate TGA Capture Zone

Approximate Limit of the TGA

Columbia Slough

NE SANDY BLVD

THE BOEING COMPANY

D-7(i) 10.99
D-8(i) 10.60
D-12(i) 10.38
E-13 --7.74
D-11(i) 12.24
E-12 -14.55
BOP-7(i) 20.81
E-4 13.98
E-3 17.90
BOP-22R(ds) 11.91
E-2 19.17
BOP-82(i) 27.58
BOP-83(i) 27.36
BOP-81(i) 31.53
BOP-77(i) 37.67
BOP-73(i) 38.13
BOP-80(i) 31.93
BOP-74(i) 38.26
BOP-76(i) 39.38
BOP-72(i) 39.39
BOP-75(i) 40.16
BOP-16(i) 28.78
BOP-60R(ds) 11.75
E-15 17.82
BOP-57(ib) 34.75
BOP-57(ia) 35.83
E-9 73.10
E-11 58.41
E-16 33.73
E-5 34.76
BOP-56(i) 41.53
E-8 81.31
BOP-48(i) 81.16
BOP-65(ds) 11.96
LAI-1 81.87
BOP-10(i) 69.58
E-7 75.36
LAI-2 84.85
BOP-9(i) 34.20
BOP-62(ds) 11.79
E-6 45.51
LAI-3 87.71
LAI-7 81.26
LAI-8 Dry
LAI-4 88.46
DP1 50.48
BOP-59(i) 68.85
LAI-6 88.78
LAI-5 90.01

-15 -10 -5 0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85

0 360 720
Scale in Feet

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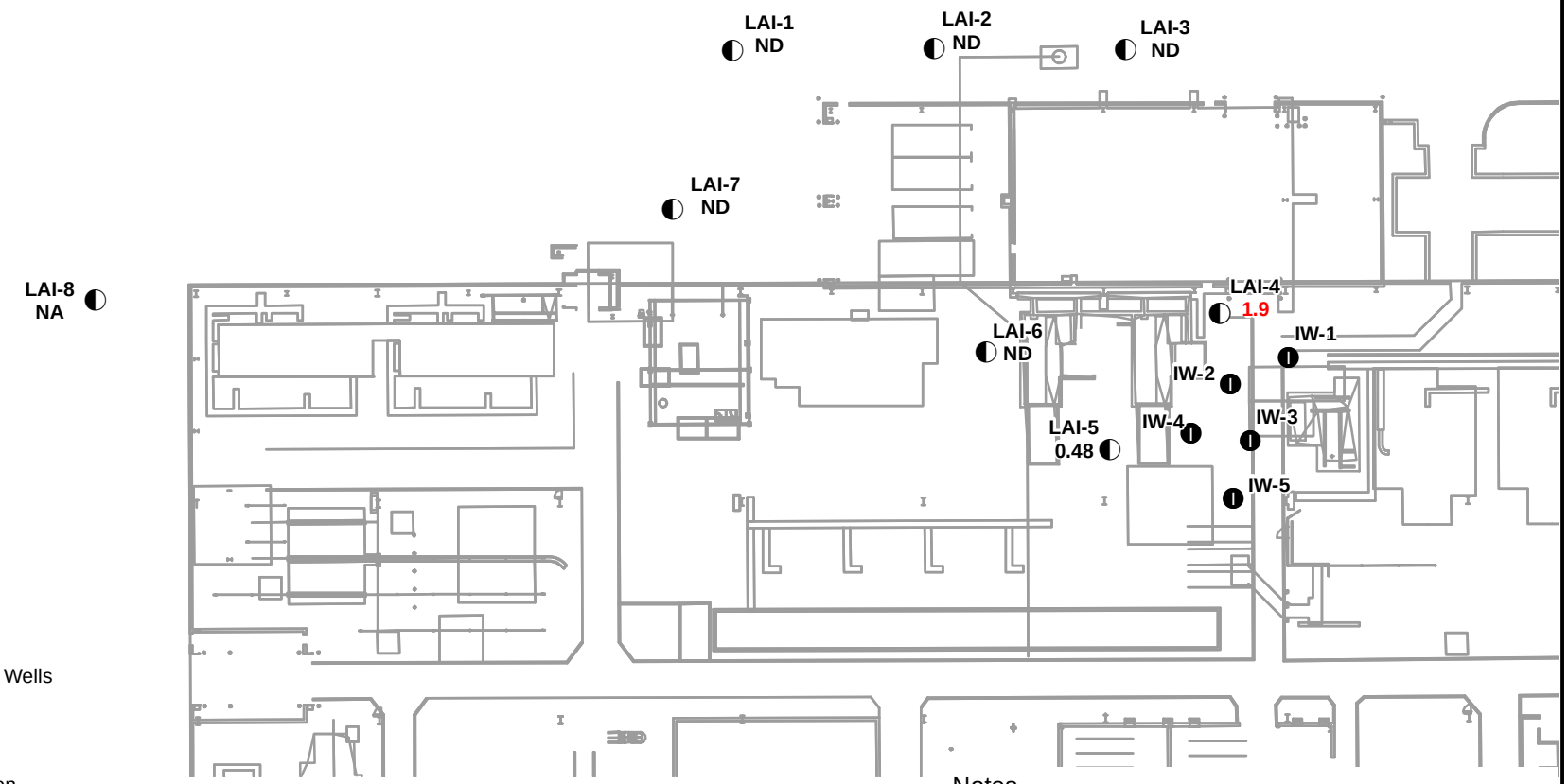
Boeing Portland Gresham, Oregon	**TGA Groundwater Elevation Contours and Capture Zone August 2013**	Figure 7

G:\Projects\025\116\114\430\BOP Annual Report\Figure 08 Coolant Release Results.mxd 3/18/2014 NAD 1983 StatePlane Oregon North FIPS 3601 Feet



Legend

◑	Injection Well
◐	TGA Monitoring Wells
NA	Not Sampled
ND	Not Detected
LAI-4 1.9	Well Identification Total diesel- and Motor Oil-Range Petroleum Hydrocarbons For August 2013

Notes

1. Red values are above the site-specific cleanup level (1.35 mg/L).
2. Figure only shows west portion of building.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Adapted from: Boeing 2006

0 50 100

Scale in Feet

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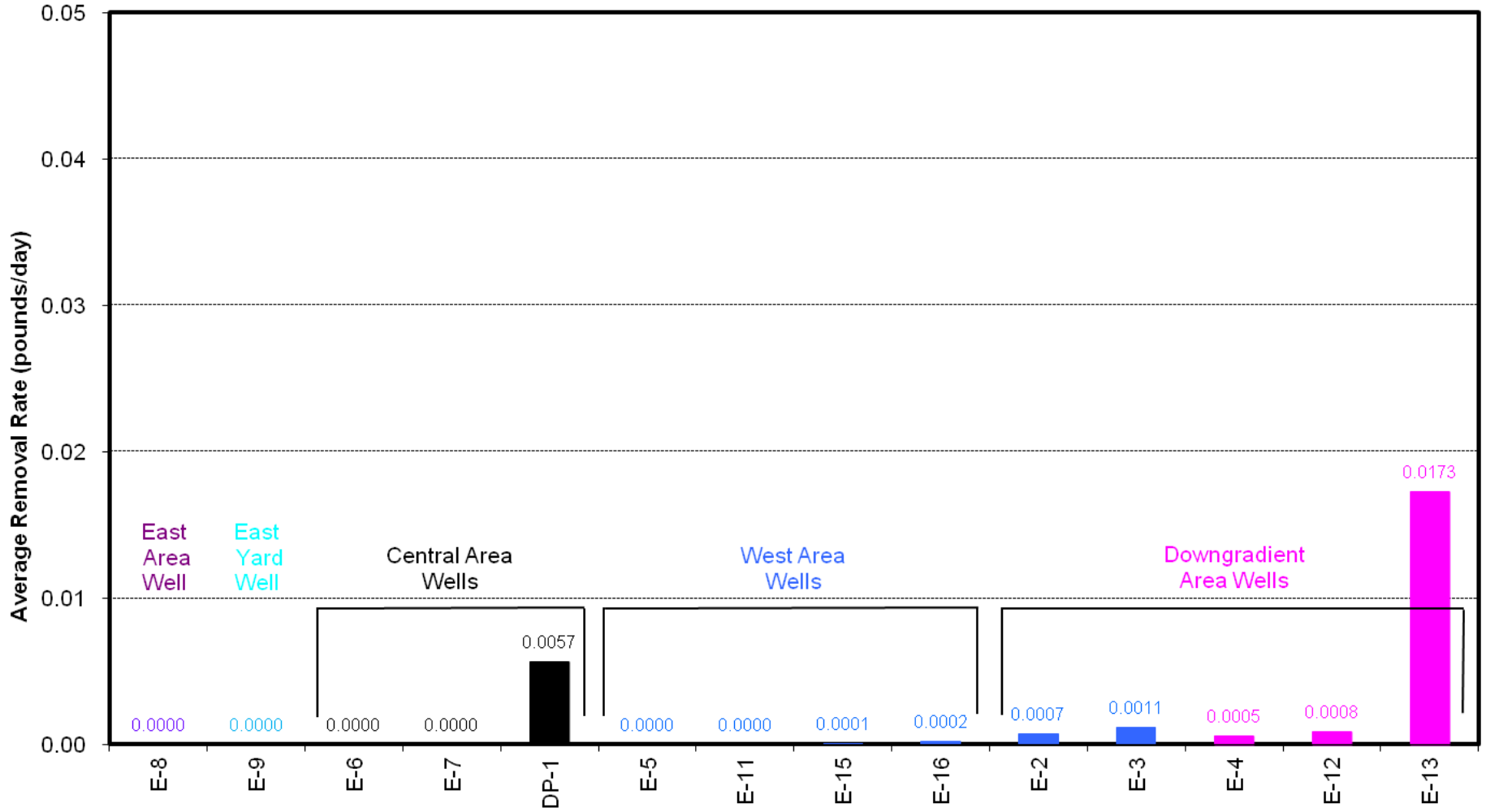
Boeing Portland
Gresham, Oregon

Coolant Release Groundwater Results August 2013

Figure 8

Source: P:\025\116\WIP\R\TGA\2013 Prog-Perf_Rpt\Tables\Figure 9.xlsx Tot VOC Mass Plot 2012- Fig



Notes: 1. Total VOCs include the following constituents: TCA, TCE, total 1,2-DCE, PCE, and 1,1-DCE.
2. Pumping operations at Well E-1 were suspended on 4/13/2000, well decommissioned on 6/29/2004.
3. Pumping operations at Wells E-5 through E-9 were suspended on 7/8/2002.
4. Extraction well E-10 was decommissioned on 3/29/2010.
5. Extraction well E-14 was decommissioned on 4/1/2010.

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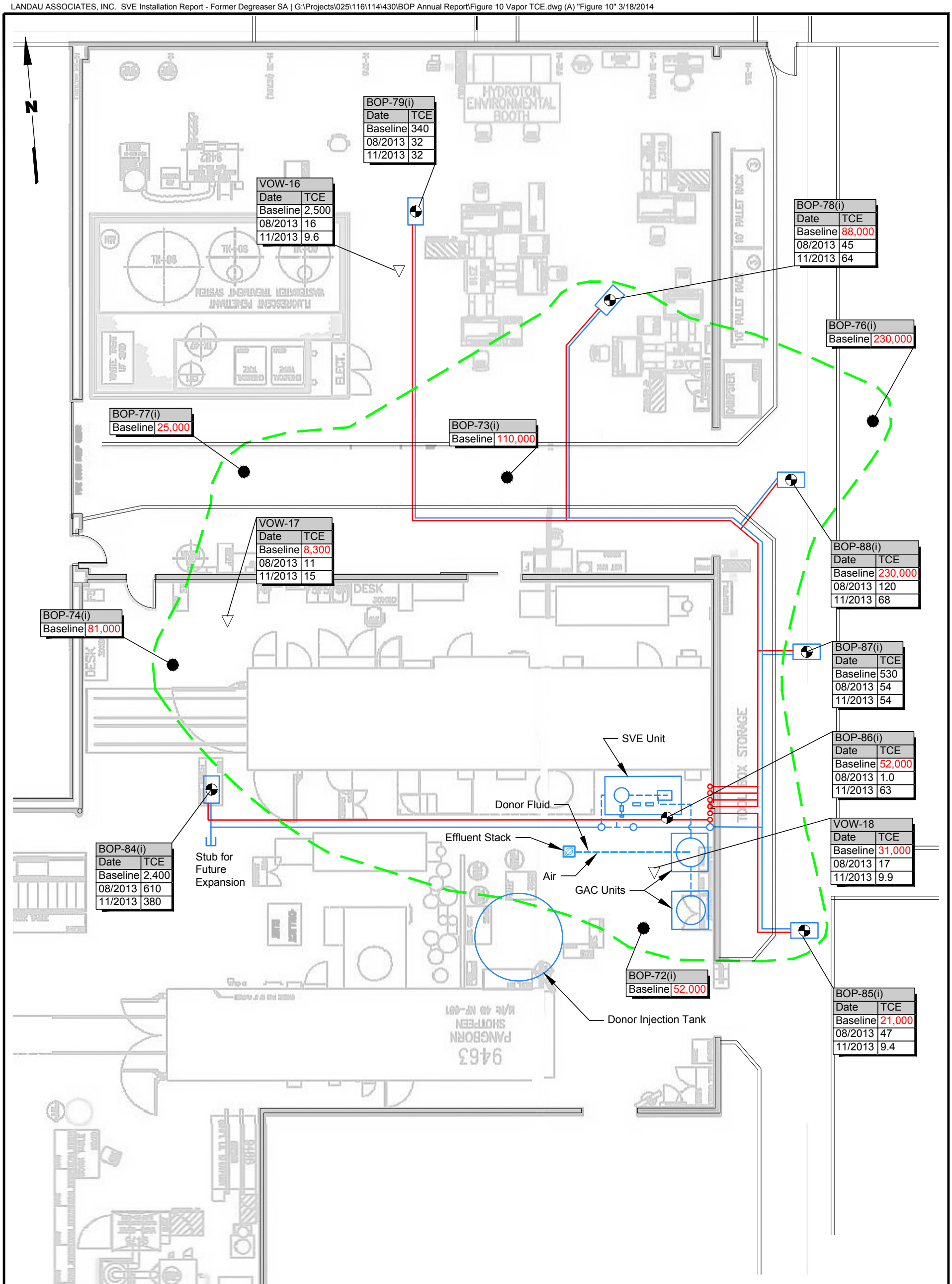
Boeing Portland
Gresham, Oregon

Average Total VOC Mass Removal Rates for 2013

Figure
9



Notes

1. Values shown in RED are above screening level (2,900 µg/m^3)
2. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Legend

- TGA Monitoring Well Location
- Multi-Purpose Well Location
- Vapor Observation Well Location
- Below-ground Donor Injection Piping
- Below-ground SVE Piping
- Aboveground SVE Piping
- Baseline 2012 Concentrations Above Screening Levels
- Vertical Pipe Segment
- Well Vault

BOP-84(i) | Date | TCE | 08/2013 | 610 — Collection Data and TCE Concentration (µg/m^3)

Source: The Boeing Company

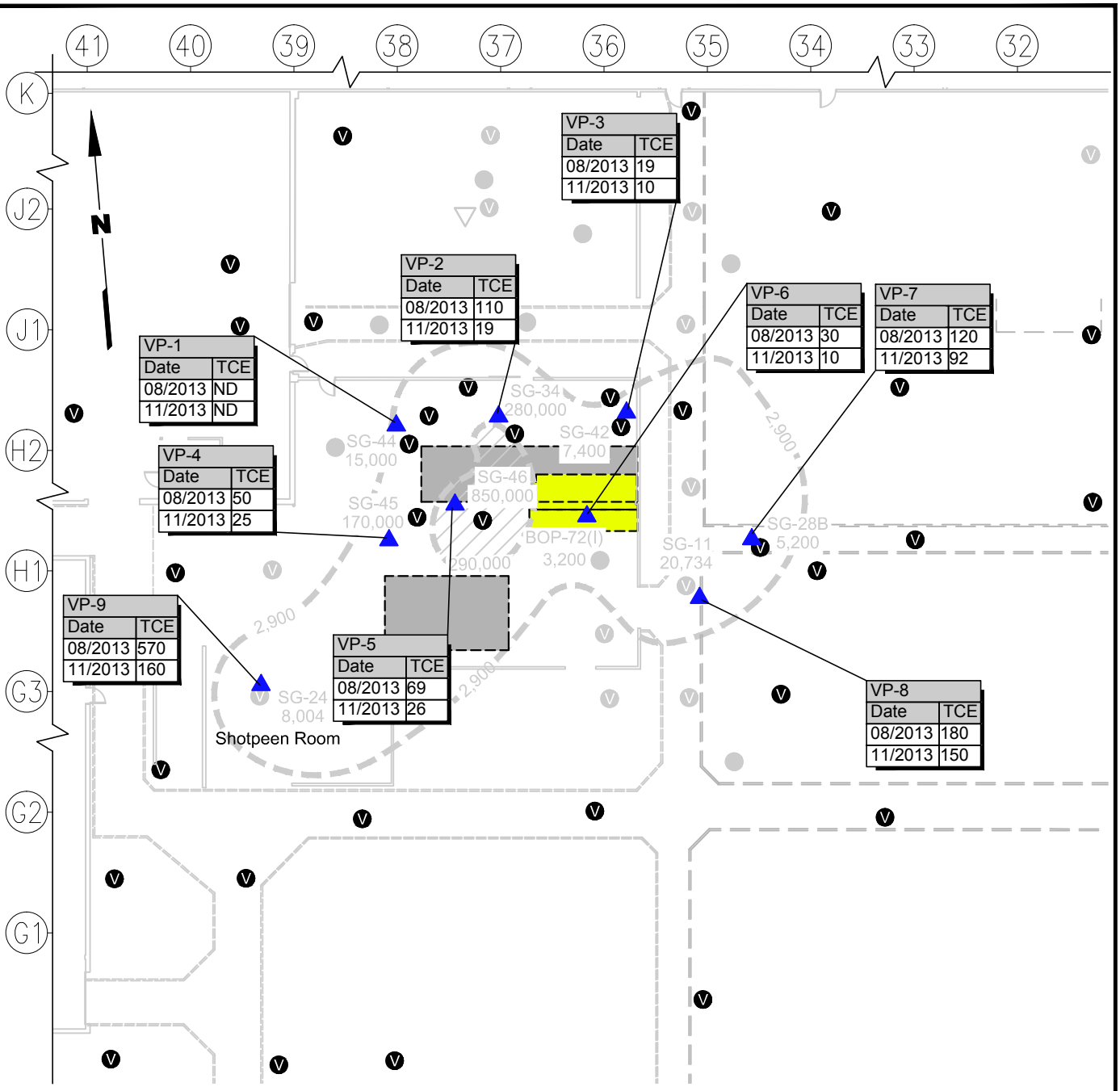
0 10 20
Scale in Feet

LANDAU ASSOCIATES

Boeing Portland
Gresham, Oregon

TCE Vapor Results - SVE System

Figure 10



Notes

1. Values shown in Red are above the RBC screening level of 2,900 µg/m^3.
2. Hot spot defined by DEQ as 100 times greater than the RBC.
3. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

0 30 60

Scale in Feet

Source: Boeing 2009

Legend

BOP-74(i) — TGA Monitoring Well and Sub-Slab Vapor Sampling Location and Designation

VOW-16 — Vapor Observation Well

VP-1 — Sub-Slab Vapor Pin Location

SG-05 — Sub-Slab Vapor Sampling Location and Designation from Phased Investigations 2009-2011

ND — TCE Not Detected above Laboratory Reporting Limits

1,490 — TCE Concentration (µg/m^3)

Baseline 2012 TCE Isoconcentration Contours

Baseline 2012 Hot Spot

Approximate Location of Basements

Approximate Location of Former Degreasers

VP-1 / Date / TCE / 08/2013 / 6.3 — Sample Location; Collection Data and TCE Concentration (µg/m^3)

Landau Associates, Inc. | G:\Projects\025\116\114\430\BOP Annual Report\Figure 11 Vapor TCE SubSlab.dwg (A) "Figure 11" 3/18/2014

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Boeing Portland
Gresham, Oregon

Sub-Slab TCE Vapor Results - Former Degreaser Source Area

Figure 11

Legend

- TGA Monitoring Wells
- Multiple-Purpose Wells
- Vapor Observation Wells
- Approximate Location of Former Degreasers

N

BOP-83(i)

BOP-82(i)

BOP-81(i)

BOP-80(i)

85-001 Building Expansion

85-001 Building

Vitra Deburr Machinery Area

40-ft ROI of First PRB Injection (conducted 12/2011)

68-ft ROI of Second PRB Injection (conducted 8/2012)

Estimated PRB Treatment Zone

Estimated 10-ft to 15-ft ROI, Typ

BOP-79(i)
VOW-16
BOP-78(i)
BOP-77(i)
BOP-73(i)
BOP-76(i)
BOP-88(i)
VOW-17
BOP-87(i)
BOP-74(i)
BOP-86(i)
BOP-84(i)
VOW-18
BOP-72(i)
BOP-85(i)
BOP-75(i)

0 40 80
Scale in Feet

Data Source: The Boeing Company

Boeing Portland
Gresham, Oregon

Source Area Bioremediation Injection Wells

Figure 12

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TABLE 1
GROUNDWATER PERFORMANCE MONITORING PLAN (a)

Aquifer and Well Use	Location	Sampling Frequency July - December 2013		Sampling Frequency Proposed	
		Groundwater Elevation	Groundwater Quality	Groundwater Elevation	Groundwater Quality
West Area					
TGA Well	BOP-16(i)	S	Q	S	Q
TGA Well	BOP-57(ia)	S	S	S	S
TGA Well	BOP-57(ib)	S	S	S	S
TGA Extraction Well	E-5	Q	A	Q	A
TGA Extraction Well	E-11	Q	Q	Q	Q
TGA Extraction Well	E-15	Q	Q	Q	Q
TGA Extraction Well	E-16	Q	Q	Q	Q
Upper TSA Well	BOP-60R(ds) (b)	A	A	A	A
Central Area					
TGA Well	BOP-10(i)	S	S	S	S
TGA Well	BOP-56(i)	S	S	S	S
TGA Well	BOP-59(i)	S	S	S	S
TGA Extraction Well	E-6	Q	A	Q	A
TGA Extraction Well	E-7	Q	A	Q	A
TGA Extraction Well	DP-1	Q	Q	Q	Q
Upper TSA Well	BOP-65(ds) (b)	S	S	S	S
East Yard					
TGA Well	BOP-48(i)	S	A	S	A
TGA Extraction Well	E-9	Q	A	Q	A
Upper TSA Well	BOP-61(ds) (b)	S	S	S	S
East Area					
TGA Extraction Well	E-8	Q	A	Q	A
Southwest Area					
TGA Well	BOP-9(i)	S	S	S	S
Upper TSA Well	BOP-62(ds) (b)	S	A	S	A
Downgradient Area					
TGA Well	BOP-7(i)	S	Q	S	Q
TGA Well	D-7(i)	S	A	S	A
TGA Well	D-8(i)	S	S	S	S
TGA Well	D-11(i)	S	A	S	A
TGA Well	D-12(i)	S	S	S	S
TGA Extraction Well	E-2	Q	Q	Q	Q
TGA Extraction Well	E-3	Q	Q	Q	Q
TGA Extraction Well	E-4	Q	Q	Q	Q
TGA Extraction Well	E-12	Q	Q	Q	Q
TGA Extraction Well	E-13	Q	Q	Q	Q
Upper TSA Well	BOP-22R(ds) (b)	A	A	A	A

TABLE 1
GROUNDWATER PERFORMANCE MONITORING PLAN (a)

Aquifer and Well Use	Location	Sampling Frequency July - December 2013		Sampling Frequency Proposed	
		Groundwater Elevation	Groundwater Quality	Groundwater Elevation	Groundwater Quality
Former Degreaser Source Control Area					
	BOP-72(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-73(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-74(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-75(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-76(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-77(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-78(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-79(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-80(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-81(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-82(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-83(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-84(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-85(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-86(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-87(i)	Q (c)	Q (c)	Q (c)	Q (c)
	BOP-88(i)	Q (c)	Q (c)	Q (c)	Q (c)
Coolant Release					
	LAI-1	Q	C-A	A	C-A
	LAI-2	Q	C-A	A	C-A
	LAI-3	Q	C-A	A	C-A
	LAI-4	Q	S/C-S	S	S/C-S
	LAI-5	Q	C-A	A	C-A
	LAI-6	Q	C-A	A	C-A
	LAI-7	Q	S/C-S	S	S/C-S
	LAI-8	Q	S/C-S	S	S/C-S

S = Semiannual; Q = Quarterly; A = Annual; D = Discontinue Monitoring; -- = No Data; C = Coolant
S/C-A = Well sampled for multiple purposes. First abbreviation indicates sampling frequency for VOC remedy/second abbreviation indicates sampling frequency for coolant release.
Shaded cells indicate wells with proposed modification to monitoring frequency.
TGA = Troutdale Gravel Aquifer
TSA = Troutdale Sandstone Aquifer

(a) From Table 3-3 of Five-Year Performance Evaluation, January 2001 through December 2005 (Landau Associates 2006), based on Phase 2 Corrective Measures Study (Landau Associates 1996).
(b) TSA water quality data collected to evaluate remedy performance as part of TGA corrective measure performance. Diffusion Bag Samples (DBS) to be utilized for TSA sample collection.
(c) Well monitored rountinely on a quarterly basis or increased to monthly for post-bioremediation injection monitoring purposes.

TABLE 2
GROUNDWATER QUALITY SUMMARY
TGA AND SELECT TSA WELLS
JULY 1 THROUGH DECEMBER 31, 2013

Area	Location	Sample Type	Date	1,1-DCE	cis-1,2-DCE	1,1,1-TCA	PCE	TCE	Vinyl chloride
		MCL Cleanup Level:		**7**	**70**	**200**	**5**	**5**	**2**
East Area-TGA									
	E-8	Grab	8/2/2013	ND	1.7	ND	2.7	5.3	ND
East Yard-TGA									
	BOP-48(i)	Purge	8/21/2013	ND	ND	ND	ND	0.5	ND
	E-9	Grab	8/2/2013	ND	ND	ND	0.4	0.4	0.6
Central Area-TGA									
	BOP-10(i)	Purge	8/21/2013	ND	2.0	ND	6.5	16	ND
	BOP-56(i)	Purge	8/21/2013	0.2	2.5	ND	5.7	22	ND
	BOP-59(i)	Purge	8/7/2013	ND	3.6	ND	ND	7.1	ND
	BOP-59(i)-Dup	Purge	8/7/2013	ND	3.4	ND	ND	7.0	ND
	E-6	Grab	8/2/2013	0.2	8.5	ND	21	19	ND
	E-7	Grab	8/2/2013	1.1	35	ND	23	38	ND
	DP-1	Grab	8/7/2013	0.3	110	ND	20	30	ND
	DP-1	Grab	11/12/2013	0.4	98	ND	20	31	ND
West Area-TGA									
	BOP-16(i)	Purge	8/21/2013	ND	0.3	ND	ND	1.2	4.5
	BOP-16(i)	Purge	11/11/2013	ND	0.2	ND	ND	0.9	4.8
	BOP-57(ia) (a)	Purge	8/5/2013	0.4	2.8	ND	2.2	13	ND
	BOP-57(ib) (a)	Purge	8/5/2013	34	7.6	24	0.5	25	7.1
	E-5	Grab	8/2/2013	ND	ND	ND	0.6	1.8	ND
	E-11	Grab	8/2/2013	ND	5.9	ND	ND	ND	ND
	E-11	Grab	11/12/2013	ND	6.0	ND	ND	ND	ND
	E-15	Grab	8/2/2013	0.5	3.4	ND	ND	0.5	5.1
	E-15	Grab	11/12/2013	0.3	1.7	ND	ND	0.4	2.4
	E-16	Grab	8/2/2013	0.4	1.5	0.6	2.6	12	ND
	E-16	Grab	11/12/2013	0.5	2.0	ND	2.8	13	ND
Southwest Area - TGA									
	BOP-9(i)	Purge	8/21/2013	2.1	16	0.8	3.9	62	ND
Downgradient Area TGA									
	BOP-7(i)	Purge	8/19/2013	19 J	13 J	4.0	4.9	300	ND
	BOP-7(i)-Dup	Purge	8/19/2013	24 J	16 J	4.5	5.6	310	ND
	BOP-7(i)	Purge	11/11/2013	18	12	4.0	5.4	220	ND
	BOP-7(i)-Dup	Purge	11/11/2013	17	12	4.0	5.2	210	ND
	D-7(i)	Purge	8/2/2013	0.2	ND	ND	ND	1.1	ND
	D-8(i)	Purge	8/2/2013	2.8	1.7	0.6	0.9	30	ND
	D-11(i)	Purge	8/2/2013	ND	0.3	ND	0.2	1.5	ND
	D-12(i)	Purge	8/2/2013	ND	ND	ND	ND	1.6	ND
	E-2	Grab	8/2/2013	0.7	0.7	ND	0.7	2.9	0.3
	E-2	Grab	11/12/2013	0.6	0.5	ND	0.5	2.6	0.3
	E-2-Dup	Grab	11/12/2013	0.6	0.5	ND	0.6	2.5	0.3

TABLE 2
GROUNDWATER QUALITY SUMMARY
TGA AND SELECT TSA WELLS
JULY 1 THROUGH DECEMBER 31, 2013

Area	Location	Sample Type	Date	1,1-DCE	cis-1,2-DCE	1,1,1-TCA	PCE	TCE	Vinyl chloride
		MCL Cleanup Level:		**7**	**70**	**200**	**5**	**5**	**2**
	E-3	Grab	8/2/2013	2.2	3.5	ND	0.7	17	4.0
	E-3	Grab	11/12/2013	2.1	3.1	ND	0.7	18	1.8
	E-4	Grab	8/2/2013	5.3	0.8	ND	1.5	28	ND
	E-4	Grab	11/12/2013	6.9	1.0	ND	1.8	35	ND
	E-12	Grab	8/2/2013	1.2	0.4	ND	0.4	11	ND
	E-12	Grab	11/12/2013	1.1	0.4	ND	0.4	11	ND
	E-13	Grab	8/2/2013	2.0	0.7	ND	0.4	9.3	ND
	E-13	Grab	11/12/2013	1.6	0.7	ND	0.3	7.8	ND
GWTS Influent/Effluent									
	Tower Influent	Grab	8/7/2013	1.8	0.8	ND	0.5	8.1	ND
	Tower Influent Dup	Grab	8/7/2013	1.8	0.8	ND	0.4	8.0	ND
	Tower Influent	Grab	11/12/2013	1.4	0.7	ND	0.4	7.5	ND
	Tower Influent Dup	Grab	11/12/2013	1.5	0.8	ND	0.4	7.7	ND
	Tower Effluent	Grab	8/7/2013	ND	ND	ND	ND	ND	ND
	Tower Effluent Dup	Grab	8/7/2013	ND	ND	ND	ND	ND	ND
	Tower Effluent	Grab	11/12/2013	ND	ND	ND	ND	ND	ND
	Tower Effluent Dup	Grab	11/12/2013	ND	ND	ND	ND	ND	ND
TSA Monitoring Wells									
	BOP-22R(ds)	DBS	8/5/2013	ND	ND	ND	ND	ND	ND
	BOP-60R(ds)	DBS	8/5/2013	ND	ND	ND	ND	ND	ND
	BOP-61(ds)	Purge	8/5/2013	ND	0.5	ND	0.3	5.6	ND
	BOP-62(ds)	Purge	8/5/2013	ND	ND	ND	ND	0.3	ND
	BOP-65(ds)	Purge	8/20/2013	ND	0.9	ND	ND	3.5	ND
	BOP-66(ds)	Purge	8/20/2013	ND	ND	ND	ND	2.8	ND
Coolant Release Wells									
	LAI-4	Purge	8/20/2013	ND	ND	ND	ND	ND	ND
	LAI-7	Purge	8/20/2013	ND	2.3	ND	3.0	3.0	ND
Former Vapor Degreaser Source Area									
	BOP-72(i)	DBS	8/6/2013	ND	0.7	ND	ND	ND	2.7
	BOP-72(i)	DBS	11/7/2013	ND	0.3	ND	ND	ND	1.9
	BOP-73(i)	DBS	8/6/2013	3.0	670	ND	6.5	1800	65
	BOP-73(i)	DBS	11/7/2013	14	7800	ND	ND	17000	250
	BOP-74(i)	DBS	8/6/2013	0.5	14	ND	ND	0.6	8.1
	BOP-74(i)	DBS	11/7/2013	ND	3.6	ND	ND	ND	1.6
	BOP-75(i)	DBS	8/6/2013	2.9	37	ND	0.2	1.3	0.2
	BOP-75(i)	DBS	11/7/2013	0.4	2.4	ND	ND	2.2	25
	BOP-76(i)	DBS	8/6/2013	1.2	100	ND	ND	1.0	8.3
	BOP-76(i)	DBS	11/7/2013	0.6	37	ND	2.4	140	42
	BOP-77(i)	DBS	8/6/2013	ND	14	ND	ND	0.7	13
	BOP-77(i)	DBS	11/7/2013	ND	9.5	ND	ND	ND	19

TABLE 2
GROUNDWATER QUALITY SUMMARY
TGA AND SELECT TSA WELLS
JULY 1 THROUGH DECEMBER 31, 2013

Area	Location	Sample Type	Date	1,1-DCE	cis-1,2-DCE	1,1,1-TCA	PCE	TCE	Vinyl chloride
		MCL Cleanup Level:		**7**	**70**	**200**	**5**	**5**	**2**
	BOP-78(i)	DBS	8/7/2013	0.6	[120]	ND	0.2	[5.5]	[98]
	BOP-78(i)	DBS	11/8/2013	ND	1.1	ND	ND	ND	[17]
	BOP-79(i)	DBS	8/7/2013	0.3	37	ND	ND	1.0	[20]
	BOP-79(i)	DBS	11/8/2013	ND	13	ND	ND	1.9	[16]
	BOP-80(i)	DBS	8/19/2013	ND	ND	ND	ND	ND	0.4
	BOP-80(i)	DBS	11/11/2013	ND	ND	ND	ND	ND	0.2
	BOP-81(i)	DBS	8/19/2013	ND	ND	ND	ND	ND	0.9
	BOP-81(i)	DBS	11/11/2013	ND	ND	ND	ND	ND	0.4
	BOP-82(i)	DBS	8/19/2013	0.6	0.5	ND	1.4	[19]	ND
	BOP-82(i)	DBS	11/7/2013	0.7	0.5	ND	1.1	[17]	ND
	BOP-83(i)	DBS	8/22/2013	ND	ND	ND	ND	3.4	ND
	BOP-83(i)	DBS	11/7/2013	ND	ND	ND	ND	2.4	ND
	BOP-84(i)	DBS	8/7/2013	ND	18	ND	ND	2.2	[15]
	BOP-84(i)	DBS	11/8/2013	0.3	3.3	ND	ND	0.7	1.3
	BOP-85(i)	DBS	8/7/2013	2.2	22	ND	0.5	1.5	0.8
	BOP-85(i)	DBS	11/8/2013	ND	2.4	ND	ND	0.2	[2.1]
	BOP-86(i)	DBS	8/7/2013	1.5	15	ND	0.6	[9.1]	1.0
	BOP-86(i)	DBS	11/8/2013	ND	2.0	ND	ND	1.4	[2.6]
	BOP-87(i)	DBS	8/7/2013	2.0	6.3	ND	0.7	[21]	0.3
	BOP-87(i)	DBS	11/8/2013	ND	6.2	ND	ND	0.6	0.6
	BOP-88(i)	DBS	8/7/2013	1.4	11	ND	0.8	[7.8]	0.2
	BOP-88(i)	DBS	11/11/2013	0.3	[85]	ND	ND	0.2	[4.1]

TSA = Troutdale Sandstone Aquifer
TGA = Troutdale Gravel Aquifer
MCL = Maximum Contaminant Level
DBS = Diffusion Bag Sampler Type
ND = Not Detected
DCE = Dichloroethene
TCA = Trichloroethane
PCE = Tetracloroethene
TCE = Trichloroethene
J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte ir
Boxed value indicates concentration above the MCL cleanup level.

(a) West Area wells BOP-57(ia, ib) are installed with short (5 ft) screens. BOP-57(ia) is screened at the base of the TGA, while B(within the first layer of the Confining Unit 1 (CU1).

Notes:
1. TSA water quality data collected as part of the TGA remedy implementation.
2. Data are micrograms per liter (µg/L).

TABLE 3
GROUNDWATER ELEVATION DATA
TGA MONITORING WELLS
JULY 1 THROUGH DECEMER 31, 2013

	Date	Time	Reference Elev. (a) (ft, MSL)	Depth to Water (ft)	Groundwater Elevation (ft)
TGA WELLS					
BOP-7(i)	8/1/2013	9:38	83.08	62.27	20.81
BOP-9(i)	8/1/2013	17:10	114.74	80.54	34.20
BOP-10(i)	8/1/2013	16:03	109.19	39.61	69.58
BOP-11(i)	8/1/2013	14:10	135.44	105.10	30.34
BOP-16(i)	8/1/2013	17:13	89.08	60.30	28.78
BOP-48(i)	8/1/2013	15:21	94.17	13.01	81.16
BOP-56(i)	8/1/2013	15:59	99.07	57.54	41.53
BOP-57(ia) (b)	8/1/2013	12:43	95.45	59.62	35.83
BOP-57(ib) (b)	8/1/2013	12:39	94.57	59.82	34.75
BOP-59(i)	8/1/2013	16:09	110.20	41.35	68.85
D-7(i)	8/1/2013	9:11	45.38	34.39	10.99
D-8(i)	8/1/2013	9:07	29.30	18.70	10.60
D-11(i)	8/1/2013	8:55	77.11	64.87	12.24
D-12(i)	8/1/2013	9:02	33.51	23.13	10.38
COOLANT RELEASE WELLS					
LAI-1	8/1/2013	16:23	109.86	27.99	81.87
LAI-2	8/1/2013	16:30	109.89	25.04	84.85
LAI-3	8/1/2013	16:34	109.85	22.14	87.71
LAI-4	8/1/2013	16:37	110.71	22.25	88.46
LAI-5	8/1/2013	16:43	110.56	20.55	90.01
LAI-6	8/1/2013	16:40	110.65	21.87	88.78
LAI-7	8/1/2013	16:20	109.90	28.64	81.26
LAI-8	8/1/2013	16:17	110.59	Dry	Dry
TSA WELLS					
BOP-13(ds)	8/1/2013	10:29	128.94	121.83	7.11
BOP-13(ds)	11/6/2013	10:44	128.94	121.74	7.20
BOP-13(dg)	8/1/2013	10:26	128.71	122.41	6.30
BOP-20(ds)	8/1/2013	10:49	77.45	65.84	11.61
BOP-20(dg)	8/1/2013	10:52	77.32	65.71	11.61
BOP-21(ds)	8/1/2013	11:00	78.02	66.05	11.97
BOP-22R(ds)	8/1/2013	9:34	82.91	71.00	11.91
BOP-22(dg)	8/1/2013	9:36	81.05	68.96	12.09
BOP-23(dg)	8/1/2013	10:45	76.96	65.42	11.54
BOP-31(ds)	8/1/2013	10:39	99.04	87.35	11.69
BOP-31(ds)	11/6/2013	10:49	99.04	88.37	10.67
BOP-31(dg)	8/1/2013	10:40	98.51	86.94	11.57
BOP-42(ds)	8/1/2013	10:21	130.74	117.83	12.91
BOP-42(dg)	8/1/2013	10:19	130.71	118.42	12.29
BOP-60R(ds)	8/1/2013	12:22	82.80	71.05	11.75
BOP-60(dg)	8/1/2013	12:39	93.59	81.85	11.74
BOP-61(ds)	8/1/2013	15:07	94.64	84.55	10.09
BOP-61(dg)	8/1/2013	15:00	94.43	84.50	9.93
BOP-62(ds)	8/1/2013	16:49	112.29	100.50	11.79
BOP-65(ds)	8/1/2013	15:53	104.22	92.26	11.96

TABLE 3
GROUNDWATER ELEVATION DATA
TGA MONITORING WELLS
JULY 1 THROUGH DECEMER 31, 2013

	Date	Time	Reference Elev. (a) (ft, MSL)	Depth to Water (ft)	Groundwater Elevation (ft)
BOP-66(ds)	8/1/2013	15:28	102.97	91.11	11.86
FORMER VAPOR DEGREASER AREA WELLS					
BOP-72(i)	8/1/2013	11:49	83.64	44.25	39.39
BOP-72(i)	11/6/2013	13:27	83.64	47.11	36.53
BOP-73(i)	8/1/2013	11:30	83.65	45.52	38.13
BOP-73(i)	11/6/2013	13:37	83.65	48.22	35.43
BOP-74(i)	8/1/2013	11:23	83.69	45.43	38.26
BOP-74(i)	11/6/2013	13:42	83.69	47.89	35.80
BOP-75(i)	8/1/2013	11:46	83.70	43.54	40.16
BOP-75(i)	11/6/2013	13:30	83.70	46.46	37.24
BOP-76(i)	8/1/2013	11:33	83.65	44.27	39.38
BOP-76(i)	11/6/2013	13:35	83.65	46.89	36.76
BOP-77(i)	8/1/2013	11:26	83.68	46.01	37.67
BOP-77(i)	11/6/2013	13:40	83.68	48.49	35.19
BOP-78(i)	8/1/2013	11:34	83.16	45.15	38.01
BOP-78(i)	11/6/2013	14:00	83.16	47.37	35.79
BOP-79(i)	8/1/2013	11:32	83.34	45.47	37.87
BOP-79(i)	11/6/2013	14:10	83.34	47.55	35.79
BOP-80(i)	8/1/2013	11:17	83.60	51.67	31.93
BOP-80(i)	11/6/2013	13:45	83.60	52.51	31.09
BOP-81(i)	8/1/2013	11:14	83.57	52.04	31.53
BOP-81(i)	11/6/2013	13:50	83.57	53.03	30.54
BOP-82(i)	8/1/2013	11:58	81.10	53.52	27.58
BOP-82(i)	11/6/2013	14:20	81.10	54.84	26.26
BOP-83(i)	8/1/2013	14:52	80.42	53.06	27.36
BOP-83(i)	11/6/2013	14:26	80.42	56.11	24.31
BOP-84(i)	8/1/2013	11:22	83.67	45.73	37.94
BOP-85(i)	8/1/2013	11:44	83.69	43.63	40.06
BOP-86(i)	8/1/2013	11:52	83.70	42.61	41.09
BOP-87(i)	8/1/2013	11:41	83.68	43.67	40.01
BOP-88(i)	8/1/2013	11:39	83.67	43.85	39.82

(a) Reference Elevation for the top of PVC well casing.

(b) West Area wells BOP-57(ia, ib) are installed with short (5 ft) screens. BOP-57(ia) is screened at the base of the TGA, while BOP-57(ib) is screened within the first layer of the Confining Unit 1 (CU1).

TABLE 4
GROUNDWATER ANALYTICAL RESULTS
TPH-Dx AND FIELD PARAMETERS
COOLANT RELEASE INVESTIGATION
BOEING PORTLAND FACILITY

		NWTPH-Dx (mg/L) (a)			Field Parameters		
		Diesel	Motor Oil	Total TPH-Dx	pH	Dissolved Oxygen (mg/L)	ORP (mV)
TGA Wells							
LAI-1	8/20/2013	0.095 UJ	0.24 U	ND	5.55	4.96	38.5
LAI-2	8/20/2013	0.098 UJ	0.24 U	ND	5.22	3.35	43.6
LAI-3	8/20/2013	0.098 UJ	0.24 U	ND	5.94	4.22	14.9
LAI-4	8/20/2013	0.70 J	1.2	1.9	8.76	3.08	-208.3
LAI-5	8/20/2013	0.18 J	0.30	0.48	6.60	5.29	-7.1
LAI-6	8/20/2013	0.098 UJ	0.24 U	ND	6.60	5.30	-6.6
LAI-7	8/22/2013	0.098 UJ	0.25 U	ND	6.24	1.00	-67.1
LAI-8	8/22/2013	**Dry in August 2013**					
		Cleanup Level (b)		1.35			

DEQ = Oregon Department of Environmental Quality
TPH-Dx = Diesel-range Total Petroleum Hydrocarbons
ORP - Oxygen Reduction Potential
mg/L = milligrams per liter
mV = millivolts
U = Indicates compound was analyzed for, but was not detected at the given reporting limit.
UJ = The analyte was not detected in the sample; the reported sample detection limit is an estimate.
J = Indicates the analyte was positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.
Boxed value indicates concentration above the cleanup level.

(a) Samples analyzed after September 27, 2006 had silica gel and acid wash preparation steps conducted.
(b) Site-specific DEQ Risk-Based cleanup standard based on sum of diesel and motor oil components.

TABLE 5
EXTRACTION WELL SUMMARY
GROUNDWATER TREATMENT SYSTEM

Location	July 2013 Gallons Pumped	July 2013 Run Time Operational Minutes	July 2013 Pump Rate (gpm)	July 2013 Avg. Yield (gpm)	August 2013 Gallons Pumped	August 2013 Run Time Operational Minutes	August 2013 Pump Rate (gpm)	August 2013 Avg. Yield (gpm)	September 2013 Gallons Pumped	September 2013 Run Time Operational Minutes	September 2013 Pump Rate (gpm)	September 2013 Avg. Yield (gpm)
E-2	846,720	43,200	19.60	18.97	831,762	43,800	18.99	18.63	820,800	42,900	19.13	19.00
E-3	47,376	39,480	1.20	1.06	270,135	43,500	6.21	6.05	261,690	42,900	6.10	6.06
E-4	56,160	43,200	1.30	1.26	40,678	43,740	0.93	0.91	44,125	42,840	1.03	1.02
E-5	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-6	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-7	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-8	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-9	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-11	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-12	194,400	43,200	4.50	4.35	215,496	43,800	4.92	4.83	210,210	42,900	4.90	4.87
E-13	5,387,040	43,200	124.70	120.68	5,417,184	43,800	123.68	121.35	5,190,900	42,900	121.00	120.16
E-15	8,640	43,200	0.20	0.19	8,640	43,800	0.20	0.19	12,012	42,900	0.28	0.28
E-16	34,560	43,200	0.80	0.77	32,412	43,800	0.74	0.73	62,466	42,900	1.46	1.45
EW-3	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
EW-13	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
DP-1	126,576	43,200	2.93	2.84	121,764	43,800	2.78	2.73	126,224	42,900	2.94	2.92
Total	**6,701,472**				**6,938,071**				**6,728,427**			

TABLE 5
EXTRACTION WELL SUMMARY
GROUNDWATER TREATMENT SYSTEM

Location	October 2013 Gallons Pumped	October 2013 Run Time Operational Minutes	October 2013 Pump Rate (gpm)	October 2013 Avg. Yield (gpm)	November 2013 Gallons Pumped	November 2013 Run Time Operational Minutes	November 2013 Pump Rate (gpm)	November 2013 Avg. Yield (gpm)	December 2013 Gallons Pumped	December 2013 Run Time Operational Minutes	December 2013 Pump Rate (gpm)	December 2013 Avg. Yield (gpm)
E-2	834,217	43,860	19.02	18.69	816,240	42,960	19.00	18.89	758,206	43,080	17.60	16.98
E-3	167,546	43,860	3.82	3.75	150,360	42,960	3.50	3.48	137,856	43,080	3.20	3.09
E-4	41,781	43,980	0.95	0.94	38,610	42,900	0.90	0.89	30,156	43,080	0.70	0.68
E-5	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-6	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-7	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-8	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-9	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-11	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
E-12	214,329	43,920	4.88	4.80	211,363	42,960	4.92	4.89	213,246	43,080	4.95	4.78
E-13	5,365,260	43,620	123.00	120.19	5,267,755	42,960	122.62	121.94	5,290,224	43,080	122.80	118.51
E-15	12,702	43,860	0.29	0.28	13,708	42,840	0.32	0.32	15,078	43,080	0.35	0.34
E-16	57,018	43,860	1.30	1.28	53,700	42,960	1.25	1.24	55,065	43,020	1.28	1.23
EW-3	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
EW-13	0	0	0.00	0.00	0	0	0.00	0.00	0	0	0.00	0.00
DP-1	132,018	43,860	3.01	2.96	133,176	42,960	3.10	3.08	132,255	43,080	3.07	2.96
Total	**6,824,871**				**6,684,912**				**6,632,086**			

Notes:

1. Average yield reflects total gallons pumped divided by total minutes for the measuring period.
2. Well E-1 was decommissioned in June 2004 and is no longer shown.
3. EW-3 and EW-13 are TSA extraction wells.
4. Wells E-5 through E-11 were not operated during this time period except for sampling.
5. Well E-10 was decommissioned on 3/29/10 and E-14 was decommissioned on 4/1/10. Wells are no longer included in this table.
6. DEQ approved the pilot shutdown of EW-3. The pump was shut off on 12/12/09. The well will remain in pilot shutdown.
7. DEQ approved the pilot shutdown of EW-13. The pump was shut off on 11/25/09. The well will remain in pilot shutdown.
8. Well EW-22 was converted to a monitoring well, decommissioned on 3/26/10, and is no longer shown.

TABLE 6
VAPOR WELL ANALYTICAL RESULTS
FORMER VAPOR DEGREASER SOURCE AREA
BOEING PORTLAND

Location	Lab ID	Date Collected	VOLATILES (Method TO-15) Vinyl Chloride (µg/m3)	1,1-DCE (µg/m3)	1,1,1-TCA (µg/m3)	cis-1,2-DCE (µg/m3)	TCE (µg/m3)	PCE (µg/m3)
		Screening Level (a)	2,800	880,000	22,000,000		2,900	47,000
VOW-16	1308248-08A	8/8/2013	3.1 U	4.8 U	6.6 U	4.8 U	16	44
VOW-16	1311232-08A	11/8/2013	3.0 U	4.6 U	6.4 U	4.6 U	9.6	22
VOW-17	1308248-09A	8/8/2013	2.9 U	4.5 U	6.2 U	4.5 U	11	120
VOW-17	1311232-09A	11/8/2013	2.9 U	4.4 U	6.1 U	4.4 U	15	96
VOW-18	1308248-10A	8/8/2013	3.0 U	4.7 U	6.4 U	4.7 U	17	130
VOW-18	1311232-10A	11/8/2013	3.0 U	4.7 U	6.5 U	4.7 U	9.9	81
BOP-78(i)	1308248-01A	8/8/2013	2.8 U	4.3 U	5.9 U	4.3 U	45	56
BOP-78(i)	1311232-01A	11/8/2013	3.1 U	4.8 U	6.6 U	4.8 U	64	25
BOP-79(i)	1308248-02A	8/8/2013	3.0 U	4.7 U	6.5 U	4.7 U	32	58
BOP-79(i)	1311232-02A	11/8/2013	3.1 U	4.8 U	6.6 U	4.8 U	32	24
BOP-84(i)	1308248-03A	8/8/2013	2.8 U	4.3 U	5.9 U	4.3 U	610	160
BOP-84(i)	1311232-03A	11/8/2013	3.1 U	4.8 U	6.5 U	4.8 U	380	120
BOP-85(i)	1308248-04A	8/8/2013	3.0 U	4.7 U	6.5 U	7.8	47	150
BOP-85(i)	1311232-04A	11/8/2013	3.1 U	4.9 U	6.7 U	4.9 U	9.4	48
BOP-86(i)	1308248-05A	8/8/2013	2.8 U	4.4 U	6.0 U	4.4 U	110	83
BOP-86(i)	1311232-05A	11/8/2013	3.0 U	4.7 U	6.9	4.7 U	63	96
BOP-87(i)	1308248-06A	8/8/2013	3.2 U	4.9 U	11	4.9 U	54	140
BOP-87(i)	1311232-06A	11/8/2013	3.0 U	4.6 U	8.0	4.6 U	54	53
BOP-88(i)	1308248-07A	8/8/2013	3.1 U	4.8 U	16	4.8 U	120	100
BOP-88(i)	1311232-07A	11/8/2013	3.0 U	4.7 U	16	4.7 U	68	37

U = Indicates the compound was not detected at the reported concentration.
µg/m3 = micrograms per cubic meter
DCE = Dichloroethene
TCA = Trichloroethane
PCE = Tetrachloroethene

(a) Soil gas screening levels were developed by the Oregon Department of Environmental Quality (DEQ) by multiplying the Risk Based Concentration for air in an occupational setting by an attenuation factor of 1,000 to account for vapor intrusion through building slab. Screening levels updated June 7, 2012.

TABLE 7
SVE SYSTEM ANALYTICAL RESULTS
FORMER VAPOR DEGREASER SOURCE AREA
BOEING PORTLAND

Location	Lab ID	Date Collected	Days since startup	Days of Shutdown	Influent Flow Rate (SCFM)	VOLATILES (Method TO-15) Vinyl Chloride (µg/m3)	1,1-DCE (µg/m3)	1,1,1-TCA (µg/m3)	cis-DCE (µg/m3)	TCE (µg/m3)	PCE (µg/m3)	1,1-DCA (µg/m3)	Mass Removal (lbs/day)	Running Total Mass Removal (lbs)
		9/17/2012				**SYSTEM STARTUP**								
Inf	1210340-08A	10/12/2012	25	0	260	4.9	9.3	34	32	1000	180	NA	0.029	0.736
Gac1	1210340-09A	10/12/2012	25	0	---	3.2	4.8 U	6.6 U	4.8 U	6.5 U	19	NA	---	---
Eff	1210340-10A	10/12/2012	25	0	---	3.0 U	4.7 U	6.5 U	4.7 U	6.4 U	26	NA	---	---
Inf	1211190-11A	11/6/2012	50	0	260	3.2 U	4.9 U	14	15	450	140	NA	0.015	1.103
Gac1	1211190-13A	11/6/2012	50	0	---	3.2 U	4.9 U	6.7 U	4.9 U	6.6 U	24	NA	---	---
Eff	1211190-12A	11/6/2012	50	0	---	3.2 U	4.9 U	6.7 U	4.9 U	6.6 U	28	NA	---	---
Inf	1212183-01A	12/5/2012	79	0	255	3.0 U	4.7 U	11	9.6	320	98	NA	0.010	1.399
Gac1	1212183-02A	12/5/2012	79	0	---	3.1 U	4.8	6.6 U	4.8 U	6.5 U	35	NA	---	---
Eff	1212183-03A	12/5/2012	79	0	---	3.0 U	4.7 U	6.5 U	4.7 U	6.4 U	40	NA	---	---
Inf	1301053-01A	1/3/2013	108	2	260	3.0 U	4.7 U	11	8.1	270	150	NA	0.010	1.681
Gac1	1301053-02A	1/3/2013	108	2	---	3.1 U	5.9	6.6 U	6.5	6.5 U	27	NA	---	---
Eff	1301053-03A	1/3/2013	108	2	---	3.0 U	4.7 U	6.5 U	4.7 U	6.4 U	27	NA	---	---
Inf	1302153-01A	2/4/2013	140	0	260	3.0 U	4.7 U	12	6.0	240	74	NA	0.008	1.935
Gac1	1302153-03A	2/4/2013	140	0	---	3.2 U	5.0 U	6.9 U	19	6.8 U	27	NA	---	---
Eff	1302153-02A	2/4/2013	140	0	---	2.6 U	4.1 U	5.6 U	4.1 U	5.5 U	34	NA	---	---
Inf	1303111-01A	3/4/2013	168	0	260	2.9 U	4.5 U	11	4.5 U	190	79	NA	0.007	2.127
Gac1	1303111-02A	3/4/2013	168	0	---	2.9 U	4.5 U	6.1 U	15	6.0 U	30	NA	---	---
Eff	1303111-03A	3/4/2013	168	0	---	3.0 U	4.6 U	6.4 U	4.6 U	6.3 U	33	NA	---	---
Inf	1304124-01A	4/1/2013	196	0	260	3.1 U	4.8 U	11	4.8 U	180	130	NA	0.008	2.345
Gac1	1304124-02A	4/1/2013	196	0	---	3.1 U	4.8 U	6.6 U	13	6.5 U	48	NA	---	---
Eff	1304124-03A	4/1/2013	196	0	---	3.1 U	4.9 U	6.7 U	4.9 U	6.6 U	34	NA	---	---
Inf	1305217-20A	5/6/2013	231	0	260	3.0 U	4.6 U	12	4.6 U	210	85	NA	0.007	2.606
Gac1	1305217-21A	5/6/2013	231	0	---	2.9 U	4.5 U	6.2 U	7.2	6.1 U	33	NA	---	---
Eff	1305217-22A	5/6/2013	231	0	---	3.0 U	4.7 U	6.5 U	4.7 U	6.4 U	36	NA	---	---
Inf	1306064-01A	6/3/2013	259	0	260	2.9 U	4.5 U	10	4.5 U	200	100	NA	0.008	2.817
Gac1	1306064-02A	6/3/2013	259	0	---	2.8 U	4.3 U	5.9 U	14	5.8 U	50	NA	---	---
Eff	1306064-03A	6/3/2013	259	0	---	3.0 U	4.7 U	6.5 U	4.7 U	6.4 U	56	NA	---	---
Inf		7/1/2013			---								---	---
Gac1		7/1/2013			---	**SVE not operating or sampled in July due to injection**							---	---
Eff		7/1/2013			---								---	---
Inf	1308248-20A	8/7/2013	293	30	165	3.0 U	4.6 U	9.9	4.6 U	210	140	NA	0.006	2.839
Gac1	1308248-21A	8/7/2013	293	30	---	3.0 U	4.6 U	6.3 U	7.5	6.2 U	22	NA	---	---
Eff	1308248-20A	8/7/2013	293	30	---	2.9 U	4.5 U	6.2 U	4.5 U	6.1 U	86	NA	---	---
Inf	1309137-01A	9/6/2013	323	0	265	2.7 U	4.2 U	6.8	4.2 U	120	84	NA	0.005	2.997
Gac1	1309137-02A	9/6/2013	323	0	---	3.0 U	4.6 U	6.3 U	5.3	6.2 U	53	NA	---	---
Eff	1309137-03A	9/6/2013	323	0	---	3.0 U	4.7 U	6.4 U	4.7 U	6.3 U	72	NA	---	---
Inf	1311232-20A	11/6/2013	384	0	265	3.1 U	4.8 U	10	4.8 U	210	100	NA	0.008	3.481
Gac1	1311232-21A	11/6/2013	384	0	---	3.0 U	4.6 U	6.4 U	5.1	6.3 U	47	NA	---	---
Eff	1311232-22A	11/6/2013	384	0	---	3.0 U	4.7 U	6.5 U	9.4	6.4 U	58	NA	---	---

(a) Soil gas screening levels were developed by the Oregon Department of Environmental Quality (DEQ) by multiplying the Risk Based Concentration for air in an occupational setting by an attenuation factor of 1,000 to account for vapor intrusion through building slab. Screening levels updated June 7, 2012.
(b) SVE system monitored quarterly starting November 2013.

TABLE 8
SUBSLAB VAPOR WELL ANALYTICAL RESULTS
FORMER VAPOR DEGREASER SOURCE AREA
BOEING PORTLAND

VOLATILES (Method TO-15)

Location	Lab ID	Date Collected	Vinyl Chloride (µg/m3)	1,1-DCE (µg/m3)	1,1,1-TCA (µg/m3)	cis-1,2-DCE (µg/m3)	TCE (µg/m3)	PCE (µg/m3)
		Screening Level (a)	2,800	880,000	22,000,000		2,900	47,000
VP-1	1308248-11A	8/8/2013	3.0 U	4.7 U	6.4 U	4.7 U	6.3 U	48
VP-1	1311232-11A	11/8/2013	2.8 U	4.3 U	5.9 U	4.3 U	5.8 U	66
VP-2	1308248-12A	8/8/2013	3.0 U	4.7 U	6.4 U	4.7 U	110	74
VP-2	1311232-12A	11/8/2013	3.1 U	4.8 U	6.6 U	4.8 U	19	30
VP-3	1308248-13A	8/8/2013	3.0 U	4.6 U	27	4.6 U	19	110
VP-3	1311232-13A	11/8/2013	2.8 U	4.3 U	22	4.3 U	10	26
VP-4	1308248-14A	8/8/2013	2.9 U	4.5 U	6.2 U	4.5 U	50	140
VP-4	1311232-14A	11/8/2013	3.0 U	4.7 U	6.5 U	4.7 U	25	90
VP-5	1308248-15A	8/8/2013	3.1 U	4.8 U	6.6 U	4.8 U	69	120
VP-5	1311232-15A	11/8/2013	3.0 U	4.6 U	6.3 U	4.6 U	26	66
VP-6	1308248-16A	8/8/2013	3.2 U	4.9 U	28	4.9 U	30	180
VP-6	1311232-16A	11/8/2013	3.2 U	4.9 U	13	4.9 U	10	150
VP-7	1308248-17A	8/8/2013	3.1 U	47	1600	56	120	82
VP-7	1311232-17A	11/8/2013	3.1 U	43	1100	40	92	42
VP-8	1308248-18A	8/8/2013	5.7 U	190	4500	83	180	150
VP-8	1311232-18A	11/8/2013	7.3 U	200	3800	43	150	110
VP-9	1308248-19A	8/8/2013	3.0 U	4.6 U	39	4.6 U	570	360
VP-9	1311232-19A	11/8/2013	3.0 U	4.6 U	9.5	4.6 U	160	170

U = Indicates the compound was not detected at the reported concentration.
µg/m3 = micrograms per cubic meter
DCE = Dichloroethene
TCA = Trichloroethane
TCE = Trichloroethene
PCE = Tetrachloroethene

(a) Soil gas screening levels were developed by the Oregon Department of Environmental Quality (DEQ) by multiplying the Risk Based Concentration for air in an occupational setting by an attenuation factor of 1,000 to account for vapor intrusion through building slab. Screening levels collected during pilot tests.

TABLE 9
BIOREMEDIATION GROUNDWATER ANALYTICAL SUMMARY
FORMER VAPOR DEGREASER SOURCE AREA
BOEING PORTLAND

		Elapsed Time from Injections (a) (days)	Elapsed Time from Injection (b) (days)	Elapsed Time from Injection (c) (days)	Elapsed Time from Injection (d) (days)	Volatile Organic Compounds						Fermentation Product		Aquifer Redox Conditions						Donor Indicators	
Well	Date	Pilot Injection	PRB 1st Injection	PRB 2nd Injection	Multi-Purpose Source Zone Wells 1st Injection	PCE (µg/L)	TCE (µg/L)	CIS (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	2-Butanone (µg/L)	Acetone (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (b) (mg/L)	TOC (mg/L)	pH
BOP-72i	10/19/2010	-16				3.1	28	10	<1.0	<1.0	<2.0	<5.0	<10			1.2		12.9	0.106	1.77	
BOP-72i	12/6/2010	32				<2.0	3.6	<2.0	<2.0	25	5.4	810	300	2.81	-26.2	<5.0	3.2	<5.0	0.849	3020	6.88
BOP-72i	2/2/2011	90				<20	<20	<20	<20			1400	520								
BOP-72i	5/5/2011	182				<1.0	<1.0	6.3	<1.0			67	58	0.21	163						6.79
BOP-72i	8/10/2011	279				<1.0	<1.0	10	<1.0	<1.1	<1.2	<25	<25	0.26	-152	<0.1	2.4	1.5	7.7	263	6.77
BOP-72i	11/3/2011	364	-55			<1.0	<1.0	3.0	6.8			<25	<25	0.09	-139						6.71
BOP-72i	2/8/2012	461	42			<2.0	<2.0	<2.0	7.5			<50	<50	0.31	-318						7.46
BOP-72i	5/4/2012	547	128			<2.0	<2.0	<2.0	9.0			<50	<50	0.86	-65.7						6.69
BOP-72i	8/9/2012	644	225	-7		<1.0	<1.0	<1.0	10			<5.0	12								
BOP-72i	11/8/2012	735	316	84		<0.2	<0.2	0.2	5.1			<5.0	5.9								
BOP-72i	2/5/2013	824	405	173		<0.2	<0.2	0.3	3.4			<5.0	15								
BOP-72i	5/2/2013	910	491	259	-68	<0.2	<0.2	0.2	3.3			<5.0	13								
BOP-72i	8/6/2013	1006	587	355	28	<0.2	<0.2	0.7	2.7	5.0	<5.0	<5.0	19	0.58	-149	<0.10	3.0	<5.0	13	47.4	6.66
BOP-72i	11/7/2013	1099	680	448	121	<0.2	<0.2	0.3	1.9	<5.0	<5.0	<5.0	<5.0	0.62	-113	<0.10	2.5	<1.0	11	41.7	6.68
BOP-73i	10/19/2010	-16				12	560	90	<1.0	<1.0	<2.0	<5.0	<10			0.7		11	0.0599	1.6	
BOP-73i	12/6/2010	32				19	520	59	<2.0	<2.0	<5.0	<50	<50	3.20	14.6	1.0	2.8	10.3		2.24	6.94
BOP-73i	2/2/2011	90				37	1000	78	<1.0			<5.0	<10	0.45	-14.8						6.37
BOP-73i	5/5/2011	182				43	1200	42	<3.0			<15	<30	0.64	15.6						6.29
BOP-73i	8/10/2011	279				18	510	48	<1.0	<1.1	<1.2	<5.0	<10	0.54	-24.9	1.0	2.4	11.8	1.01	1.88	6.30
BOP-73i	11/3/2011	364				4.7	160	130	<1.0			<5.0	<10	0.10	-42.9						6.33
BOP-73i (78)	12/1/2011	392	-27			5.0	180	120	<1.0	<1.1	<1.2	<5.0	<10	0.01	-260	0.6	1.0	9.5	0.759	1.93	6.71
BOP-73i (78)	12/28/2011	419	0																	2.86	
BOP-73i (78)	1/19/2012	441	22			7.8	240	100	12			<25	<50	0.41	249	0.3	1.8	8.8		9.26	7.04
BOP-73i (78)	2/16/2012	469	50			4.0	190	59	24	<1.1	<1.2	<5.0	<10	0.66	-235	0.3	2.2	11.5	1.35	<1.50	7.74
BOP-73i (78)	3/15/2012	497	78			6.4	290	53	13	<1.1	<1.2	<5.0	<10	0.80	-220	0.8	1.9	11.2	0.535	2.14	6.90
BOP-73i (78)	4/17/2012	530	111			26	1400	50	14	<1.1	<1.2	<25	<50	1.23	-244	1.0	1.5	10.7	0.438	<1.50	7.66
BOP-73i (78)	6/12/2012	586	167			72	2700	220	45	2.8	<1.2	<5.0	<10	0.70	28.3	0.9	2.0	9.7	0.787	1.61	6.37
BOP-73i (78)	8/9/2012	644	225	-7		2.2	180	190	13			<5.0	<10								
BOP-73i (78)	8/16/2012	651	232	0																219	
BOP-73i (78)	9/18/2012	684	265	33		41	1300	340	38	<5.0	<5.0	<50	<50	0.45	-119	0.28	1.6	8.4	1.6	5.2	6.31
BOP-73i	11/14/2012	741	322	90		83	2900	110	2.6	<5.0	<5.0	<50	<50	0.83	122.5	0.89	0.5	10.2	3.2	<1.0	6.57
BOP-73i	2/6/2013	825	406	174		13	390	77	4.7	<5.0	<5.0	<10	<10	0.52	56.4	0.11	0.5	8.9	1.4		6.26
BOP-73i	5/7/2013	915	496	264	-63	16	11000	6200	380	29	<5.0	<10	<10	2.75	-28.6	<0.10	2.0	7.8	2.8	2.0	6.39
BOP-73i	8/6/2013	1006	587	355	28	6.5	1800	670	65	27	<5.0	<50	<50	0.52	-121	<0.10	1.5	10.2	4.8	2.4	6.18
BOP-73i	11/7/2013	1099	680	448	121	<4.0	17000	7800	250	30	<5.0	<100	<100	1.13	-75.5	<0.10	3.0	8.6	1.9	2.0	6.41
BOP-74i	10/19/2010	-16				1.0	38	8.0	<1.0	<1.0	<2.0	<5.0	<10			0.9		9.1	0.1	<1.50	
BOP-74i	12/6/2010	32				<1.0	24	6.5	<1.0	<1.0	<2.0	<5.0	<10	3.07	53.3	0.2	0.2	9.9		2.79	6.61
BOP-74i	2/2/2011	90				2.6	44	3.8	<1.0			<5.0	<10	0.42	81.0						6.22
BOP-74i	5/5/2011	182				2.0	26	8.0	<1.0			<5.0	<10	0.25	56.5						6.23
BOP-74i	8/10/2011	279				<1.0	8.9	7.2	<1.0	<1.1	<1.2	<5.0	<10	0.50	-124.9	<0.1	2.0	6.6	4.3	2.69	6.42
BOP-74i	11/3/2011	364				<1.0	3.1	16	<1.0			<5.0	<10	0.10	-21.2						6.46
BOP-74i (71)	12/1/2011	392	-27			<1.0	8.6	17	<1.0	<1.1	<1.2	<5.0	<10	0.01	-302	<0.1	1.6	6.7	1.8	3.03	7.03
BOP-74i (71)	1/19/2012	441	22			<1.0	11	18	<1.0	<1.1	1.6	62	24	0.21	-170	<1.0	2.0	<1.0	2.6	1450	5.48
BOP-74i (71)	2/16/2012	469	50			<1.0	2.4	44	1.6	<1.1	<1.2	70	43	0.93	-154	<0.5	3.8	<0.5	6.68	668	5.23
BOP-74i (71)	3/15/2012	497	78			<1.0	1.4	210	3.2	<1.1	<1.2	41	23	0.10	-244	<0.5	4.8	<0.5	8.41	330	6.40
BOP-74i (71)	4/17/2012	530	111			<5.0	<5.0	79	50	<1.1	<1.2	32	<50	0.13	-276.9	<0.1	1.8	0.8	8.8	72.0	6.83
BOP-74i (71)	6/12/2012	586	167			<1.0	<1.0	1.2	14	<1.1	<1.2	23	20	0.72	-9.9	<0.1	4.8	<0.1	5.72	67.6	5.78
BOP-74i (71)	8/9/2012	644	225	-7		<1.0	<1.0	<1.0	1.9			<5.0	<10								
BOP-74i (71)	9/19/2012	685	266	34		<0.2	4.5	60	2.9	<5.0	<5.0	23	17	1.20	18.0	<0.10	4.0	<1.0	13	1280	4.86
BOP-74i	11/14/2012	741	322	90		<0.2	0.6	6.9	18	<5.0	<7.0	<5.0	6.1	5.92	93.6	<0.10	4.0	<1.0	22	145	5.96
BOP-74i	2/6/2013	825	406	174		<0.2	0.5	1.7	2.9	<5.0	<5.0	21	29	0.28	-21.3	<0.10	5.0	<1.0	27	83.7	6.15
BOP-74i	5/7/2013	915	496	264	-63	<0.2	4.0	2.7	1.8	<5.0	<5.0	5.7	9.7	1.21	-53.0	<0.10	3.0	<1.0	21	128	6.04
BOP-74i	8/6/2013	1006	587	355	28	<0.2	0.6	14	8.1	<5.0	<5.0	5.1	26	2.35	-25.0	<0.10	3.5	<1.0	26	669	5.07
BOP-74i	11/7/2013	1099	680	448	121	<0.2	<0.2	3.6	1.6	7.3	<5.0	<5.0	6.5	1.49	95.6	<0.10	3.5	<1.0	17	330	6.05

TABLE 9
BIOREMEDIATION GROUNDWATER ANALYTICAL SUMMARY
FORMER VAPOR DEGREASER SOURCE AREA
BOEING PORTLAND

		Elapsed Time from Injections (a) (days)	Elapsed Time from Injection (b) (days)	Elapsed Time from Injection (c) (days)	Elapsed Time from Injection (d) (days)	Volatile Organic Compounds						Fermentation Product		Aquifer Redox Conditions						Donor Indicators	
Well	Date	Pilot Injection	PRB 1st Injection	PRB 2nd Injection	Multi-Purpose Source Zone Wells 1st Injection	PCE (µg/L)	TCE (µg/L)	CIS (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	2-Butanone (µg/L)	Acetone (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (b) (mg/L)	TOC (mg/L)	pH
BOP-75i (50)	2/2/2011	90				<1.0	48	10	<1.0			<5.0	15								
BOP-75i (50)	5/5/2011	182				<1.0	11	4.7	<1.0			<5.0	<10								
BOP-75i (50)	8/10/2011	279				<1.0	14	4.9	<1.0			<5.0	<10								
BOP-75i (50)	11/3/2011	364	-55			<1.0	21	6.0	<1.0			<5.0	<10								
BOP-75i (50)	2/8/2012	461	42			<1.0	24	7.1	<1.0			<5.0	<10								
BOP-75i (50)	5/4/2012	547	128	-104	-431	<1.0	17	6.9	<1.0			<5.0	<10								
BOP-75i (56.5)	2/2/2011	90				2.0	53	9.5	<1.0			<5.0	<10								
BOP-75i (56.5)	5/5/2011	182				1.2	40	8.0	<1.0			<5.0	<10								
BOP-75i (56.5)	8/10/2011	279				2.1	41	7.8	<1.0			<5.0	<10								
BOP-75i (56.5)	11/3/2011	364	-55			2.2	39	7.4	<1.0			<5.0	<10								
BOP-75i (56.5)	2/8/2012	461	42			1.4	40	8.2	<1.0			<5.0	<10								
BOP-75i (56.5)	5/4/2012	547	128	-104	-431	1.3	43	9.0	<1.0			<5.0	<10								
BOP-75i (62.5)	2/2/2011	90				2.4	78	10	<1.0			<5.0	<10								
BOP-75i (62.5)	5/5/2011	182				<1.0	48	13	<1.0			<5.0	<10								
BOP-75i (62.5)	8/10/2011	279				1.9	39	7.6	<1.0			<5.0	<10								
BOP-75i (62.5)	11/3/2011	364	-55			1.8	38	6.7	<1.0			<5.0	<10								
BOP-75i (62.5)	2/8/2012	461	42			1.4	41	7.9	<1.0			<5.0	<10								
BOP-75i (62.5)	5/4/2012	547	128	-104	-431	1.0	43	9.1	<1.0			<5.0	<10								
BOP-75i (68.7)	2/2/2011	90				2.5	87	11	<1.0			<5.0	<10								
BOP-75i (68.7)	5/5/2011	182				1.1	52	11	<1.0			<5.0	<10					13.5		4.77	
BOP-75i (68.7)	8/10/2011	279				1.6	59	11	<1.0			<5.0	<10	1.76	-16.3	1.1	2.4		<0.0007		6.24
BOP-75i (68.7)	11/3/2011	364	-55			1.2	58	10	<1.0			<5.0	<10								
BOP-75i (68.7)	2/8/2012	461	42			1.3	55	9.7	<1.0			<5.0	<10								
BOP-75i (68.7)	5/4/2012	547	128			<1.0	52	10	<1.0			<5.0	<10								
BOP-75i (68.7)	8/9/2012	644	225	-7		1.6	39	7.2	<1.0			<5.0	<10								
BOP-75i (68.7)	11/8/2012	735	316	84		1.0	35	6.9	<0.2			<5.0	<5.0								
BOP-75i (68.7)	2/5/2013	824	405	173		1.0	54	9.5	<0.2			<5.0	15								
BOP-75i (68.7)	5/2/2013	910	491	259		0.8	42	7.5	<0.2			<5.0	9.8								
BOP-75i (68.7)	6/17/2013	956	537	305	-22	0.7	35	9.8	<0.2	<5.0	<5.0	<5.0	14	1.91	73.6	1.7	0.0	13.6	<0.005	2.3	6.25
BOP-75i (68.7)	8/6/2013	1006	587	355	28	0.2	1.3	37	0.2	<5.0	<5.0	<5.0	19	2.32	-160	<0.10	3.0	<1.0	0.39	51.3	6.43
BOP-75i (68.7)	11/7/2013	1099	680	448	121	<0.2	2.2	2.4	25	<5.0	<5.0	<5.0	9.7	0.77	-167.0	<0.10	3.5	4.5	12	5.5	6.55
BOP-75i (73.5)	2/2/2011	90				<1.0	53	9.0	<1.0			<5.0	<10								
BOP-75i (73.5)	5/5/2011	182				<1.0	46	12	<1.0			<5.0	<10								
BOP-75i (73.5)	8/10/2011	279				1.2	54	16	<1.0	<1.1	<1.2	<5.0	<10						<0.0007		
BOP-75i (73.5)	11/3/2011	364	-55			<1.0	51	14	<1.0			<5.0	<10								
BOP-75i (73.5)	2/8/2012	461	42			<1.0	48	12	<1.0			<5.0	<10								
BOP-75i (73.5)	5/4/2012	547	128	-104	-431	<1.0	43	13	<1.0			<5.0	<10								
BOP-76i (50)	2/2/2011	90				1.5	6.9	<1.0	<1.0			<5.0	<10								
BOP-76i (50)	5/5/2011	182				<1.0	5.2	1.0	<1.0			<5.0	<10								
BOP-76i (50)	8/10/2011	279				1.5	12	4.5	<1.0			<5.0	<10								
BOP-76i (50)	11/3/2011	364	-55			1.4	40	2.4	<1.0			<5.0	<10								
BOP-76i (50)	2/8/2012	461	42			<1.0	2.1	<1.0	<1.0			<5.0	<10								
BOP-76i (50)	5/4/2012	547	128	-104	-431	<1.0	1.9	<1.0	<1.0			<5.0	<10								
BOP-76i (56.5)	2/2/2011	90				2.5	7.7	<1.0	<1.0			<5.0	<10								
BOP-76i (56.5)	5/5/2011	182				1.2	7.0	1.1	<1.0			<5.0	<10								
BOP-76i (56.5)	8/10/2011	279				1.6	12	4.9	<1.0			<5.0	<10								
BOP-76i (56.5)	11/3/2011	364	-55			2.2	28	1.6	<1.0			<5.0	<10								
BOP-76i (56.5)	2/8/2012	461	42			<1.0	1.8	<1.0	<1.0			<5.0	<10								
BOP-76i (56.5)	5/4/2012	547	128	-104	-431	<1.0	6.6	1.8	<1.0			<5.0	<10								

TABLE 9
BIOREMEDIATION GROUNDWATER ANALYTICAL SUMMARY
FORMER VAPOR DEGREASER SOURCE AREA
BOEING PORTLAND

		Elapsed Time from Injections (a) (days)	Elapsed Time from Injection (b) (days)	Elapsed Time from Injection (c) (days)	Elapsed Time from Injection (d) (days)	Volatile Organic Compounds						Fermentation Product		Aquifer Redox Conditions						Donor Indicators	
Well	Date	Pilot Injection	PRB 1st Injection	PRB 2nd Injection	Multi-Purpose Source Zone Wells 1st Injection	PCE (µg/L)	TCE (µg/L)	CIS (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	2-Butanone (µg/L)	Acetone (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (b) (mg/L)	TOC (mg/L)	pH
BOP-76i (62.5)	2/2/2011	90				1.6	8.3	<1.0	<1.0			<5.0	<10								
BOP-76i (62.5)	5/5/2011	182				<1.0	7.0	1.1	<1.0			<5.0	<10								
BOP-76i (62.5)	8/10/2011	279				1.6	12	4.6	<1.0			<5.0	<10								
BOP-76i (62.5)	11/3/2011	364	-55			1.2	26	1.6	<1.0			<5.0	<10								
BOP-76i (62.5)	2/8/2012	461	42			<1.0	1.9	<1.0	<1.0			<5.0	<10								
BOP-76i (62.5)	5/4/2012	547	128	-104	-431	<1.0	8.7	1.6	<1.0			<5.0	<10								
BOP-76i (68.7)	2/2/2011	90				1.7	8.5	<1.0	<1.0			<5.0	<10								
BOP-76i (68.7)	5/5/2011	182				<1.0	6.8	1.2	<1.0			<5.0	<10								
BOP-76i (68.7)	8/10/2011	279				1.2	13	4.6	<1.0	<1.1	<1.2	<5.0	<10	3.59	110	3.8	1.1	10.2	<0.0007	2.37	6.20
BOP-76i (68.7)	11/3/2011	364	-55			1.4	27	1.6	<1.0			<5.0	<10								
BOP-76i (68.7)	2/8/2012	461	42			<1.0	2.1	<1.0	<1.0			<5.0	<10								
BOP-76i (68.7)	5/4/2012	547	128			<1.0	9.2	1.5	<1.0			<5.0	<10								
BOP-76i (68.7)	8/9/2012	644	225	-7		1.1	33	2.2	<1.0			<5.0	<10								
BOP-76i (68.7)	11/8/2012	735	316	84		0.8	9.8	1.7	<0.2			<5.0	<5.0								
BOP-76i (68.7)	2/5/2013	824	405	173		0.8	11	1.5	<0.2			<5.0	17								
BOP-76i (68.7)	5/2/2013	910	491	259		1.4	22	1.7	<0.2			<5.0	14								
BOP-76i (68.7)	6/17/2013	956	537	305	-22	1.1	26	1.9	<0.2	<5.0	<5.0	<5.0	15	1.34	75.5	3.7	0.0	11.0	<0.005	1.6	6.18
BOP-76i (68.7)	8/6/2013	1006	587	355	28	<0.2	1.0	100	8.3	<5.0	<5.0	<5.0	23	2.24	-130.0	<0.10	3.5	<1.0	3.4	111	6.14
BOP-76i (68.7)	11/7/2013	1099	680	448	121	2.4	140	37	42	<5.0	<5.0	<5.0	13	1.51	-204.2	<0.10	3.5	3.5	11.0	6.9	6.44
BOP-76i (73.5)	2/2/2011	90				1.4	8.1	<1.0	<1.0			<5.0	<10								
BOP-76i (73.5)	5/5/2011	182				<1.0	6.6	1.2	<1.0			<5.0	<10								
BOP-76i (73.5)	8/10/2011	279				<1.0	9.3	42	<1.0			<5.0	<10								
BOP-76i (73.5)	11/3/2011	364	-55			1.1	25	1.6	<1.0			<5.0	<10								
BOP-76i (73.5)	2/8/2012	461	42			<1.0	2.6	<1.0	<1.0			<5.0	<10								
BOP-76i (73.5)	5/4/2012	547	128	-104	-431	<1.0	9.0	1.5	<1.0			<5.0	<10								
BOP-77i (60)	2/2/2011	90				2.6	53	2.5	<1.0			<5.0	11								
BOP-77i (60)	5/5/2011	182				1.5	34	3.7	<1.0			<5.0	<10								
BOP-77i (60)	8/10/2011	279				2.8	51	1.8	<1.0			<5.0	<10								
BOP-77i (60)	11/3/2011	364	-55	-287	-614	<1.0	10	5.5	<1.0			<5.0	<10								
BOP-77i (66.5)	2/2/2011	90				3.2	51	2.4	<1.0			<5.0	<10								
BOP-77i (66.5)	5/5/2011	182				2.2	38	3.6	<1.0			<5.0	<10								
BOP-77i (66.5)	8/10/2011	279				2.1	20	1.5	<1.0			<5.0	<10								
BOP-77i (66.5)	11/3/2011	364	-55	-287	-614	1.1	9.3	6.2	<1.0			<5.0	<10			<0.10		4.1	15.0	1130	
BOP-77i (72.5)	2/2/2011	90				2.9	50	2.4	<1.0			<5.0	<10								
BOP-77i (72.5)	5/5/2011	182				1.6	38	3.6	<1.0			<5.0	11								
BOP-77i (72.5)	8/10/2011	279				1.9	17	1.6	<1.0			<5.0	<10								
BOP-77i (72.5)	11/3/2011	364	-55	-287	-614	<1.0	9.3	5.9	<1.0			<5.0	<10								
BOP-77i (78.7)	2/2/2011	90				1.7	88	2.7	<1.0			<5.0	<10								
BOP-77i (78.7)	5/5/2011	182				<1.0	41	3.8	<1.0			<5.0	<10								
BOP-77i (78.7)	8/10/2011	279				1.8	17	1.6	<1.0			<5.0	<10								
BOP-77i (78.7)	11/3/2011	364				<1.0	11	6.7	<1.0			<5.0	<10								
BOP-77i (78.7)	12/1/2011	392	-27			1.1	32	7.1	<1.0	<1.1	<1.2	<5.0	<10	0.0	-275	0.2	0.8	8.4	<0.0007	2.41	6.77
BOP-77i (78.7)	12/28/2011	419	0																	12100	
BOP-77i (78.7)	12/28/2011	419	0																	13800	
BOP-77i (78.7)	1/19/2012	441	22			<20	21	<20	<20			170	<200	1.09	-154	<1.0	2.1	4.0		3800	5.40
BOP-77i (78.7)	2/16/2012	469	50			<1.0	8.4	48	1.8	<1.1	<1.2	49	42	0.58	-154	<0.5	5.0	<0.5	6.6	884	5.69
BOP-77i (78.7)	3/15/2012	497	78			<1.0	2.2	120	4.6	<1.1	<1.2	20	64	0.72	-262	<0.5	4.4	<0.5	10	148	6.96
BOP-77i (78.7)	4/17/2012	530	111			<3.0	<3.0	21	62	<1.1	<1.2	35	40	0.40	-275	<0.1	5.6	0.6	12.2	208	7.12
BOP-77i (78.7)	6/12/2012	586	167			<1.0	1.4	1.2	60	<1.1	<1.2	54	35	0.67	-50.4	<0.1	4.3	<0.1	0.314	314	6.36
BOP-77i (78.7)	8/9/2012	644	225			<1.0	<1.0	<1.0	59			6.1	<10								
BOP-77i (78.7)	8/16/2012	651	232																	23,800	
BOP-77i (78.7)	9/18/2012	684	265	33		<4.0	<4.0	28	4.1	<5.0	<5.0	880	<100	0.78	25.8	<0.50	3.8	6.3	9.2	4670	4.66
BOP-77i (78.7)	11/14/2012	741	322	90		<0.2	17	150	15	<5.0	<6.0	<5.0	9.7	1.49	160.5	<1.0	3.5	<10.0	22	2270	5.66

TABLE 9
BIOREMEDIATION GROUNDWATER ANALYTICAL SUMMARY
FORMER VAPOR DEGREASER SOURCE AREA
BOEING PORTLAND

		Elapsed Time from Injections (a) (days)	Elapsed Time from Injection (b) (days)	Elapsed Time from Injection (c) (days)	Elapsed Time from Injection (d) (days)	Volatile Organic Compounds						Fermentation Product		Aquifer Redox Conditions						Donor Indicators	
Well	Date	Pilot Injection	PRB 1st Injection	PRB 2nd Injection	Multi-Purpose Source Zone Wells 1st Injection	PCE (µg/L)	TCE (µg/L)	CIS (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	2-Butanone (µg/L)	Acetone (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (b) (mg/L)	TOC (mg/L)	pH
BOP-77i (78.7)	2/6/2013	825	406	174		<0.4	11	31	3.2	5.5	<5.0	83	190	0.35	6.4	<0.10	2.5	4.1	15	1136	5.76
BOP-77i (78.7)	5/7/2013	915	496	264	-63	<0.2	18	17	11	13	<5.0	7.5	9.7	1.52	-74.9	<0.10	2.5	<1.0	23	112	6.15
BOP-77i (78.7)	8/6/2013	1006	587	355	28	<0.2	0.7	14	13	8.6	<5.0	7.2	29	1.14	-44.3	<0.10	3.5	<1.0	17	888	5.38
BOP-77i (78.7)	11/7/2013	1099	680	448	121	<0.2	<0.2	9.5	19	22	<5.0	<5.0	7.0	0.91	-107	<0.10	3.5	<1.0	20	111	6.21
BOP-77i (83.5)	2/2/2011	90				2.3	690	51	<1.0			<5.0	<10								
BOP-77i (83.5)	5/5/2011	182				<1.0	19	58	<1.0			<5.0	<10								
BOP-77i (83.5)	8/10/2011	279				1.6	17	1.6	<1.0	<1.1	<1.2	<5.0	<10	0.76	0.7	<0.1	1.4	6.5	5.5	2.35	6.35
BOP-77i (83.5)	11/3/2011	364	-55	-287	-614	<1.0	6.4	42	<1.0			<5.0	<10								
BOP-78i (51.5)	11/21/2011	382	-37			1.6	39	5.6	<1.0			<5.0	<10								
BOP-78i (51.5)	8/9/2012	644	225	-7		3.4	160	3.2	<1.0			<5.0	<10								
BOP-78i (51.5)	11/8/2012	735	316	84	-243	<0.2	0.7	6.1	49			<5.0	11								
BOP-78i (57.5)	11/21/2011	382	-37			1.9	35	5.6	<1.0			<5.0	<10								
BOP-78i (57.5)	8/9/2012	644	225	-7		1.2	31	8.1	<1.0			<5.0	<10								
BOP-78i (57.5)	11/8/2012	735	316	84	-243	<0.2	0.4	7.1	50			<5.0	6.6								
BOP-78i (63.5)	11/21/2011	382	-37			1.6	36	5.8	<1.0			<5.0	<10								
BOP-78i (63.5)	8/9/2012	644	225	-7		1.3	31	9.4	<1.0			<5.0	<10								
BOP-78i (63.5)	11/8/2012	735	316	84	-243	<0.2	0.3	7.0	52			<5.0	9.9								
BOP-78i (69.5)	11/21/2011	382	-37			1.7	37	6.1	<1.0			<5.0	<10								
BOP-78i (69.5)	8/9/2012	644	225	-7		1.1	30	9.3	<1.0			<5.0	<10								
BOP-78i (69.5)	11/8/2012	735	316	84		<0.2	0.3	7.2	51			<5.0	5.8								
BOP-78i (69.5)	2/6/2013	825	406	174		<0.2	0.3	11	78			<5.0	17								
BOP-78i (69.5)	5/2/2013	910	491	259	-68	<0.2	0.3	0.6	19			<5.0	10								
BOP-78i (69.5)	8/7/2013	1007	588	356	29	0.2	5.5	120	98			6.6	19								
BOP-78i (69.5)	11/8/2013	1100	681	449	122	<0.2	<0.2	1.1	17			<5.0	5.0								
BOP-78i (75.5)	11/21/2011	382	-37			1.7	39	6.7	<1.0			<5.0	<10								
BOP-78i (75.5)	8/9/2012	644	225	-7		1.2	30	9.5	1.2			<5.0	<10								
BOP-78i (75.5)	11/8/2012	735	316	84	-243	<0.2	0.3	7.0	52			<5.0	6.0								
BOP-79i (51.5)	11/21/2011	382	-37			1.2	42	5.5	<1.0			<5.0	<10								
BOP-79i (51.5)	8/9/2012	644	225	-7		2.0	74	10	3.2			<5.0	<10								
BOP-79i (51.5)	11/8/2012	735	316	84	-243	<0.2	0.5	3.8	64			<5.0	6.3								
BOP-79i (57.5)	11/21/2011	382	-37			1.6	42	4.7	<1.0			<5.0	<10								
BOP-79i (57.5)	8/9/2012	644	225	-7		2.1	90	12	2.5			<5.0	<10								
BOP-79i (57.5)	11/8/2012	735	316	84	-243	<0.2	0.5	3.7	58			<5.0	10								
BOP-79i (63.5)	11/21/2011	382	-37			1.8	43	5.6	<1.0			<5.0	<10								
BOP-79i (63.5)	8/9/2012	644	225	-7		3.0	99	12	<1.0			<5.0	<10								
BOP-79i (63.5)	11/8/2012	735	316	84	-243	<0.2	0.3	4.1	70			<5.0	6.9								
BOP-79i (69.5)	11/21/2011	382	-37			1.8	42	5.0	<1.0			<5.0	<10								
BOP-79i (69.5)	8/9/2012	644	225	-7		2.2	95	12	<1.0			<5.0	<10								
BOP-79i (69.5)	11/8/2012	735	316	84		<0.2	0.2	3.7	68			<5.0	6.1								
BOP-79i (69.5)	2/6/2013	825	406	174		<0.2	0.2	0.6	5.7			<5.0	13								
BOP-79i (69.5)	5/2/2013	910	491	259	-68	<0.2	0.4	24	41			<5.0	13								
BOP-79i (69.5)	8/7/2013	1007	588	356	29	<0.2	1.0	37	20			<5.0	27								
BOP-79i (69.5)	11/8/2013	1100	681	449	122	<0.2	1.9	13	16			<5.0	5.5								

TABLE 9
BIOREMEDIATION GROUNDWATER ANALYTICAL SUMMARY
FORMER VAPOR DEGREASER SOURCE AREA
BOEING PORTLAND

		Elapsed Time from Injections (a) (days)	Elapsed Time from Injection (b) (days)	Elapsed Time from Injection (c) (days)	Elapsed Time from Injection (d) (days)	Volatile Organic Compounds						Fermentation Product		Aquifer Redox Conditions						Donor Indicators	
Well	Date	Pilot Injection	PRB 1st Injection	PRB 2nd Injection	Multi-Purpose Source Zone Wells 1st Injection	PCE (µg/L)	TCE (µg/L)	CIS (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	2-Butanone (µg/L)	Acetone (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (b) (mg/L)	TOC (mg/L)	pH
BOP-79i (75.5)	11/21/2011	382	-37			1.6	41	5.2	<1.0			<5.0	<10								
BOP-79i (75.5)	8/9/2012	644	225	-7		1.9	89	12	1.3			<5.0	<10								
BOP-79i (75.5)	11/8/2012	735	316	84	-243	<0.2	<0.2	2.6	68			<5.0	6.0								
BOP-80i (63.5)	11/21/2011	382	-37	-269	-596	<1.0	6.0	9.8	5.1			<5.0	<10								
BOP-80i (73.25)	11/21/2011	382	-37	-269	-596	<1.0	3.7	8.1	7.6			<5.0	54								
BOP-80i (83)	11/21/2011	382	-37	-269	-596	<1.0	3.1	7.4	7.2			<5.0	43								
BOP-80i (92.75)	11/21/2011	382	-37	-269	-596	<1.0	2.4	7.0	7.1			<5.0	38								
BOP-80i (102.5)	11/21/2011	382				<1.0	2.4	7.0	7.0			<5.0	<10								
BOP-80i (102.5)	12/1/2011	392	-27			<1.0	15	6.1	5.3	2.9	<1.2	<5.0	<10	0.0	-273	<0.1	2.4	3.8	3.97	2.43	6.74
BOP-80i (102.5)	12/28/2011	419	0																	192	
BOP-80i (102.5)	1/9/2012	431	12			<1.0	<1.0	<1.0	1.4			<5.0	<10	0.15	-255	0.2	1.7	0.4		4.93	6.80
BOP-80i (102.5)	2/16/2012	469	50			<1.0	<1.0	<1.0	<1.0	<1.1	2.2	<5.0	<10	0.29	-237	0.1	2.7	2.4	7.44	3.28	7.14
BOP-80i (102.5)	3/15/2012	497	78			<1.0	<1.0	<1.0	1.7	1.6	2.4	<5.0	<10	0.43	-241	<0.1	4.0	0.5	7.98	4.72	6.99
BOP-80i (102.5)	4/17/2012	530	111			<1.0	<1.0	<1.0	<1.0	<1.1	<1.2	<5.0	<10	0.28	-263.4	<0.1	3.6	1.0	12.8	2.89	7.04
BOP-80i (102.5)	6/12/2012	586	167	-65		<1.0	<1.0	<1.0	1.7	2.9	4.4	<5.0	<10	0.24	12.8	<0.1	2.3	0.1	10.4	2.50	6.01
BOP-80i (102.5)	8/16/2012	651	232	0																1.50	
BOP-80i (102.5)	9/18/2012	684	265	33		2.0	160	35	14	<5.0	7.1	<10	<10	0.28	-160.1	<0.10	2.9	1.9	14	13.9	6.35
BOP-80i (102.5)	11/14/2012	741	322	90		3.0	610	240	33	<5.0	6.1	<25	<25	1.47	76.0	<0.10	2.5	3.1	7.5	1.5	6.48
BOP-80i (102.5)	2/6/2013	825	406	174		<0.2	1.4	<0.2	0.4	<5.0	5.2	<5.0	<5.0	0.40	-7.0	0.15	3.0	<1.0	23	1.2	6.44
BOP-80i (102.5)	5/9/2013	917	498	266	-61	<0.2	0.8	<0.2	0.7	<5.0	12	<5.0	<5.0	0.57	-13.5	0.11	2.5	<1.0	20	1.3	6.31
BOP-80i (102.5)	8/19/2013	1019	600	368	41	<0.2	<0.2	<0.2	0.4	<5.0	9.7	<5.0	20	1.16	-54.0	0.36	2.5	2.3	17	1.5	5.53
BOP-80i (102.5)	11/11/2013	1103	684	452	125	<0.2	<0.2	<0.2	0.2	<5.0	14	<5.0	5.7	0.57	-64.8	<0.10	4.5	<1.0	22	1.4	5.99
BOP-81i (59.5)	11/21/2011	382	-37	-269	-596	<1.0	2.5	<1.0	<1.0			<5.0	<10								
BOP-81i (69.25)	11/21/2011	382	-37	-269	-596	<1.0	<1.0	1.2	4.9			<5.0	60								
BOP-81i (79)	11/21/2011	382	-37	-269	-596	<1.0	<1.0	1.4	5.2			<5.0	<10								
BOP-81i (88.75)	11/21/2011	382	-37	-269	-596	<1.0	<1.0	1.1	3.2			<5.0	50								
BOP-81i (98.5)	11/21/2011	382				<1.0	<1.0	1.6	6.2			<5.0	<10								
BOP-81i (98.5)	12/1/2011	392	-27			<1.0	<1.0	1.0	4.1	2.0	2.2	<5.0	<10	0.0	-280	<0.1	1.1	0.5	8.3	2.38	6.76
BOP-81i (98.5)	12/28/2011	419	0																	4.71	
BOP-81i (98.5)	1/9/2012	431	12			<1.0	<1.0	<1.0	1.9			<5.0	<10	0.33	-238	0.2	1.5	0.5		2.65	6.69
BOP-81i (98.5)	2/16/2012	469	50			<1.0	<1.0	<1.0	<1.0	<1.1	<1.2	<5.0	<10	0.23	-243	<0.1	1.9	0.5	16.4	3.26	7.21
BOP-81i (98.5)	3/15/2012	497	78			<1.0	<1.0	<1.0	<1.0	<1.1	<1.2	<5.0	<10	0.31	-246	0.1	2.7	0.3	24.7	3.00	6.96
BOP-81i (98.5)	4/17/2012	530	111			<1.0	<1.0	<1.0	<1.0	<1.1	<1.2	<5.0	<10	0.28	-271	<0.1	2.6	0.2	23.4	2.51	6.77
BOP-81i (98.5)	6/12/2012	586	167	-65		<1.0	<1.0	<1.0	<1.0	<1.1	1.8	<5.0	<10	0.36	-1.8	<0.1	4.3	<0.1	20.9	2.34	6.10
BOP-81i (98.5)	8/16/2012	651	232	0																3.2	
BOP-81i (98.5)	9/18/2012	684	265	33		<0.2	<0.2	<0.2	0.6	<5.0	8.4	<5.0	<5.0	0.21	-125	<0.10	1.7	<1.0	18.0	3.0	6.49
BOP-81i (98.5)	11/14/2012	741	322	90		<0.2	<0.2	<0.2	0.5	<5.0	8.6	<5.0	<5.0	0.60	42.7	0.11	2.0	1.4	15.0	<1.0	6.49
BOP-81i (98.5)	2/6/2013	825	406	174		<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	<5.0	<5.0	0.56	-93.4	0.12	2.0	2.0	30.0	<1.0	6.55
BOP-81i (98.5)	5/9/2013	917	498	266	-61	<0.2	0.3	<0.2	0.5	<5.0	<5.0	<5.0	<5.0	2.65	-18.1	0.39	1.5	7.4	7.1	<1.0	6.49
BOP-81i (98.5)	8/19/2013	1019	600	368	41	<0.2	<0.2	<0.2	0.9	<5.0	<5.0	<5.0	19	3.96	-24.4	1.2	0.0	16.4	3.4	<1.0	6.74
BOP-81i (98.5)	11/11/2013	1103	684	452	125	<0.2	<0.2	<0.2	0.4	<5.0	8.9	<5.0	6.6	0.42	-75.1	0.26	4.5	3.8	20.0	1.2	6.04
BOP-82i (55.5)	11/21/2011	382	-37	-269	-596	<1.0	16	<1.0	<1.0			<5.0	36								

TABLE 9
BIOREMEDIATION GROUNDWATER ANALYTICAL SUMMARY
FORMER VAPOR DEGREASER SOURCE AREA
BOEING PORTLAND

		Elapsed Time from Injections (a) (days)	Elapsed Time from Injection (b) (days)	Elapsed Time from Injection (c) (days)	Elapsed Time from Injection (d) (days)	Volatile Organic Compounds						Fermentation Product		Aquifer Redox Conditions						Donor Indicators	
Well	Date	Pilot Injection	PRB 1st Injection	PRB 2nd Injection	Multi-Purpose Source Zone Wells 1st Injection	PCE (µg/L)	TCE (µg/L)	CIS (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	2-Butanone (µg/L)	Acetone (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (b) (mg/L)	TOC (mg/L)	pH
BOP-82i (64)	11/21/2011	382	-37	-269	-596	3.9	70	1.3	<1.0			<5.0	30								
BOP-82i (72.5)	11/21/2011	382				4.6	91	1.6	<1.0			<5.0	<10								
BOP-82i (72.5)	12/1/2011	392	-27			4.0	66	1.4	<1.0	<1.1	<1.2	<5.0	<10	0.0	-153	3.3	1.1	9.4	<0.0007	<1.50	6.36
BOP-82i (72.5)	12/28/2011	419	0																	3.12	
BOP-82i (72.5)	1/9/2012	431	12			2.6	47	1.0	<1.0			<5.0	<10	0.31	-239	<0.2	2.1	7.3		9.81	6.74
BOP-82i (72.5)	2/16/2012	469	50			1.9	38	6.8	<1.0	<1.1	<1.2	<5.0	<10	1.61	-197	1.7	0.1	10.3	0.0144	4.85	6.94
BOP-82i (72.5)	3/15/2012	497	78			2.0	36	11	<1.0	<1.1	<1.2	<5.0	<10	0.82	-184	1.3	1.5	10.0	<0.0007	3.25	6.97
BOP-82i (72.5)	4/17/2012	530	111			1.6	29	4.5	<1.0	<1.1	<1.2	<5.0	<10	1.29	-219	1.8	0.6	10.6	<0.0007	2.46	6.78
BOP-82i (72.5)	6/12/2012	586	167	-65		1.3	24	2.5	<1.0	<1.1	<1.2	<5.0	<10	2.76	145.6	1.8	0.1	9.9	<0.0007	2.56	5.54
BOP-82i (72.5)	8/16/2012	651	232	0																1.6	
BOP-82i (72.5)	9/18/2012	684	265	33		1.0	19	1.6	0.5	<5.0	<5.0	<5.0	<5.0	2.75	-0.5	1.8	1.0	9.9	<0.015	1.4	6.45
BOP-82i (72.5)	11/14/2012	741	322	90		1.6	24	1.6	0.3	<5.0	<5.0	<5.0	<5.0	3.03	72.7	1.8	0.0	10.3	0.036	<1.0	6.61
BOP-82i (72.5)	2/6/2013	825	406	174		1.5	15	1.8	0.4	<5.0	<5.0	<5.0	<5.0	3.53	93.9	1.3	0.0	10.7	0.036	<1.0	6.50
BOP-82i (72.5)	5/6/2013	914	495	263	-64	1.1	17	0.9	0.3	<5.0	<5.0	<5.0	<5.0	4.24	202.8	1.0	0.0	11.6	0.48	<1.0	6.26
BOP-82i (72.5)	8/19/2013	1019	600	368	41	1.4	19	0.5	<0.2	<5.0	<5.0	<5.0	21		14.2	1.1	0.0	11.5	0.11	<1.0	6.24
BOP-82i (72.5)	11/7/2013	1099	680	448	121	1.1	17	0.5	<0.2			<5.0	6.0								
BOP-82i (81)	11/21/2011	382	-37	-269	-596	4.5	76	1.5	<1.0			<5.0	<10								
BOP-82i (89.5)	11/21/2011	382	-37	-269	-596	3.9	80	1.5	<1.0			<5.0	54								
BOP-83i (55.5)	11/21/2011	382	-37	-269	-596	<1.0	2.1	<1.0	<1.0			<5.0	<10								
BOP-83i (61.5)	11/21/2011	382	-37	-269	-596	<1.0	2.0	<1.0	<1.0			6.5	69								
BOP-83i (67.5)	11/21/2011	382	-37	-269	-596	<1.0	2.1	<1.0	<1.0			<5.0	<10								
BOP-83i (73.5)	11/21/2011	382	-37	-269	-596	<1.0	2.2	<1.0	<1.0			<5.0	<10								
BOP-83i (79.5)	11/21/2011	382				<1.0	31	<1.0	<1.0			<5.0	<10								
BOP-83i (79.5)	12/1/2011	392	-27			<1.0	16	<1.0	<1.0	<1.1	<1.2	<5.0	<10	0.0	-150	8.0	1.0	20.0	<0.0007	<1.50	6.73
BOP-83i (79.5)	12/28/2011	419	0																	2.87	
BOP-83i (79.5)	1/9/2012	431	12			1.8	36	<1.0	<1.0			<5.0	<10	6.18	-201	7.2	0.1	19.7		<1.5	6.70
BOP-83i (79.5)	2/16/2012	469	50			2.6	58	2.5	<1.0	<1.1	<1.2	<5.0	<10	5.38	-181	6.6	0.1	24.5	<0.0007	2.73	7.10
BOP-83i (79.5)	3/15/2012	497	78			1.1	19	<1.0	<1.0	<1.1	<1.2	<5.0	<10	6.44	-165	7.5	0.1	16.7	<0.0007	1.90	6.87
BOP-83i (79.5)	4/17/2012	530	111			<1.0	7.3	<1.0	<1.0	<1.1	<1.2	<5.0	<10	3.56	-206	5.2	0.1	13.8	<0.0007	<1.50	6.34
BOP-83i (79.5)	6/12/2012	586	167	-65		<1.0	3.1	<1.0	<1.0	<1.1	<1.2	<5.0	<10	8.16	147.4	6.8	0.1	14.2	<0.015	<1.50	5.98
BOP-83i (79.5)	8/16/2012	651	232	0																<1.0	
BOP-83i (79.5)	9/18/2012	684	265	33		0.5	9.7	0.3	<0.2	<5.0	<5.0	<5.0	<5.0	5.14	65.7	6.6	0.0	13.6	<0.015	1.2	6.07
BOP-83i (79.5)	11/14/2012	741	322	90		<0.2	5.3	<0.2	<0.2	<5.0	<5.0	<5.0	<5.0	6.95	110.3	6.3	0.0	12.2	0.0064	<1.0	6.69
BOP-83i (79.5)	2/6/2013	825	406	174		1.2	21	0.9	<0.2	<5.0	<5.0	<5.0	<5.0	7.73	152.7	5.9	0.0	11.5	<0.005	<1.0	6.63
BOP-83i (79.5)	5/6/2013	914	495	263	-64	0.8	14	0.6	<0.2	<5.0	<5.0	<5.0	<5.0	9.40	206.6	6.0	0.0	11.8	<0.005	<1.0	6.32
BOP-83i (79.5)	8/22/2013	1022	603	371	44	<0.2	3.4	<0.2	<0.2	<5.0	<5.0	<5.0	21	7.13	171.6	5.7	0.0	11.5	<0.005	<1.0	6.35
BOP-83i (79.5)	11/7/2013	1099	680	448	121	<0.2	2.4	<0.2	<0.2			<5.0	6.2								
BOP-84i(57)	2/8/2012	461	42			<1.0	15	54	1.4			<5.0	<10								
BOP-84i(57)	5/4/2012	547	128			<1.0	<1.0	<1.0	120			<5.0	<10								
BOP-84i(57)	8/9/2012	644	225	-7		<1.0	3.8	3.6	5.6			<5.0	<10								
BOP-84i(57)	11/8/2012	735	316	84	-243	<0.2	0.4	9.5	34			<5.0	11								

TABLE 9
BIOREMEDIATION GROUNDWATER ANALYTICAL SUMMARY
FORMER VAPOR DEGREASER SOURCE AREA
BOEING PORTLAND

		Elapsed Time from Injections (a) (days)	Elapsed Time from Injection (b) (days)	Elapsed Time from Injection (c) (days)	Elapsed Time from Injection (d) (days)	Volatile Organic Compounds						Fermentation Product		Aquifer Redox Conditions						Donor Indicators	
Well	Date	Pilot Injection	PRB 1st Injection	PRB 2nd Injection	Multi-Purpose Source Zone Wells 1st Injection	PCE (µg/L)	TCE (µg/L)	CIS (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	2-Butanone (µg/L)	Acetone (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (b) (mg/L)	TOC (mg/L)	pH
BOP-84i(63.5)	2/8/2012	461	42			<1.0	11	58	1.5			<5.0	<10								
BOP-84i(63.5)	5/4/2012	547	128			<1.0	<1.0	<1.0	140			<5.0	<10								
BOP-84i(63.5)	8/9/2012	644	225	-7		<1.0	1.7	2.4	5.9			<5.0	<10								
BOP-84i(63.5)	11/8/2012	735	316	84	-243	<0.2	0.4	9.6	35			<5.0	9.5								
BOP-84i(69.5)	2/8/2012	461	42			<1.0	9.1	56	1.5			<5.0	<10								
BOP-84i(69.5)	5/4/2012	547	128			<1.0	<1.0	<1.0	160			<5.0	<10								
BOP-84i(69.5)	8/9/2012	644	225	-7		<1.0	<1.0	1.9	7.4			<5.0	<10								
BOP-84i(69.5)	11/8/2012	735	316	84	-243	<0.2	0.4	10	34			<5.0	10								
BOP-84i(75)	2/8/2012	461	42			<1.0	7.1	55	1.4			<5.0	<10								
BOP-84i(75)	5/4/2012	547	128			<1.0	<1.0	1.8	150			<5.0	<10								
BOP-84i(75)	6/12/2012	586	167			<1.0	<1.0	1.2	14	13.6	<1.2	<5.0	<10	0.65	-37.3	<0.1	3.7	<0.1	9.82	16.7	6.33
BOP-84i(75)	8/9/2012	644	225	-7		<1.0	<1.0	1.3	8.4			<5.0	<10								
BOP-84i(75)	8/16/2012	651	232	0																	
BOP-84i(75)	9/19/2012	685	266	34		<0.4	4.1	69	2.9	<5.0	<5.0	<10	<10	0.28	17.7	<0.10	3.5	<1.0	14	2620	4.57
BOP-84i(75)	11/8/2012	735	316	84		<0.2	0.5	11	35	<5.0	5.7	<5.0	9.5			<0.10		<1.0	22	276	
BOP-84i(75)	11/9/2012	736	317	85										0.81	131.2		3.0				6.36
BOP-84i(75)	2/5/2013	824	405	173		<0.2	0.5	0.7	2.3	<5.0	<5.0	<5.0	19	0.97	-43.9	<0.10	2.0	<1.0	26	80.5	6.29
BOP-84i(75)	5/6/2013	914	495	263	-64	<0.2	0.4	0.5	1.6	<5.0	<5.0	<5.0	11	1.92	-75.2	<0.10	2.0	<1.0	21	102	6.12
BOP-84i(75)	8/7/2013	1007	588	356	29	<0.2	2.2	18	15			<5.0	28								
BOP-84i(75)	11/8/2013	1100	681	449	122	<0.2	0.7	3.3	1.3			7.9	37								
BOP-84i(80.5)	2/8/2012	461	42			<1.0	5.6	53	1.4			<5.0	<10								
BOP-84i(80.5)	5/4/2012	547	128			<1.0	<1.0	3.0	160			<5.0	<10								
BOP-84i(80.5)	8/9/2012	644	225	-7		<1.0	<1.0	<1.0	9.0			<5.0	<10								
BOP-84i(80.5)	11/8/2012	735	316	84	-243	<0.2	1.3	41	23			<5.0	7.0								
BOP-85i(52)	2/8/2012	461	42			1.8	24	3.8	<1.0			<5.0	<10								
BOP-85i(52)	5/4/2012	547	128			<1.0	12	2.2	<1.0			<5.0	<10								
BOP-85i(52)	8/9/2012	644	225	-7		1.4	34	5.6	<1.0			<5.0	<10								
BOP-85i(52)	11/8/2012	735	316	84	-243	1.0	15	1.8	<0.2			55	12								
BOP-85i(58)	2/8/2012	461	42			1.6	33	6.3	<1.0			<5.0	<10								
BOP-85i(58)	5/4/2012	547	128			<1.0	32	6.4	<1.0			<5.0	<10								
BOP-85i(58)	8/9/2012	644	225	-7		1.1	34	6.0	<1.0			<5.0	<10								
BOP-85i(58)	11/8/2012	735	316	84	-243	1.3	22	4.8	<0.2			31	9.3								
BOP-85i(63.5)	2/8/2012	461	42			1.5	34	6.5	<1.0			<5.0	<10								
BOP-85i(63.5)	5/4/2012	547	128			<1.0	31	6.2	<1.0			<5.0	<10								
BOP-85i(63.5)	8/9/2012	644	225	-7		1.0	31	5.8	<1.0			<5.0	<10								
BOP-85i(63.5)	11/8/2012	735	316	84	-243	1.3	21	4.5	<0.2			17	8.9								
BOP-85i(68.5)	2/8/2012	461	42			1.6	33	6.5	<1.0			<5.0	<10								
BOP-85i(68.5)	5/4/2012	547	128			<1.0	29	6.5	<1.0			<5.0	<10								
BOP-85i(68.5)	8/9/2012	644	225	-7		1.2	32	5.7	<1.0			<5.0	<10								
BOP-85i(68.5)	11/8/2012	735	316	84		0.9	20	4.3	<0.2			14	9.3								
BOP-85i(68.5)	2/6/2013	825	406	174		0.8	37	7.0	<0.2			<5.0	<5.0								
BOP-85i(68.5)	5/2/2013	910	491	259	-68	1.1	30	5.8	<0.2			<5.0	10								
BOP-85i(68.5)	8/7/2013	1007	588	356	29	0.5	1.5	22	0.8			<5.0	24								
BOP-85i(68.5)	11/8/2013	1100	681	449	122	<0.2	0.2	2.4	2.1			<5.0	5.6								
BOP-85i(73.5)	2/8/2012	461	42			1.5	20	4.3	<1.0			<5.0	<10								
BOP-85i(73.5)	5/4/2012	547	128			<1.0	14	7.8	<1.0			<5.0	<10								
BOP-85i(73.5)	8/9/2012	644	225	-7		<1.0	3.6	23	<1.0			<5.0	<10								
BOP-85i(73.5)	11/8/2012	735	316	84	-243	0.5	17	8.2	<0.2			16	8.7								

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BOEING PORTLAND

		Elapsed Time from Injections (a) (days)	Elapsed Time from Injection (b) (days)	Elapsed Time from Injection (c) (days)	Elapsed Time from Injection (d) (days)	Volatile Organic Compounds						Fermentation Product		Aquifer Redox Conditions						Donor Indicators	
Well	Date	Pilot Injection	PRB 1st Injection	PRB 2nd Injection	Multi-Purpose Source Zone Wells 1st Injection	PCE (µg/L)	TCE (µg/L)	CIS (µg/L)	VC (µg/L)	Ethene (µg/L)	Ethane (µg/L)	2-Butanone (µg/L)	Acetone (µg/L)	DO (mg/L)	ORP (mV)	Nitrate (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (b) (mg/L)	TOC (mg/L)	pH
BOP-86i(52)	2/8/2012	461	42			1.4	26	7.2	<1.0			<5.0	<10								
BOP-86i(52)	5/4/2012	547	128			1.3	28	4.0	<1.0			<5.0	<10								
BOP-86i(52)	8/9/2012	644	225	-7		1.2	42	6.9	<1.0			<5.0	<10								
BOP-86i(52)	11/8/2012	735	316	84	-243	1.3	16	3.4	0.4			51	11								
BOP-86i(58)	2/8/2012	461	42			1.2	23	18	<1.0			<5.0	<10								
BOP-86i(58)	5/4/2012	547	128			1.0	28	5.0	<1.0			<5.0	<10								
BOP-86i(58)	8/9/2012	644	225	-7		1.2	42	7.5	<1.0			<5.0	<10								
BOP-86i(58)	11/8/2012	735	316	84	-243	1.1	20	4.0	0.2			10	8.9								
BOP-86i(64)	2/8/2012	461	42			1.3	23	18	<1.0			<5.0	<10								
BOP-86i(64)	5/4/2012	547	128			<1.0	25	5.0	<1.0			<5.0	<10								
BOP-86i(64)	8/9/2012	644	225	-7		1.2	41	7.4	<1.0			<5.0	<10								
BOP-86i(64)	11/8/2012	735	316	84	-243	1.1	20	3.9	0.3			<5.0	8.5								
BOP-86i(69)	2/8/2012	461	42			1.2	21	17	<1.0			<5.0	<10								
BOP-86i(69)	5/4/2012	547	128			<1.0	28	5.2	<1.0			<5.0	<10								
BOP-86i(69)	8/9/2012	644	225	-7		1.0	39	7.7	<1.0			<5.0	<10								
BOP-86i(69)	11/8/2012	735	316	84		0.9	20	4.6	0.5			<5.0	7.8								
BOP-86i(69)	2/6/2013	825	406	174		0.6	31	6.2	<0.2			<5.0	<5.0								
BOP-86i(69)	5/2/2013	910	491	259	-68	0.7	35	7.4	<0.2			<5.0	10								
BOP-86i(69)	8/7/2013	1007	588	356	29	0.6	9.1	15	1.0			<5.0	13								
BOP-86i(69)	11/8/2013	1100	681	449	122	<0.2	1.4	2.0	2.6			10	27								
BOP-86i(74.5)	2/8/2012	461	42			<1.0	<1.0	36	<1.0			<5.0	<10								
BOP-86i(74.5)	5/4/2012	547	128			<1.0	17	8.4	<1.0			<5.0	<10								
BOP-86i(74.5)	8/9/2012	644	225	-7		<1.0	27	12	<1.0			<5.0	<10								
BOP-86i(74.5)	11/8/2012	735	316	84	-243	0.5	24	10	1.3			<5.0	8.3								
BOP-87i(52)	2/8/2012	461	42			1.3	14	1.8	<1.0			<5.0	<10								
BOP-87i(52)	5/4/2012	547	128			<1.0	24	1.4	<1.0			<5.0	<10								
BOP-87i(52)	8/9/2012	644	225	-7		2.2	52	2.6	<1.0			<5.0	<10								
BOP-87i(52)	11/8/2012	735	316	84		1.2	9.7	1.6	<0.2			<5.0	9.1								
BOP-87i(52)	2/6/2013	825	406	174		0.4	8.5	1.2	<0.2			<5.0	<5.0								
BOP-87i(52)	5/2/2013	910	491	259	-68	0.2	7.1	1.2	<0.2			<5.0	12								
BOP-87i(52)	8/7/2013	1007	588	356	29	0.7	21	6.3	0.3			<5.0	14								
BOP-87i(52)	11/8/2013	1100	681	449	122	<0.2	0.6	6.2	0.6			21	75								
BOP-87i(58)	2/8/2012	461	42			1.1	26	5.4	<1.0			<5.0	<10								
BOP-87i(58)	5/4/2012	547	128			<1.0	13	1.7	<1.0			<5.0	<10								
BOP-87i(58)	8/9/2012	644	225	-7		1.1	33	4.2	<1.0			<5.0	<10								
BOP-87i(58)	11/8/2012	735	316	84	-243	1.2	9.2	1.6	<0.2			<5.0	8.6								
BOP-87i(63.5)	2/8/2012	461	42			1.2	24	5.1	<1.0			<5.0	<10								
BOP-87i(63.5)	5/4/2012	547	128			<1.0	12	1.8	<1.0			<5.0	<10								
BOP-87i(63.5)	8/9/2012	644	225	-7		<1.0	32	4.1	<1.0			<5.0	<10								
BOP-87i(63.5)	11/8/2012	735	316	84	-243	1.0	9.1	1.8	<0.2			<5.0	7.9								
BOP-87i(68.5)	2/8/2012	461	42			1.1	22	4.7	<1.0			<5.0	<10								
BOP-87i(68.5)	5/4/2012	547	128			<1.0	12	2.0	<1.0			<5.0	<10								
BOP-87i(68.5)	8/9/2012	644	225	-7		<1.0	31	4.2	<1.0			<5.0	<10								
BOP-87i(68.5)	11/8/2012	735	316	84	-243	0.5	6.6	4.4	<0.2			<5.0	8.1								

TABLE 9
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BOEING PORTLAND

		Elapsed Time from Injections (a) (days)	Elapsed Time from Injection (b) (days)	Elapsed Time from Injection (c) (days)	Elapsed Time from Injection (d) (days)	Volatile Organic Compounds						Fermentation Product		Aquifer Redox Conditions						Donor Indicators	
		Pilot	PRB	PRB	Multi-Purpose Source Zone Wells	PCE	TCE	CIS	VC	Ethene	Ethane	2-Butanone	Acetone	DO	ORP	Nitrate	Iron II	Sulfate	Methane (b)	TOC	pH
Well	Date	Injection	1st Injection	2nd Injection	1st Injection	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(µg/L)	(mg/L)	(mV)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	(mg/L)	
BOP-87i(73.5)	2/8/2012	461	42			<1.0	9.6	10	<1.0			<5.0	<10								
BOP-87i(73.5)	5/4/2012	547	128			<1.0	14	2.9	<1.0			<5.0	<10								
BOP-87i(73.5)	8/9/2012	644	225	-7		<1.0	26	4.1	<1.0			<5.0	<10								
BOP-87i(73.5)	11/8/2012	735	316	84	-243	1.2	9.9	1.3	<0.2			<5.0	8.4								
BOP-88i(51)	2/8/2012	461	42			2.0	26	2.2	<1.0			<5.0	<10								
BOP-88i(51)	5/4/2012	547	128			<1.0	19	2.5	<1.0			<5.0	<10								
BOP-88i(51)	8/9/2012	644	225	-7		2.8	130	8.9	<1.0			<5.0	<10								
BOP-88i(51)	11/8/2012	735	316	84		1.2	11	1.5	<0.2			27	11								
BOP-88i(51)	2/6/2013	825	406	174		0.9	11	1.4	0.2			<5.0	11								
BOP-88i(51)	5/2/2013	910	491	259	-68	0.6	14	2.2	1.2			<5.0	9.9								
BOP-88i(51)	8/7/2013	1007	588	356	29	0.8	7.8	11	0.2	<5.0	<5.0	<5.0	21	1.19	-133	<0.10	2.0	<1.0	1.9	294	5.88
BOP-88i(51)	11/11/2013	1103	684	452	125	<0.2	0.2	85	4.1	<5.0	<5.0	15	36	1.21	-90.1	<0.10	4.0	<1.0	17.0	458	6.20
BOP-88i(56.5)	2/8/2012	461	42			1.7	22	4.9	<1.0			<5.0	<10								
BOP-88i(56.5)	5/4/2012	547	128			<1.0	13	3.3	<1.0			<5.0	<10								
BOP-88i(56.5)	8/9/2012	644	225	-7		1.8	53	34	1.3			<5.0	<10								
BOP-88i(56.5)	11/8/2012	735	316	84	-243	1.1	8.6	1.8	0.7			7.4	8.8								
BOP-88i(61.5)	2/8/2012	461	42			1.8	21	4.4	<1.0			<5.0	<10								
BOP-88i(61.5)	5/4/2012	547	128			<1.0	13	3.6	<1.0			<5.0	<10								
BOP-88i(61.5)	8/9/2012	644	225	-7		1.7	51	34	1.2			<5.0	<10								
BOP-88i(61.5)	11/8/2012	735	316	84	-243	1.1	8.3	1.8	0.7			6.6	8.9								
BOP-88i(66)	2/8/2012	461	42			1.9	20	4.3	<1.0			<5.0	<10								
BOP-88i(66)	5/4/2012	547	128			<1.0	14	4.5	<1.0			<5.0	<10								
BOP-88i(66)	8/9/2012	644	225	-7		1.6	52	36	1.3			<5.0	<10								
BOP-88i(66)	11/8/2012	735	316	84	-243	1.0	8.4	1.8	0.4			6.0	8.7								
BOP-88i(70.5)	2/8/2012	461	42			2.3	20	7.2	<1.0			<5.0	<10								
BOP-88i(70.5)	5/4/2012	547	128			<1.0	13	5.1	<1.0			<5.0	<10								
BOP-88i(70.5)	8/9/2012	644	225	-7		1.7	51	36	1.2			<5.0	<10								
BOP-88i(70.5)	11/8/2012	735	316	84		1.0	8.1	2.0	0.4			6.1	8.7								
BOP-88i(70.5)	6/17/2013	956	537	305	-22	0.6	24	5.4	5.7	<5.0	<5.0	<5.0	11	3.44	74.7	3.3	0.0	11.5	0.093	1.5	6.37
Injected Fluid	12/28/2011		0																	20000	
	8/14/2012			0																28500	

µg/L = micrograms per liter
mg/L = milligrams per liter
mV = millivolts

PRB = Permeable Reactive Barrier
PCE = Tetrachloroethene
TCE = Trichloroethene

DCE = Dichloroethene
VC = Vinyl Chloride
DO = Dissolved Oxygen

ORP = Oxygen Reduction Potential
TOC = Total Organic Carbon

(a) Conducted a pilot injection program for sodium lactate at BOP-72(i) between 11/4 and 11/9 2010. Injected 900 gallons of water mixed with about 3/4 drum of Wilclear sodium lactate. Results of the pilot test indicated the well was slow to injec
(b) Performed PRB donor injection at BOP-74(i) on 12/28/2011. Injected 15 drums of LactOil, Newman Zone veg oil emulsion, and Wilclear sodium lactate mixed with 15,000 gallons of water. Injection rates were about 70 to 80 gpm.
(c) Conducted second PRB injection of 30K gallons of lactoil and water from injection system inside building.
(d) Conducted multiple purpose source zone gravity feed injection of 10K gallons of lactoil and water from injection system inside building.

Notes:
Shade indicates parameter was not analyzed or not measured.
No parameters collected due to sodium lactate in well.
Not enough volume for parameters - sample collected from diffusion bag.
Compound with highest molar fraction
BOP-75i (68.7) Baseline source area injection data