

Technical Memorandum

TO: Mr. Kenneth Thiessen, Oregon Department of Environmental Quality
Ms. Deborah Taeye, The Boeing Company

FROM: Evelyn Ives, PE; Erin Waibel, RG; Clint Jacob, PE, LG

DATE: September 7, 2022

RE: **Addendum No. 5**
Source Area Bioremediation Work Plan
Combined Treatment of TGA Source Wells and Permeable Reactive Barrier
Building 85-001 Former Vapor Degreaser Source Area
Boeing Portland Facility
Project No. 025116.122
ECSI #13

Introduction

This technical memorandum presents Addendum No. 5 to the above-indicated work plan (Landau Associates, Inc. [Landau] 2013) for bioremediation at the Troutdale Groundwater Aquifer (TGA) Former Vapor Degreaser Source Area (FVDSA) in the northwest portion of Building 85-001 at The Boeing Company (Boeing) Facility in Gresham, Oregon. The FVDSA is an area of the TGA with the highest chlorinated volatile organic compound (cVOC) concentrations and has responded favorably to bioremediation since 2010, as evidenced by the reduced plume size and the lowering of trichloroethene (TCE) concentrations to near the cleanup level. TCE is the parent cVOC targeted for treatment; TCE and breakdown products are evaluated to measure the progress of the TGA remedy. The FVDSA is inside the 85-001 Building (Figure 1) at the location of two former degreaser pits and, based on the investigation results, the area of the site with the highest cVOC concentrations.

This addendum provides procedures to conduct an additional injection event to address localized cVOC concentration rebound and accelerate TGA groundwater remedy cleanup. This addendum describes a 2022 injection event, which will be the sixth injection event, to three identified source area wells and an eighth injection event to maintain the permeable reactive barrier (PRB) on the downgradient edge of the source area. In addition to applying the previously utilized high-retention vegetable oil (HRO) and crude glycerin substrates as electron donor, this work plan again includes the injection of colloidal zero-valent iron (cZVI) into wells BOP-78(i), BOP-87(i), and BOP-88(i) (these same three wells were previously injected with donor and cZVI in 2020). Injection of the three wells will focus additional treatment in the area of well BOP-73(i), where the highest concentrations of TCE and breakdown product vinyl chloride (VC) have been observed and where concentration rebound continues to occur. The observed rebound (TCE at 24.5 micrograms per liter [$\mu\text{g/L}$] in May 2022 and VC at 785 $\mu\text{g/L}$ in August 2021 at well BOP-73(i)) is a primary indication that treatment effectiveness is waning and additional injection is needed to continue and enhance biotic (biological) and abiotic (chemical) treatment of remaining TCE. Concurrent injection of electron donor substrates into well BOP-74(i) will revitalize the PRB treatment of desorbed TCE and VC downgradient of this source well.

This Addendum No. 5 incorporates the previously Oregon Department of Environmental Quality (ODEQ) -approved work plan and addenda described below. Background and investigation results are presented in prior documents (Landau 2017b, 2022). This work plan addendum is submitted on behalf of Boeing under the ODEQ Order on Consent (Order) DEQ No. LQSR-NWR-04-12.

Previous Injections Summary and Results

The source area bioremediation program has consisted of injection into seven source wells (BOP-78[i], BOP-79[i], and BOP-84[i] through BOP-88[i]) near the two former vapor degreaser pits and to BOP-74(i) to create the PRB. The PRB was established on the downgradient edge of the source zone to intercept and treat contaminant flux before it could arrive at downgradient locations (e.g., monitoring wells BOP-80[i] through BOP-83[i]). It is understood that concentrations of TCE and breakdown products often increase due to enhanced desorption during bioremediation; these expected increases in contaminant concentrations have been observed during the course of treatment, confirming the benefit of the PRB. To create optimal PRB treatment conditions before enhancing TCE desorption in the source, two PRB injection events (described in the prior PRB work plan [Landau 2011] and PRB Addendum No. 1 [Landau 2012]) were completed before injections began at source wells. The source area bioremediation work plan (Landau 2013) describes the initial injection to source area wells and presents a combined groundwater monitoring program to monitor the effects of both PRB injection and injection of source area wells. As described in Source Area Bioremediation Work Plan Addendums Nos. 1 through 4 (Landau 2014, 2015, 2017a, 2020), subsequent injection events for the FVDSA include both PRB and source area wells. Beginning in 2014, Textrol BR and glycerin were substituted for LactOil. In 2014 and 2015, ferrous sulfate was added to the injection solution to stimulate abiotic degradation concurrent with biotic degradation. In 2018, Textrol BR was replaced by HRO. In July 2020 (most recent injection), additional nutrients were provided in the donor solution and cZVI was also injected into the three wells (BOP-78[i], BOP-87[i], and BOP-88[i]) to focus additional abiotic treatment at the highest concentration well BOP-73(i). Table 1 presents a summary of these prior injection events.

As designed, injection of the PRB well and source area wells has resulted in a comingled treatment zone. The treatment zone has extended to the northwest due to downgradient transport of electron donor by the flow of groundwater. The resulting treatment zone is approximately 140 feet (ft) wide (north to south) and 150–160 ft thick (east to west). The locations of source wells and the nearest downgradient wells (BOP-80[i] through BOP-83[i]) and the estimated maximum extent of the treatment zone are presented on Figure 1.

The progress of the bioremediation remedy within and downgradient of the treatment zone is primarily demonstrated by enhanced reductive dechlorination, which is evidenced by the decrease in TCE concentrations and the sequential increase in breakdown daughter products (cis-1,2-dichloroethene [cDCE] and VC), and non-toxic end products ethene and ethane. Sequential reductive

dechlorination is evident on the time versus concentration plot for BOP-73(i) presented on Figure 2. Data from monitoring well BOP-73(i) is particularly helpful in understanding the progression of treatment in the source area because the highest TCE concentrations were consistently detected at this well, the well has not been injected, and the well is centrally located within the extent of source area contamination.

Conditions favorable for bioremediation, including enhanced aquifer redox conditions, are also indicated by groundwater data. The most recent evaluation of monitoring results is presented in the 2021 Annual Report (Landau 2022). The cumulative results through May 2022 are presented in Table 2.

Planned 2022 Injection of PRB and Source Area Wells

In 2022, donor solution will be injected into PRB injection well BOP-74(i) and into three selected wells (BOP-78[i], BOP-87[i], and BOP-88[i]). This injection approach will focus additional treatment on remaining TCE mass in the vicinity of BOP-73(i) while maintaining optimal treatment in the PRB.

The prior injection performed in July 2020 was just more than 2 years ago, and the beneficial effects of that injection event are waning. A primary indicator of the need for an additional injection is the rebound in TCE and TCE breakdown products observed during at the historically highest-concentration well BOP-73(i) (Figure 2) over the last four quarterly sampling events (August 2021, November 2021, February 2022, and May 2022). TCE concentrations exceeded the cleanup level (5 µg/L) in May 2022 for the first time since November 2018 at a concentration of 24.6 µg/L. cDCE concentrations exceeded the cleanup level (70 µg/L) in August 2021 at a concentration of 93 µg/L and most recently in May 2022 at a concentration of 276 µg/L. Following a non-detect in February 2021, VC concentrations increased to 785 µg/L (above the cleanup level of 2 µg/L) by August 2021, then steadily decreased to 106 µg/L by May 2022. Complete reductive dechlorination continues at BOP-73(i), as indicated in May 2022 by a concentration of 1,634 µg/L of ethene+ethane and continued ethene+ethane predominance on a molar basis (92 percent molar fraction; Table 2). However, the recent rebound in TCE and TCE breakdown products is evidence that additional source zone treatment is needed and treatment has become less than optimal because of consumption of previously injected substrates.

Injection Design

The proposed 2022 injection will be similar to the injection completed in 2020 (see Table 1), except four wells (BOP-79[i], BOP-84[i], BOP-85[i], and BOP-86[i]) will not be included in the injection event. Injection solution for the injection event will again contain emulsified vegetable oil and glycerin. This combination of slow- and fast-release donors optimizes donor availability and longevity. Both electron donors will be fermented by microorganisms to form hydrogen needed for reductive dechlorination and to maintain the highly reduced redox conditions required for biological reductive dechlorination. Nitrate and phosphorus nutrients will be added in addition to yeast extract provided during prior

injections to promote the growth and health of natural bacteria. cZVI will be added to the injection solution at three identified source wells (BOP-78[i], BOP-87[i], and BOP-88[i]). cZVI strongly stimulates the abiotic degradation process, which was previously stimulated through addition of ferrous sulfate during the 2014 and 2015 injections. Abiotic (i.e., chemical) degradation is a concurrent and complimentary degradation mechanism to biological reductive dechlorination being stimulated through donor and nutrient amendment. The predominant abiotic reaction is reductive elimination (or β -elimination) whereby iron chemically reduces TCE and cDCE to chloroacetylene and acetylene, respectively, without formation of VC. These non-toxic acetylenes break down quickly to ethene and ethane under anaerobic conditions (Butler and Hayes 2001). Because of its high reactivity, acetylene is rarely detected, or detected at very low concentrations, even when reductive elimination is actively occurring. These three identified source wells were chosen based on their proximity to the former vapor degreaser units and well BOP-73(i) where the rebound in concentrations has been observed.

The total injection solution volume will be approximately 31,100 gallons. The target injection volumes are 19,100 gallons for the PRB well (BOP-74 [i]) and 4,000 gallons for each of the three cZVI/HRO wells.¹ Injection to the four remaining FVDSA wells (BOP-79[i], BOP-84[i], BOP-85[i], and BOP-86[i]), injected in 2020, was deemed unnecessary in 2022 because TCE and breakdown products have remained below the cleanup levels in this area since at least the 2020 injection.² This injection solution design is further described in the following paragraphs and summarized in Table 3.

The primary injection substrates will consist of Newman Zone HRO™ (HRO) and crude glycerin as electron donor substrates. HRO is a 100 percent fermentable electron donor product containing 90 percent by weight (%wt) vegetable oil and 10%wt oleaginous surfactants. Crude glycerin is completely soluble and immediately available for fermentation; crude glycerin is a regionally sourced byproduct of biodiesel production from recycled fryer oil. The injection solution will consist of tap water mixed with 3.3 percent volume (%vol) HRO and 5.1%vol glycerin.³

For the 2022 injection, nutrients will be added to the injection solution consisting of yeast extract plus nitrogen and phosphorus. Yeast extract has been provided since the first injection as the source of micronutrients (i.e., trace nutrients). Given the extended period of treatment that has occurred in the source zone, the macronutrients nitrogen and phosphorus will be added to address potential nutrient limitations to the degradation of TCE and breakdown products. Phosphorus and nitrogen are required by microorganisms for cellular growth and reproduction; a shortage of these nutrients will cause

¹ These targets are consistent with the previous injection events. In 2020, BOP-74(i) received 18,100 gallons and the source area wells received an average of 4,000 gallons per well (28,000 gallons total). In 2018, BOP-74(i) received 19,500 gallons and the seven source area wells, not including BOP-75(i), received approximately 4,400 gallons each, for a total of 31,200 gallons.

² VC exceeded the cleanup level at BOP-79(i) once in August 2021; the prior cleanup level exceedance occurred in November 2018.

³ In 2020, the glycerin vendor has changed from Whole Energy to SeSequential, resulting in a crude glycerin concentration difference. The volume required was modified to account for different glycerin concentrations in the two products.

microbiological growth and transformation processes to slow down. These macronutrients will be provided in the form of monoammonium phosphate (MAP) and calcium ammonium nitrate (CAN-27). Phosphorus was contained in the Textrol BR substrate used for prior injections in 2014 and 2015. Nutrients will be provided at the following rates and total quantities:

- Yeast extract: 1 pound (lb) per 1,000 gallons of solution; rounded to 31 lbs total
- MAP: 5.31 lb per 1,000 gallons of solution; rounded to 165 lbs total
- CAN-27: 8.04 lb per 1,000 gallons of solution; rounded to 250 lbs total.

Quantities of MAP and CAN-27 were determined by considering the nutrient requirements of the microbial community (Ammary 2004). Using this approach, the estimated carbon:nitrogen:phosphorus ratio for this injection event is 683:5:1 on a molar basis. This ratio was used to calculate the mass of nitrogen and phosphorus required by the microbial community to utilize 100 percent of the HRO and glycerin injected.

The three source wells (BOP-78[i], BOP-87[i], and BOP-88[i]) will be injected with cZVI in the form of the remediation product Regenesis S-MicroZVI. Each well will receive 1.3 drums (44 gallons, 666 lbs) of the S-MicroZVI product, which is equivalent to 1.1%vol of the injection solution. This dosing will provide a total of 2,000 lbs of zero-valent iron (ZVI) to the highest concentration portion of the source zone. The mass of cZVI delivered to each well is approximately 1.3 times the mass used in 2020, for enhanced treatment.

S-MicroZVI consists of colloidal iron particles from 1 to 3 microns (μm) in diameter; the particles remain suspended in the injection fluid and transmit easily through aquifer pore space (Freim 2018). This relatively new colloidal product is a substantial improvement over nano-scale ZVI (0.2 μm) and micro-scale ZVI (50 μm). Nano-scale ZVI tends to agglomerate in large clusters that are not easily transmitted through the aquifer, is very expensive, and is consumed quickly. Micro-scale ZVI must be injected as a slurry using hydrofracturing techniques, which precludes the use of this product for repeated injections through monitoring wells. S-MicroZVI contains sulfidated ZVI, meaning the ZVI particles have a coating of ferrous sulfide to prevent it from losing reactive capacity during storage and delivery (REGENESIS 2018). S-MicroZVI is a suspension in glycerol which provides improved suspension and shelf life.

Injection Process

Consistent with prior injections, each injection well will receive a flush of clear water prior to and post-injection to assist with clearing the well screens of any accumulated debris. The clear water injections will consist of approximately 200–300 gallons for each well. Additionally, each injection well will be redeveloped prior the 2022 injection to improve injection rates.

Mixing and injection will occur at the mixing station setup inside the building near the source area. The mixing station consists of a potable water tap; a 4,000-gallon batch tank; an electric pump (120-volt); a diaphragm pump; a donor staging area; and a multi-well injection manifold. The injection manifold connects to sub-grade conveyance lines leading to the seven source wells; the PRB well (BOP-74[i]) will be injected through an individual hose run. The 4,000-gallon batch tank was cleaned thoroughly to remove dried residue of injection fluid after the 2020 injection. To remove potential particulates in the crude glycerin,⁴ crude glycerin and water will be passed through a bag filter (10- μ m) during the mixing process, consistent with the 2018 and 2020 injections, as described below. Secondary containment is provided for the mixing station to contain any spills for cleanup, as shown on Figure 3.

Injection solution for PRB well BOP-74(i) will be mixed in 10 batches in the 4,000-gallon storage tank. The three targeted source wells (BOP-78[i], BOP-87[i], BOP-88[i]) will be batched and injected separately because of the additional cZVI substrate.

The injection solution will be mixed for six of the 10 batches (PRB location) as follows:

- Mixing tank will be filled with approximately 3,075 gallons of potable water.
- Tank water will be dechlorinated by adding a pond water dechlorinating product containing sodium thiosulfite (Chlor-No-More, www.PondRX.com) per product directions.
- While recirculating water from the tank through the filter and back to the tank with the electric pump, 0.61 totes (160 gallons) of glycerin will be added using a hose and drop tube extended from the suction side of the pump. A small amount of liquid, food-grade defoaming agent (*NO FOAM* distributed by Wilbur-Ellis) will be added, as needed, to minimize foaming of the injection solution.
- While recirculating water from the tank, pre-dissolved MAP (20.0 lbs) and CAN-27 (28.9 lbs) will be added using a hose and drop tube extended from the suction side of the pump.⁵
- Following addition of glycerin, MAP, and CAN-27, and adequate recirculation for mixing, the tank contents will be injected to the wells, with valves adjusted to bypass the filter. During injection, the following substrates will added inline to the flow (i.e., metered in on the suction side of the pump); substrates will be added proportionally during the injection period:
 - Approximately 0.42 totes (108 gallons) of HRO. Passing water and HRO together through the pump will create the vegetable oil emulsion for injection. In-line mixing and direct injection minimizes any standing time for the emulsion to coalesce into larger oil droplets. HRO will be added at an approximate rate of 3.52 gallons per 100 gallons of tank mixture.

⁴ Soft particles were observed in injection fluid during the 2015 injections that may have been from the crude glycerin or dried flakes of donor residue in the batch tank from prior injections.

⁵ Dry CAN-27 and MAP will be pre-dissolved in drums or totes prior to addition to the mixing tanks. CAN-27 contains about 10%wt of dolomite as an inert solid, which will settle out as the product dissolves. The liquid from the drums or totes will be added to the mixing tanks and the settled dolomite will be retained for disposal.

- 3.18 lbs of yeast extract.

The cZVI injection solution will be mixed separately for the three identified source wells (BOP-78[i], BOP-87[i], BOP-88[i]). As a result, four of the 10 batches (described above) will be mixed and injected with the following volume modifications:

- Mixing tank will be filled with approximately 2,870 gallons of potable water.
- While recirculating water from the tank through the filter and back to the tank with the electric pump, 0.59 totes (153 gallons) of glycerin will be added.
- While recirculating water from the tank, pre-dissolved MAP (11.3 lbs) and CAN-27 (19.1 lbs) will be added.
- Following addition of glycerin, MAP, and CAN-27, and adequate recirculation for mixing, the tank contents will be injected to the wells, with valves adjusted to bypass the filter. During injection, the following substrates will added inline to the flow (i.e., metered in on the suction side of the pump); substrates will be added proportionally during the injection period:
 - Approximately 0.38 totes (98 gallons) of HRO at an approximate rate of 3.4 gallons per 100 gallons of tank mixture.
 - 3.0 lbs of yeast extract mixed with water.
 - Approximately 1 drum (33 gallons) of ZVI at an approximate rate of 5.8 gallons per 500 gallons of tank mixture.

Precautions will be taken to prevent unplanned leaks of injection fluid. A tank level alarm will be utilized for all tank filling operations. Injection hose Camlock connections will be strapped closed and the hose will be monitored for leaks. The well seal of injection wells and surrounding floor and any nearby subsurface vaults will be monitored for potential water discharge indicative of injection short-circuiting to the surface. If any potential, minor leaks occur when disconnecting hoses, these will be collected and contained using buckets and a wet/dry vacuum. Potential incidental spills inside the secondary containment caused by mixing operations will be cleaned up using the wet/dry vacuum. When feasible, donor fluid and rinsate water will be added back into the batch tank for injection into a well or will be disposed of offsite. A spill kit will be set up at the injection location and will contain cat litter, adsorbent pads, and berming material to contain larger spills.

Performance Groundwater Monitoring and Reporting

Performance groundwater monitoring for wells located in and downgradient of the source area will continue on a semiannual basis (February and August). Additionally, within the source area, groundwater sampling will continue on a quarterly basis (February, May, August, and November) to evaluate injection effectiveness and longevity of treatment. Groundwater monitoring parameters will include analysis of chemicals of concern, aquifer redox, and electron donor, as summarized in Table 4.

Annual reports will document and evaluate the results of the groundwater monitoring events for that calendar year. The report for each year will be submitted in the first quarter of the following calendar year. The 2022 injection will be documented in the 2022 annual report.

Schedule

Injection activities are currently planned to occur in fall 2022 depending on facility operations.

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Attachments

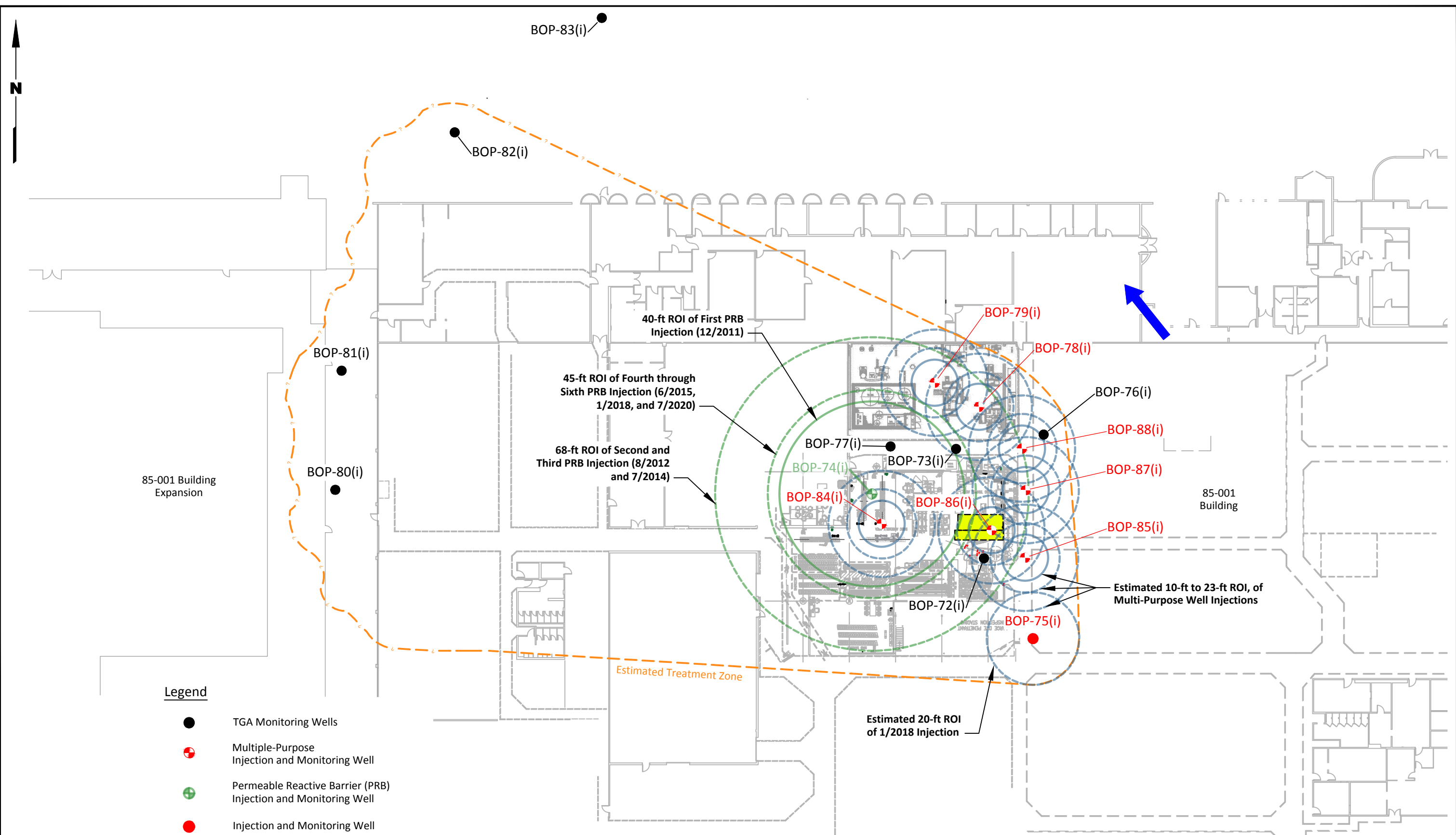
- Figure 1: Former Vapor Degreaser Source Area Bioremediation Injection Wells
- Figure 2: Time versus Concentration Plot—BOP-73(i)
- Figure 3: Injection and Mixing Station
- Table 1: Summary of Injection Events
- Table 2: Bioremediation Progress Results
- Table 3: Injection Design
- Table 4: Bioremediation Monitoring Parameters

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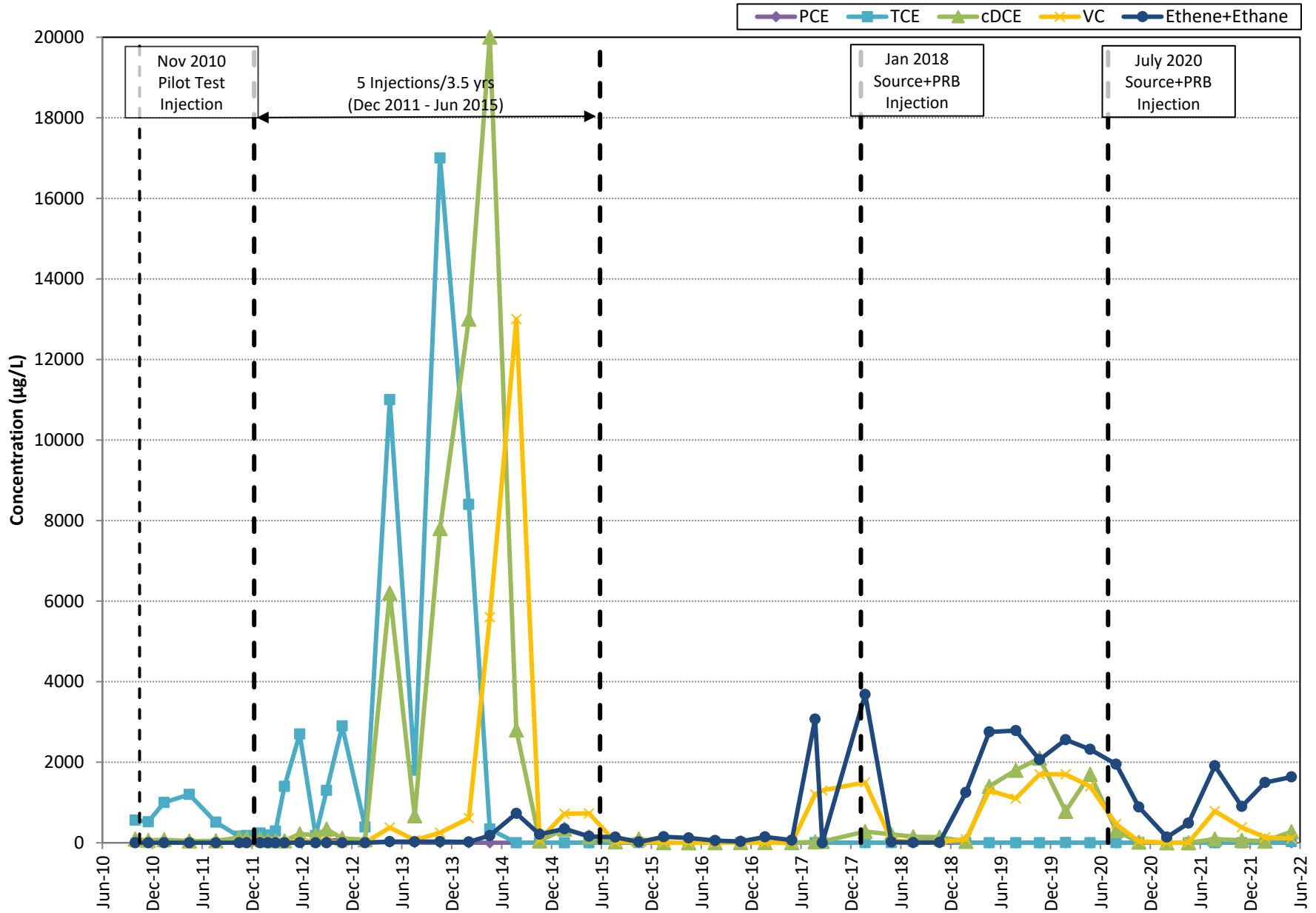
Legend

- TGA Monitoring Wells
- ⊕ Multiple-Purpose Injection and Monitoring Well
- ⊕ Permeable Reactive Barrier (PRB) Injection and Monitoring Well
- Injection and Monitoring Well
- Approximate Location of Former Degreasers
- - - Treatment Zone
- ← Groundwater Flow Direction

Data Source: The Boeing Company



Boeing Portland Gresham, Oregon	Former Vapor Degreaser Source Area Bioremediation Injection Wells	Figure 1
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Boeing Portland
Gresham, Oregon

Time versus Concentration Plot
BOP-73(i)

Figure
2

Table 1
Summary of Injection Events
Former Vapor Degreaser Source Area
Boeing Portland

Injection Event	Well(s)	Amount of Injection Solution (Electron Donor + Potable Water)
November 2010 (Pilot Injection)	BOP-72(i)	Pilot Well: 900 gallons (LactOil)
December 2011 (PRB)	BOP-74(i)	PRB: 15,000 gallons (LactOil)
August 2012 (PRB)	BOP-74(i)	PRB: 30,000 gallons (LactOil)
July 2013 (Source Wells)	BOP-78(i), BOP-79(i), and BOP-84(i) through BOP-88(i)	Source Wells: 9,200 gallons (LactOil)
July 2014 (PRB + Source Wells)	BOP-74(i), BOP-78(i), BOP-79(i), and BOP-84(i) through BOP-88(i)	PRB: 30,000 gallons Source Wells: 20,000 gallons Total: 50,000 gallons (Glycerin, Ferrous Sulfate, and Textrol BR)
July 2015 (PRB + Source Wells)	BOP-74(i), BOP-78(i), BOP-79(i), and BOP-84(i) through BOP-88(i)	PRB: 20,000 gallons Source Wells: 30,000 gallons Total: 50,000 gallons (Glycerin, Ferrous Sulfate, and Textrol BR)
January 2018 (PRB + Source Wells)	BOP-74(i), BOP-78(i), BOP-79(i), BOP-84(i) through BOP-88(i), and BOP-75(i)	PRB: 19,000 gallons Source Wells: 35,000 gallons Total: 54,000 gallons (Glycerin and HRO)
July 2020 (PRB + Source Wells)	BOP-74(i), BOP-78(i), BOP-79(i), and BOP-84(i) through BOP-88(i)	PRB: 18,100 gallons Source Wells: 28,000 gallons Total: 46,100 gallons (Glycerin and HRO; also cZVI to three targeted source wells)
PROPOSED: Fall 2022 (PRB + Three Targeted Source Wells)	PROPOSED: BOP-74(i), BOP-79(i), BOP-87(i), and BOP-88(i)	PROPOSED: PRB: 19,100 gallons Three Targeted Source Wells: 12,000 gallons Total: 31,100 gallons (Glycerin and HRO at PRB; also cZVI to three targeted source wells)

Notes:

cZVI = colloidal zero-valent iron

HRO = RNAS high-retention oil vegetable oil substrate

PRB = permeable reactive barrier

Textrol BR = vegetable oil substrate

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	from Previous Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (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	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-72(i) Monitoring Well	10/19/2010		3.1	28	10	<1.0	<1.0	--	--	--	1.2	--	12.9	0.106	1.77		0.06	0.64	0.31	0.00	0.00	0.00
	12/6/2010	32	<2.0	3.6	<2.0	<2.0	30.4	--	2.81	-26.2	<5.0	3.2	<5.0	0.849	3020	6.88	0.00	0.02	0.00	0.00	0.81	0.16
BOP-72(i)	2/2/2011	90	<20	<20	<20	<20	--	--	--	--	--	--	--	--	--	--	ND	ND	ND	ND	ND	ND
BOP-72(i)	5/5/2011	182	<1.0	<1.0	6.3	<1.0	--	--	0.21	163	--	--	--	--	--	6.79	0.00	0.00	1.00	0.00	--	--
BOP-72(i)	8/10/2011	279	<1.0	<1.0	10	<1.0	<1.1	<1.1	0.26	-151.6	<0.1	2.4	1.5	7.7	263	6.77	0.00	0.00	1.00	0.00	0.00	0.00
BOP-72(i)	11/3/2011	364	<1.0	<1.0	3.0	6.8	--	--	0.09	-138.8	--	--	--	--	--	6.71	0.00	0.00	0.22	0.78	--	--
BOP-72(i)	2/8/2012	42	<2.0	<2.0	<2.0	7.5	--	--	0.31	-317.5	--	--	--	--	--	7.46	0.00	0.00	0.00	1.00	--	--
BOP-72(i)	5/4/2012	128	<2.0	<2.0	<2.0	9.0	--	--	0.86	-65.7	--	--	--	--	--	6.69	0.00	0.00	0.00	1.00	--	--
BOP-72(i)	8/9/2012	225	<1.0	<1.0	<1.0	10	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--
BOP-72(i)	11/8/2012	84	<0.2	<0.2	0.2	5.1	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.02	0.98	--	--
BOP-72(i)	2/5/2013	173	<0.2	<0.2	0.3	3.4	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.05	0.95	--	--
BOP-72(i)	5/2/2013	259	<0.2	<0.2	0.2	3.3	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.04	0.96	--	--
BOP-72(i)	8/6/2013	28	<0.2	<0.2	0.7	2.7	5	<5.0	0.58	-148.8	<0.10	3.0	<5.0	13	47.4	6.66	0.00	0.00	0.03	0.19	0.78	0.00
BOP-72(i)	11/7/2013	121	<0.2	<0.2	0.3	1.9	<5.0	<5.0	0.62	-113.4	<0.10	2.5	<1.0	11	41.7	6.68	0.00	0.00	0.09	0.91	0.00	0.00
BOP-72(i)	2/5/2014	211	<0.2	<0.2	0.2	1.9	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.06	0.94	--	--
BOP-72(i)	5/7/2014	302	<0.2	<0.2	<0.2	1.5	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--
BOP-72(i)	8/13/2014	28	<0.2	<0.2	0.2	1.1	<5.0	<5.0	0.43	68.2	<0.10	3.0	<1.0	14	36.6	6.12	0.00	0.00	0.10	0.90	0.00	0.00
BOP-72(i)	11/6/2014	113	<0.2	<0.2	0.3	1.9	<5.0	<5.0	0.26	-147.7	<0.10	3.0	2.8	14	13.6	6.56	0.00	0.00	0.09	0.91	0.00	0.00
BOP-72(i)	2/5/2015	204	<0.2	<0.2	1.2	3.3	6.2	<5.0	0.25	-113.1	<0.10	5.5	16.2	13	8.6	6.34	0.00	0.00	0.04	0.18	0.77	0.00
BOP-72(i)	5/6/2015	294	<0.2	2.0	5.4	9.1	<5.0	<5.0	0.97	-91.2	<0.10	4.5	16.8	11	6.7	6.33	0.00	0.07	0.26	0.67	0.00	0.00
BOP-72(i)	8/10/2015	22	<0.2	<0.2	0.4	1.9	<5.0	<5.0	1.37	-167.7	<0.10	7.0	1.1	15	161.0	6.45	0.00	0.00	0.12	0.88	0.00	0.00
BOP-72(i)	11/4/2015	108	<0.2	<0.2	1.1	2.9	<5.0	<5.0	1.09	-100.5	<0.10	7.0	6.9	18	3.7	6.54	0.00	0.00	0.20	0.80	0.00	0.00
BOP-72(i)	2/3/2016	199	<0.2	<0.2	2.1	3.2	<5.0	<5.0	1.78	-57.7	<0.10	7.0	4.7	6	3.2	7.23	0.00	0.00	0.30	0.70	0.00	0.00
BOP-72(i)	5/4/2016	290	<0.2	1.0	2.2	2.9	<5.0	<5.0	1.59	-119.1	<0.10	7.0	9.7	16	3.9	6.29	0.00	0.10	0.30	0.60	0.00	0.00
BOP-72(i)	8/9/2016	387	<0.2	2.7	6.5	5.2	<5.0	<5.0	0.38	-124.8	<0.10	7.0	16.5	9.9	<1.0	6.32	0.00	0.12	0.39	0.49	0.00	0.00
BOP-72(i)	11/10/2016	480	<0.2	6.7	14	3.0	<5.0	<5.0	0.70	-38.80	<0.10	7.0	17.7	20	2.2	6.34	0.00	0.21	0.59	0.20	0.00	0.00
BOP-72(i)	2/7/2017	569	<0.2	4.9	16	2.7	<5.0	<5.0	0.89	-76.3	<0.10	7.0	16.4	18	3.4	6.51	0.00	0.15	0.67	0.18	0.00	0.00
BOP-72(i)	5/16/2017	667	<0.2	1.8	16	6.4	<5.0	<5.0	0.79	6.78	<0.10	1.0	13.7	25	7.0	6.30	0.00	0.05	0.59	0.36	0.00	0.00
BOP-72(i)	8/9/2017	752	<0.2	1.8	17	8.3	<5.0	<5.0	0.8	-42.7	<0.10	7.0	14.2	9.1	5.7	6.2	0.00	0.04	0.54	0.41	0.00	0.00
BOP-72(i)	2/8/2018	16	<0.2	0.2	2.3	1.4	<5.0	<5.0	0.33	55.6	0.56	3.5	195	16	6530	4.93	0.00	0.03	0.50	0.47	0.00	0.00
BOP-72(i)	5/15/2018	111	<0.2	1	5.5	1	<5.0	<5.0	0.52	38.9	<0.10	7.0	14.6	19	2630	5.14	0.00	0.09	0.71	0.20	0.00	0.00
BOP-72(i)	8/3/2018	191	<0.2	0.4	3	0.8	<5.0	<5.0	0.27	-38.5	0.23	7.0	9.9	17	1440	5.56	0.00	0.07	0.66	0.27	0.00	0.00
BOP-72(i)	2/12/2019	384	<0.2	<0.2	1.4	1.1	<5.0	<5.0	0.20	-73.2	<0.50	2.0	2.0	11	<50.0	5.90	0.00	0.00	0.45	0.55	0.00	0.00
BOP-72(i)	5/9/2019	470	<0.2	<0.2	0.8	0.8	<5.0	<5.0	0.9	-83.03	<0.10	6.0	<1.0	15	13.9	6.00	0.00	0.00	0.39	0.61	0.00	0.00
BOP-72(i)	8/13/2019	567	<0.2	<0.2	0.5	0.5	<5.0	<5.0	0.43	-62.4	<0.10	4.5	1.3	18	11.6	6.16	0.00	0.00	0.39	0.61	0.00	0.00
BOP-72(i)	11/8/2019	654	<0.2	<0.2	0.6	0.8	<5.0	<5.0	0.34	-109.4	<0.10	4.0	1.1	12	12.9	6.13	0.00	0.00	0.33	0.67	0.00	0.00
BOP-72(i)	2/11/2020	749	<0.2	<0.2	2.3	1.1	<5.0	<5.0	0.42	-65	<0.10	6.0	<1.0	17	13.2	7.04	0.00	0.00	0.57	0.43	0.00	0.00
BOP-72(i)	5/11/2020	839	<0.2	<0.2	4.6	2.3	<5.0	<5.0	0.62	-99.8	<0.50	4.0	1.2	18	9.1	5.96	0.00	0.00	0.56	0.44	0.00	0.00
BOP-72(i)	8/13/2020	29	<0.200	<0.200	1.11	0.832	<5.00	<5.00	0.23	-31.3	<0.500	4.5	48	12.7	2200	5.00	0.00	0.00	0.46	0.54	0.00	0.00
BOP-72(i)	11/5/2020	112	<0.200	<0.200	<0.200	<0.200	<5.00	<5.00	2.36	-105.9	<0.500	3.0	<1.00	12.7	154	6.50	ND	ND	ND	ND	ND	ND
BOP-72(i)	2/16/2021	215	<0.200	<0.200	<0.200	1.13	<5.00	<5.00	0.40	-110.4	<0.100	3.0	14.1	12.2	4.15	5.99	0.00	0.00	0.00	1.00	0.00	0.00
BOP-72(i)	5/6/2021	294	<0.200	<0.200	<0.200	0.547	<5.00	<5.00	0.18	27.3	1.4	2.5	<5.00	11.3	4.25	6.24	0.00	0.00	0.00	1.00	0.00	0.00
BOP-72(i)	8/12/2021	392	<0.200	<0.200	0.451	0.539	<0.500	<0.500	0.00	-69.3	0.852	6.0	1.24	18.3	5.58	6.02	0.00	0.00	0.35	0.65	0.00	0.00
BOP-72(i)	11/18/2021	490	<0.200	<0.200	0.611	0.871	<5.00	<5.00	0.26	-140.6	<0.250	7.0	10.9	19.3	9.67	6.02	0.00	0.00	0.31	0.69	0.00	0.00
BOP-72(i)	2/9/2022	573	<0.200	<0.200	0.496	0.346	<5.00	<5.00	0.17	-71.4	<0.250	3.5	<1.00	14	18.6	11.22	0.00	0.00	0.48	0.52	0.00	0.00
BOP-72(i)	5/17/2022	671	<0.200	<0.200	0.489	0.361	<5.00	<5.00	0.95	-18.8	<0.250	7.0	<1.00	14.4	11	6.36	0.00	0.00	0.47	0.53	0.00	0.00

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	from Previous Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (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	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-73(i)	10/19/2010		12	560	90	<1.0	<1.0	--	--	--	0.7	--	11	0.0599	1.6	--	0.01	0.81	0.18	0.00	0.00	0.00
Monitoring Well	12/6/2010	32	19	520	59	<2.0	<2.0	--	3.20	14.6	1.0	2.8	10.3	--	2.24	6.94	0.02	0.85	0.13	0.00	0.00	0.00
BOP-73(i)	2/2/2011	90	37	1000	78	<1.0	--	--	0.45	-14.8	--	--	--	--	--	6.37	0.03	0.88	0.09	0.00	--	--
BOP-73(i)	5/5/2011	182	43	1200	42	<3.0	--	--	0.64	15.6	--	--	--	--	--	6.29	0.03	0.93	0.04	0.00	--	--
BOP-73(i)	8/10/2011	279	18	510	48	<1.0	<1.1	<1.1	0.54	-24.9	1.0	2.4	11.8	1.01	1.88	6.30	0.02	0.87	0.11	0.00	0.00	0.00
BOP-73(i)	11/3/2011	364	4.7	160	130	<1.0	--	--	0.10	-42.9	--	--	--	--	--	6.33	0.01	0.47	0.52	0.00	--	--
BOP-73(i)	12/1/2011	392	5.0	180	120	<1.0	<1.1	<1.1	--	--	--	--	9.5	0.759	1.93	6.71	0.01	0.52	0.47	0.00	0.00	0.00
BOP-73(i)	1/19/2012	22	7.8	240	100	12	--	--	0.41	249	0.3	1.8	8.8	--	9.26	7.04	0.02	0.59	0.33	0.06	--	--
BOP-73(i)	2/16/2012	50	4.0	190	59	24	<1.1	<1.1	0.66	-235.3	0.3	2.2	11.5	1.35	<1.50	7.74	0.01	0.59	0.25	0.16	0.00	0.00
BOP-73(i)	3/15/2012	78	6.4	290	53	13	<1.1	<1.1	0.80	-220	0.8	1.9	11.2	0.535	2.14	6.90	0.01	0.74	0.18	0.07	0.00	0.00
BOP-73(i)	4/17/2012	111	26	1400	50	14	<1.1	<1.1	1.23	-244.1	1.0	1.5	10.7	0.438	<1.50	7.66	0.01	0.92	0.04	0.02	0.00	0.00
BOP-73(i)	6/12/2012	167	72	2700	220	45	2.8	<1.1	0.70	28.3	0.9	2.0	9.7	0.787	1.61	6.37	0.02	0.85	0.09	0.03	0.00	0.00
BOP-73(i)	8/9/2012	225	2.2	180	190	13	--	--	--	--	--	--	--	--	219	--	0.00	0.39	0.55	0.06	--	--
BOP-73(i)	9/18/2012	33	41	1300	340	38	<5.0	<5.0	0.45	-119	0.28	1.6	8.4	1.6	5.2	6.31	0.02	0.69	0.25	0.04	0.00	0.00
BOP-73(i)	11/14/2012	90	83	2900	110	2.6	<5.0	<5.0	0.83	122.5	0.89	0.5	10.2	3.2	<1.0	6.57	0.02	0.93	0.05	0.00	0.00	0.00
BOP-73(i)	2/6/2013	174	13	390	77	4.7	<5.0	<5.0	0.52	56.4	0.11	0.5	8.9	1.4	--	6.26	0.02	0.76	0.20	0.02	0.00	0.00
BOP-73(i)	5/7/2013	264	16	11000	6200	380	29	<5.0	2.75	-28.6	<0.10	2.0	7.8	2.8	--	6.39	0.00	0.54	0.41	0.04	0.01	0.00
BOP-73(i)	8/6/2013	28	6.5	1800	670	65	27	<5.0	0.52	-120.5	<0.10	1.5	10.2	4.8	2.4	6.18	0.00	0.60	0.31	0.05	0.04	0.00
BOP-73(i)	11/7/2013	121	<4.0	17000	7800	250	30	<5.0	1.13	-75.5	<0.10	3.0	8.6	1.9	2.0	6.41	0.00	0.60	0.37	0.02	0.00	0.00
BOP-73(i)	2/20/2014	226	<40	8400	13000	610	21	<5.0	1.23	23.0	<0.10	4.0	6.9	2.6	1.5	6.54	0.00	0.31	0.64	0.05	0.00	0.00
BOP-73(i)	5/8/2014	303	<20	340	20000	5600	180	<5.0	0.50	-43.5	<0.10	2.5	<1.0	3.4	7.2	6.92	0.00	0.01	0.68	0.29	0.02	0.00
BOP-73(i)	8/13/2014	28	<2.0	<2.0	2800	13000	730	<5.0	1.14	17.3	<0.10	4.5	1.4	4.8	32.9	5.87	0.00	0.00	0.11	0.79	0.10	0.00
BOP-73(i)	11/6/2014	113	<0.2	1.7	47	73	210	<5.0	0.15	-108.1	<0.10	3.0	4.1	5.6	11.9	6.41	0.00	0.00	0.05	0.13	0.82	0.00
BOP-73(i)	2/5/2015	204	<2.0	<2.0	340	720	347.1	<5.0	0.45	-103.3	<0.10	5.0	1.1	8.4	4.3	6.41	0.00	0.00	0.13	0.42	0.44	0.01
BOP-73(i)	5/6/2015	294	<2.0	<2.0	150	730	160	<5.0	1.08	-86.1	<0.10	5.0	1.4	13	7.2	6.35	0.00	0.00	0.08	0.62	0.30	0.00
BOP-73(i)	8/10/2015	22	<0.2	1.3	24	20	140	<5.0	0.66	-200.4	<0.10	7.0	4.8	12	28.4	6.27	0.00	0.00	0.04	0.06	0.90	0.00
BOP-73(i)	11/4/2015	108	<0.2	5.8	92	19	18.6	<5.0	0.51	-79.6	<0.10	7.0	10.9	7.5	5.1	6.36	0.00	0.02	0.49	0.16	0.16	0.17
BOP-73(i)	2/3/2016	199	<0.2	0.4	2.5	8.8	149	<5.0	1.11	-45.7	<0.10	7.0	2.4	15	9.6	7.18	0.00	0.00	0.00	0.03	0.52	0.45
BOP-73(i)	5/4/2016	290	<0.2	<0.2	<0.2	<0.2	120	<5.0	0.92	-153.3	<0.10	7.0	1.6	20.0	3.7	6.34	0.00	0.00	0.00	0.00	0.19	0.81
BOP-73(i)	8/9/2016	387	<0.2	0.7	2.7	2.6	54	<5.0	0.26	-124.8	<0.10	7.0	8.0	6.8	2.3	6.37	0.00	0.00	0.01	0.02	0.00	0.96
BOP-73(i)	11/10/2016	480	<0.2	1.5	5.1	3.2	32	<5.0	0.30	-60.1	<0.10	7.0	7.3	2.9	2.5	6.39	0.00	0.01	0.04	0.04	0.00	0.90
BOP-73(i)	2/7/2017	570	<0.2	1.4	5.7	3.4	145	<5.0	0.49	-54.9	<0.10	7.0	4.4	11	5.0	6.45	0.00	0.00	0.01	0.01	0.59	0.39
BOP-73(i)	5/16/2017	667	<0.2	<0.2	1.3	1.9	65	<5.0	0.51	-24.9	<0.10	2.0	9.3	6.1	3.9	6.41	0.00	0.00	0.01	0.01	0.35	0.63
BOP-73(i)	8/9/2017	752	<0.2	<0.2	24	1200	3070	<5.0	0.6	-43.1	<0.10	7.0	2.2	19	15.4	6.4	0.00	0.00	0.00	0.15	0.78	0.07
BOP-73(i)	9/5/2017	779	<0.2	0.8	31	1300	--	--	1.2	-30.6	NS	NS	NS	NS	NS	6.5	0.00	0.00	0.02	0.98	--	--
BOP-73(i)	2/8/2018	16	<0.2	0.9	280	1500	3683	<5.0	0.18	21.2	<0.50	2.0	1.1	22	370	5.68	0.00	0.00	0.02	0.15	0.81	0.02
BOP-73(i)	5/15/2018	111	<0.2	1.5	210	62	21.7	<5.0	0.51	-35.1	<0.10	7.0	<1.0	7	17.8	6.40	0.00	0.00	0.55	0.25	0.08	0.11
BOP-73(i)	8/3/2018	192	<0.2	38	150	22	5.1	<5.0	0.19	-18.0	<0.10	3.5	11.2	1.4	3.4	6.32	0.00	0.12	0.65	0.15	0.08	0.00
BOP-73(i)	11/7/2018	288	<0.2	47	140	24	9.4	<5.0	7.70	-32.0	<0.10	6.5	11.4	1.2	2.9	6.50	0.00	0.14	0.57	0.15	0.13	0.00
BOP-73(i)	2/12/2019	384	<0.2	<0.2	35	86	1249	<5.0	2.42	110.7	<0.50	1.5	<1.0	3.9	8.8	5.32	0.00	0.00	0.01	0.03	0.93	0.04
BOP-73(i)	5/8/2019	470	<4.0	<4.0	1400	1300	2751	<5.0	1.03	25.30	<0.50	3.0	<1.0	15	3.9	6.55	0.00	0.00	0.11	0.16	0.72	0.01
BOP-73(i)	8/13/2019	567	<4.0	<4.0	1800	1100	2785	<5.0	0.30	-48.8	<0.10	2.5	<1.0	17	2.5	6.27	0.00	0.00	0.14	0.13	0.71	0.02
BOP-73(i)	11/8/2019	653	<4.0	<4.0	2100	1700	2063	<5.0	0.72	-102.1	<0.10	2.5	<1.0	12	3.4	6.89	0.00	0.00	0.18	0.22	0.58	0.02
BOP-73(i)	2/11/2020	749	<4.0	4.2	780	1700	2559	<5.0	0.39	-22.9	<0.10	3.5	<1.0	16	2.9	7.25	0.00	0.00	0.06	0.22	0.71	0.02
BOP-73(i)	5/11/2020	838	<4.0	<4.0	1700	1400	2320	<5.0	0.56	-42.8	<0.50	2.0	<1.0	15	2.9	6.81	0.00	0.00	0.14	0.18	0.64	0.03
BOP-73(i)	8/14/2020	29	<1.00	1.17	302	463	1949.5	<5.00	0.64	-4.3	<0.500	3.5	<5.00	9.75	694	5.23	0.00	0.00	0.04	0.09	0.83	0.03

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	from Previous Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (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	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-73(i)	11/5/2020	112	<0.200	<0.200	17.9	38.1	888	<5.00	0.36	-87.4	0.12	2.0	<1.00	17	274	6.14	0.00	0.00	0.01	0.02	0.83	0.15
BOP-73(i)	2/16/2021	215	<0.200	<0.200	0.231	<0.200	139	<5.00	0.82	-104.4	<0.100	3.5	<1.00	15.2	4.95	6.33	0.00	0.00	0.00	0.00	0.00	1.00
BOP-73(i)	5/6/2021	294	<0.200	<0.200	0.4	4.63	486.8	<5.00	0.35	43.1	1.79	5.0	<5.00	12.7	4.4	6.28	0.00	0.00	0.00	0.00	0.16	0.84
BOP-73(i)	8/10/2021	391	<4.00	<4.00	93	785	1911	<5.00	0.78	-53.5	<0.500	4.5	<5.00	13.0	1.69	6.24	0.00	0.00	0.01	0.16	0.66	0.17
BOP-73(i)	11/17/2021	489	<0.200	0.502	62.3	382	901	<5.00	0.22	-127.5	<0.250	--	1.67	6.56	2.51	6.37	0.00	0.00	0.02	0.16	0.54	0.28
BOP-73(i)	2/10/2022	574	<0.200	<0.200	39.8	135	1496	<5.00	0.39	-81.0	<0.250	6.5	<1.00	12.90	5.39	6.35	0.00	0.00	0.01	0.04	0.55	0.40
BOP-73(i)	5/17/2022	671	<0.200	24.6	276	106	1634	<5.00	1.06	1.4	<0.250	7.0	1.71	11.80	10.2	6.57	0.00	0.00	0.05	0.03	0.60	0.32
BOP-74(i)	10/19/2010		1.0	38	8.0	<1.0	<1.0	--	--	--	0.9	--	9.1	0.1	<1.50	--	0.02	0.77	0.22	0.00	0.00	0.00
PRB Well	12/6/2010	32	<1.0	24	6.5	<1.0	<1.0	--	3.07	53.3	0.2	0.2	9.9	--	2.79	6.61	0.00	0.73	0.27	0.00	0.00	0.00
BOP-74(i)	2/2/2011	90	2.6	44	3.8	<1.0	--	--	0.42	81.0	--	--	--	--	--	6.22	0.04	0.86	0.10	0.00	--	--
BOP-74(i)	5/5/2011	182	2.0	26	8.0	<1.0	--	--	0.25	56.5	--	--	--	--	--	6.23	0.04	0.68	0.28	0.00	--	--
BOP-74(i)	8/10/2011	279	<1.0	8.9	7.2	<1.0	<1.1	<1.1	0.50	-124.9	<0.1	2.0	6.6	4.3	2.69	6.42	0.00	0.48	0.52	0.00	0.00	0.00
BOP-74(i)	11/3/2011	364	<1.0	3.1	16	<1.0	--	--	0.10	-21.2	--	--	--	--	--	6.46	0.00	0.13	0.87	0.00	--	--
BOP-74(i)	12/1/2011	392	<1.0	8.6	17	<1.0	<1.1	<1.1	0.01	-302.2	<0.1	1.6	6.7	1.8	3.03	7.03	0.00	0.27	0.73	0.00	0.00	0.00
BOP-74(i)	1/19/2012	22	<1.0	11	18	<1.0	1.6	<1.1	0.21	-170	<1.0	2.0	<1.0	2.6	1450	5.48	0.00	0.26	0.58	0.00	0.00	0.16
BOP-74(i)	2/16/2012	50	<1.0	2.4	44	1.6	<1.1	<1.1	0.93	-154	<0.5	3.8	<0.5	6.68	668	5.23	0.00	0.04	0.91	0.05	0.00	0.00
BOP-74(i)	3/15/2012	78	<1.0	1.4	210	3.2	<1.1	<1.1	0.10	-244	<0.5	4.8	<0.5	8.41	330	6.40	0.00	0.00	0.97	0.02	0.00	0.00
BOP-74(i)	4/17/2012	111	<5.0	<5.0	79	50	<1.1	<1.1	0.13	-276.9	<0.1	1.8	0.8	8.8	72.0	6.83	0.00	0.00	0.50	0.50	0.00	0.00
BOP-74(i)	6/12/2012	167	<1.0	<1.0	1.2	14	<1.1	<1.1	0.72	-9.9	<0.1	4.8	<0.1	5.72	67.6	5.78	0.00	0.00	0.05	0.95	0.00	0.00
BOP-74(i)	8/9/2012	225	<1.0	<1.0	<1.0	1.9	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--
BOP-74(i)	9/19/2012	34	<0.2	4.5	60	2.9	<5.0	<5.0	1.20	18.0	<0.10	4.0	<1.0	13	1280	4.86	0.00	0.05	0.88	0.07	0.00	0.00
BOP-74(i)	11/14/2012	90	<0.2	0.6	6.9	18	<5.0	<5.0	5.92	93.6	<0.10	4.0	<1.0	22	145	5.96	0.00	0.01	0.20	0.79	0.00	0.00
BOP-74(i)	2/6/2013	174	<0.2	0.5	1.7	2.9	<5.0	<5.0	0.28	-21.3	<0.10	5.0	<1.0	27	83.7	6.15	0.00	0.06	0.26	0.68	0.00	0.00
BOP-74(i)	5/7/2013	264	<0.2	4.0	2.7	1.8	<5.0	<5.0	1.21	-53.0	<0.10	3.0	<1.0	21	128	6.04	0.00	0.35	0.32	0.33	0.00	0.00
BOP-74(i)	8/6/2013	28	<0.2	0.6	14	8.1	<5.0	<5.0	2.35	-25.0	<0.10	3.5	<1.0	26	669	5.07	0.00	0.02	0.52	0.47	0.00	0.00
BOP-74(i)	11/7/2013	121	<0.2	<0.2	3.6	1.6	7.3	<5.0	1.49	95.6	<0.10	3.5	<1.0	17	330	6.05	0.00	0.00	0.11	0.08	0.81	0.00
BOP-74(i)	2/20/2014	226	<0.2	<0.2	2.4	0.9	5	<5.0	0.92	-71.6	<0.10	6.0	<1.0	22	66.2	6.37	0.00	0.00	0.12	0.07	0.00	0.81
BOP-74(i)	5/8/2014	303	<0.2	<0.2	2.8	3.3	5.9	<5.0	1.15	-33.7	<0.10	3.0	<1.0	19	32.8	6.58	0.00	0.00	0.10	0.18	0.72	0.00
BOP-74(i)	11/6/2014	113	<0.2	0.3	11	2.1	<5.0	<5.0	0.12	-134.5	0.63	7.0	501	21	2860	4.16	0.00	0.02	0.76	0.22	0.00	0.00
BOP-74(i)	2/6/2015	205	<0.2	0.4	15	1.9	<5.0	<5.0	0.23	-95.9	0.54	7.0	626	21	2230	4.86	0.00	0.02	0.82	0.16	0.00	0.00
BOP-74(i)	5/6/2015	294	<0.2	0.5	15	1.6	<5.0	<5.0	0.79	-107.6	0.27	7.0	247		1240	4.92	0.00	0.02	0.84	0.14	0.00	0.00
BOP-74(i)	11/4/2015	108	<0.2	<0.2	5.3	2.9	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.54	0.46	--	--
BOP-74(i)	2/3/2016	199	<0.2	<0.2	11	3.1	<5.0	<5.0	1.68	60.4	<1.0	7.0	1460	21	4200	5.5	0.00	0.00	0.70	0.30	0.00	0.00
BOP-74(i)	5/4/2016	290	<0.2	0.2	11	2.6	<5.0	<5.0	0.52	-21.6	<1.0	7.0	601.0	19.0	2480	4.57	0.00	0.01	0.72	0.27	0.00	0.00
BOP-74(i)	8/9/2016	387	<0.2	0.2	11	1.6	<5.0	<5.0	--	-36.9	0.45	7.0	453	18	1840	4.72	0.00	0.01	0.81	0.18	0.00	0.00
BOP-74(i)	11/10/2016	480	<0.2	0.2	9.9	1.3	<5.0	<5.0	0.34	-9.0	0.16	7.0	225	22	1430	4.87	0.00	0.01	0.82	0.17	0.00	0.00
BOP-74(i)	2/7/2017	570	<0.2	0.2	8.7	1.3	<5.0	<5.0	0.33	-18.1	0.24	7.0	110	23	1690	5.00	0.00	0.01	0.80	0.19	0.00	0.00
BOP-74(i)	5/16/2017	667	<0.2	<0.2	7.5	1.1	<5.0	<5.0	0.39	-35.7	0.26	2.0	147	28	1580	5.04	0.00	0.00	0.81	0.19	0.00	0.00
BOP-74(i)	8/9/2017	753	<0.2	<0.2	7.1	1	<5.0	<5.0	0.4	-22.3	0.19	7.0	42.2	23	1310	5.0	0.00	0.00	0.82	0.18	0.00	0.00
BOP-74(i)	2/27/2018	35	<0.2	<0.2	2.1	1	<5.0	<5.0	0.67	5.2	0.83	7.0	158	23	7320	4.86	0.00	0.00	0.58	0.42	0.00	0.00
BOP-74(i)	5/15/2018	112	<0.4	<0.4	3.2	0.7	<5.0	<5.0	0.43	32.1	<0.10	7.0	67.1	20	2000	5.06	0.00	0.00	0.75	0.25	0.00	0.00
BOP-74(i)	8/8/2018	197	<0.2	<0.2	3.6	0.8	31	<5.0	0.36	-28.9	<0.10	2.0	77.9	20	2550	4.5	0.00	0.00	0.03	0.01	0.60	0.35
BOP-74(i)	2/12/2019	384	<0.2	<0.2	3.2	2.7	<5.0	<5.0	0.35	67.4	<0.50	3.5	30.7	12	2070	4.9	0.00	0.00	0.43	0.57	0.00	0.00
BOP-74(i)	5/9/2019	470	<0.2	0.2	3.6	3.5	<5.0	<5.0	0.00	43.43	<0.10	4.0	20.3	22	1410	4.84	0.00	0.02	0.39	0.59	0.00	0.00
BOP-74(i)	8/13/2019	567	<0.2	<0.2	3.1	1.8	6.7	<5.0	0.21	-20.7	<0.10	2.0	48.9	27	1150	4.90	0.00	0.00	0.11	0.10	0.80	0.00
BOP-74(i)	11/8/2019	653	<0.2	<0.2	3.1	1.6	17.7	<5.0	0.32	51.6	<0.10	2.0	97.9	18	1510	4.69	0.00	0.00	0.05	0.04	0.58	0.33

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	from Previous Injection (days)	Volatile Organic Compounds Analytical Results							Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (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	PCE	TCE	cDCE	VC	Ethene	Ethane	
BOP-74(i)	2/12/2020	749	<0.2	<0.2	2.8	1.6	13.6	<5.0	0.55	-4.7	<0.10	3.5	10.3	22	752	5.45	0.00	0.00	0.06	0.05	0.35	0.54	
BOP-74(i)	5/11/2020	839	<0.2	<0.2	2.7	1.4	<5.0	<5.0	0.54	-24.4	0.38	3.5	23.3	19	646	4.97	0.00	0.00	0.55	0.45	0.00	0.00	
BOP-74(i)	11/5/2020	113	<0.200	<0.200	5.88	1.1	6.16	<5.00	0.55	34.8	4.6	2.5	10.8	13.3	3910	4.65	0.00	0.00	0.20	0.06	0.74	0.00	
BOP-74(i)	2/16/2021	215	<0.200	0.217	10.4	1.64	<5.00	<5.00	0.59	-12.8	<0.100	4.0	1.13	14.2	2010	4.88	0.00	0.01	0.79	0.19	0.00	0.00	
BOP-74(i)	5/6/2021	294	<0.200	0.236	9.48	1.35	10.3	<5.00	0.09	34.5	1.83	2.0	<5.00	16.4	1630	4.69	0.00	0.00	0.21	0.05	0.00	0.74	
BOP-74(i)	8/12/2021	392	<0.200	0.216	9.04	1.15	<5.00	<5.00	0.00	56.0	1.02	--	18.8	18.9	1310	4.10	0.00	0.01	0.82	0.16	0.00	0.00	
BOP-74(i)	11/18/2021	490	<0.200	<0.200	5.96	1.44	<5.00	<5.00	0.04	44.9	<0.250	6.5	<1.0	23.9	609	4.34	0.00	0.00	0.73	0.27	0.00	0.00	
BOP-74(i)	2/8/2022	572	<0.200	<0.200	5.72	1.15	21.4	<5.00	-0.20	349.1	<0.250	7.0	<1.00	24	625	2.96	0.00	0.00	0.07	0.02	0.46	0.45	
BOP-74(i)	5/12/2022	666	<0.200	<0.200	4.67	1.13	25.42	<5.00	0.81	190.9	<0.250	5.0	<1.00	17.1	533	4.10	0.00	0.00	0.05	0.02	0.65	0.28	
BOP-75(i)	2/2/2011	90	2.5	87	11	<1.0	--	--	--	--	--	--	--	--	--	--	0.02	0.84	0.14	0.00	--	--	
Upgradient Well	5/5/2011	182	1.1	52	11	<1.0	--	--	--	--	--	13.5	--	--	4.77	--	0.01	0.77	0.22	0.00	--	--	
BOP-75(i)	8/10/2011	279	1.6	59	11	<1.0	<1.1	<1.1	1.76	-16.3	1.1	2.4	--	<0.0007	--	6.24	0.02	0.78	0.20	0.00	0.00	0.00	
BOP-75(i)	11/3/2011	364	1.2	58	10	<1.0	--	--	--	--	--	--	--	--	--	--	0.01	0.80	0.19	0.00	--	--	
BOP-75(i)	2/8/2012	42	1.3	55	9.7	<1.0	--	--	--	--	--	--	--	--	--	--	0.01	0.80	0.19	0.00	--	--	
BOP-75(i)	5/4/2012	128	<1.0	52	10	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	0.79	0.21	0.00	--	--	
BOP-75(i)	8/9/2012	225	1.6	39	7.2	<1.0	--	--	--	--	--	--	--	--	--	--	0.03	0.78	0.20	0.00	--	--	
BOP-75(i)	11/8/2012	84	1.0	35	6.9	<0.2	--	--	--	--	--	--	--	--	--	--	0.02	0.78	0.21	0.00	--	--	
BOP-75(i)	2/5/2013	173	1.0	54	9.5	<0.2	--	--	--	--	--	--	--	--	--	--	0.01	0.80	0.19	0.00	--	--	
BOP-75(i)	5/2/2013	259	0.8	42	7.5	<0.2	--	--	--	--	--	--	--	--	--	--	0.01	0.80	0.19	0.00	--	--	
BOP-75(i)	6/17/2013	305	0.7	35	9.8	<0.2	<5.0	<5.0	1.91	73.6	1.7	0.0	13.6	<0.005	2.3	6.25	0.01	0.72	0.27	0.00	0.00	0.00	
BOP-75(i)	8/6/2013	28	0.2	1.3	37	0.2	<5.0	<5.0	2.32	-159.5	<0.10	3.0	<1.0	0.39	51.3	6.43	0.00	0.02	0.96	0.01	0.00	0.00	
BOP-75(i)	11/7/2013	121	<0.2	2.2	2.4	25	<5.0	<5.0	0.77	-167.0	<0.10	3.5	4.5	12	5.5	6.55	0.00	0.04	0.06	0.91	0.00	0.00	
BOP-75(i)	2/5/2014	211	<0.2	2.6	1.3	18	--	--	--	--	--	--	--	--	--	--	0.00	0.06	0.04	0.90	--	--	
BOP-75(i)	5/7/2014	302	<0.2	7.4	2.7	14	--	--	--	--	--	--	--	--	--	--	0.00	0.18	0.09	0.73	--	--	
BOP-75(i)	8/13/2014	28	<0.2	6.2	9.5	10	<5.0	<5.0	0.40	-30.2	<0.10	7.0	27.7	9.9	258	5.38	0.00	0.15	0.32	0.52	0.00	0.00	
BOP-75(i)	11/5/2014	112	<0.2	<0.2	4.3	11	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.20	0.80	--	--	
BOP-75(i)	2/6/2015	205	<0.2	9.1	8.6	4.2	<5.0	<5.0	0.26	-117.3	<0.10	--	3.4	14	3.9	6.11	0.00	0.31	0.39	0.30	0.00	0.00	
BOP-75(i)	5/4/2015	292	<0.2	13	6.4	4.3	--	--	--	--	--	--	--	--	--	--	0.00	0.42	0.28	0.29	--	--	
BOP-75(i)	8/10/2015	22	<0.2	1.5	4.2	3.3	<5.0	<5.0	0.50	-217.3	<0.10	7.0	255	15	1170	5.34	0.00	0.11	0.40	0.49	0.00	0.00	
BOP-75(i)	11/6/2015	110	<0.2	0.4	4.7	4.2	--	--	--	--	--	--	--	--	--	--	0.00	0.03	0.41	0.57	--	--	
BOP-75(i)	2/3/2016	199	<0.2	1.1	3.5	4.3	<5.0	<5.0	1.51	-65.6	<0.10	7.0	5.5	18	2.5	7.26	0.00	0.07	0.32	0.61	0.00	0.00	
BOP-75(i)	5/5/2016	291	<0.2	2.0	3.9	5.4	--	--	--	--	--	--	--	--	--	--	0.00	0.11	0.28	0.61	--	--	
BOP-75(i)	8/9/2016	387	<0.2	1.0	3.0	4.7	<5.0	<5.0	0.38	-125.9	<0.10	7.0	6.0	18	1.9	6.19	0.00	0.07	0.27	0.66	0.00	0.00	
BOP-75(i)	11/4/2016	475	<0.2	6.2	3.0	3.4	--	--	--	--	--	--	--	--	--	--	0.00	0.36	0.23	0.41	--	--	
BOP-75(i)	2/7/2017	569	<0.2	4.9	2.9	4.1	<5.0	<5.0	0.44	-67.1	<0.10	7.0	11.6	11	2.7	6.32	0.00	0.28	0.23	0.49	0.00	0.00	
BOP-75(i)	5/16/2017	668	<0.2	5.3	3.2	3.4	--	--	--	--	--	--	--	--	--	--	0.00	0.32	0.26	0.43	--	--	
BOP-75(i)	8/9/2017	752	<0.2	8.4	4.9	3.4	<5.0	<5.0	0.5	-50.9	<0.10	7.0	16.1	6.5	2.4	6.2	0.00	0.38	0.30	0.32	0.00	0.00	
BOP-75(i)	2/27/2018	34	<0.2	<0.2	0.3	0.2	<5.0	<5.0	0.19	-98.7	<1.0	7.0	31.7	1.2	3450	4.92	0.00	0.00	0.49	0.51	0.00	0.00	
BOP-75(i)	5/15/2018	111	<0.2	<0.2	0.6	0.4	<5.0	<5.0	1.1	63.2	0.35	7.0	23.6	16	3630	4.78	0.00	0.00	0.49	0.51	0.00	0.00	
BOP-75(i)	8/3/2018	192	<0.2	<0.2	0.9	0.8	14.2	<5.0	0.33	-9.6	0.54	6.5	28.8	19	2560	5.27	0.00	0.00	0.02	0.02	0.60	0.36	
BOP-75(i)	11/7/2018	287	<0.2	0.2	1.1	0.6	<5.0	<5.0	8.4	0.3	0.71	7.0	28.7	20	2100	5.5	0.00	0.07	0.50	0.43	0.00	0.00	
BOP-75(i)	2/12/2019	384	<0.2	0.2	1.7	0.5	<5.0	<5.0	0.2	21.6	<0.50	1.5	<1.0	13	373	5.6	0.00	0.06	0.65	0.30	0.00	0.00	
BOP-75(i)	5/8/2019	470	<0.2	<0.2	1.9	0.2	<5.0	<5.0	0.91	47.10	<0.50	2.0	<1.0	25	56.8	6.06	0.00	0.00	0.86	0.14	0.00	0.00	
BOP-75(i)	8/13/2019	566	<0.2	<0.2	1.4	0.2	<5.0	<5.0	0.70	-108.8	<0.10	2.5	1.3	21	39.2	6.12	0.00	0.00	0.82	0.18	0.00	0.00	
BOP-75(i)	11/8/2019	654	<0.2	<0.2	0.7	0.3	<5.0	<5.0	0.33	-94.8	<0.10	5.0	1.6	27	64.1	6.08	0.00	0.00	0.60	0.40	0.00	0.00	
BOP-75(i)	2/11/2020	749	<0.2	<0.2	0.6	0.6	<5.0	<5.0	0.5	-36.8	<0.10	6.0	1.1	21	63.6	6.73	0.00	0.00	0.39	0.61	0.00	0.00	

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	from Previous Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (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	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-75(i)	5/11/2020	839	<0.2	<0.2	0.3	0.3	<5.0	<5.0	0.54	-87.0	<0.50	5.0	1.3	19	57.9	5.79	0.00	0.00	0.39	0.61	0.00	0.00
BOP-75(i)	8/13/2020	29	<0.200	0.402	0.97	0.214	<5.00	<5.00	0.49	35.9	<0.500	6.0	49.6	14.2	3620	4.84	0.00	0.19	0.61	0.21	0.00	0.00
BOP-75(i)	11/5/2020	112	<0.200	0.343	1.79	0.219	<5.00	<5.00	0.51	-7.0	<0.500	3.50	<1.00	15.9	1740	4.93	0.00	0.11	0.75	0.14	0.00	0.00
BOP-75(i)	2/16/2021	215	<0.200	<0.200	1.98	<0.200	<5.00	<5.00	0.44	-128.1	0.132	3.00	<1.00	15.5	288	5.86	0.00	0.00	1.00	0.00	0.00	0.00
BOP-75(i)	5/6/2021	294	<0.200	<0.200	1.45	<0.200	<5.00	<5.00	0.67	47.1	1.45	3.50	<5.00	15	45.4	5.94	0.00	0.00	1.00	0.00	0.00	0.00
BOP-75(i)	8/12/2021	392	<0.200	<0.200	0.777	<0.200	<5.00	<5.00	0.01	-60.2	0.513	5.00	2.35	20.8	69.8	5.83	0.00	0.00	1.00	0.00	0.00	0.00
BOP-75(i)	11/18/2021	490	<0.200	<0.200	0.475	0.239	<5.00	<5.00	0.23	-150.1	<0.250	6.50	1.94	21.9	76.6	5.92	0.00	0.00	0.56	0.44	0.00	0.00
BOP-75(i)	2/8/2022	572	<0.200	<0.200	0.428	0.363	<5.00	<5.00	-0.18	-9.6	<0.250	7.00	2.08	21.4	65.3	4.87	0.00	0.00	0.43	0.57	0.00	0.00
BOP-75(i)	5/12/2022	666	<0.200	<0.200	0.299	0.266	<5.00	<5.00	0.85	-74.5	<0.250	7.00	1.26	15.6	60.2	5.75	0.00	0.00	0.42	0.58	0.00	0.00
BOP-76(i)	2/2/2011	90	1.7	8.5	<1.0	<1.0	--	--	--	--	--	--	--	--	--	--	0.14	0.86	0.00	0.00	--	--
Monitoring Well	5/5/2011	182	<1.0	6.8	1.2	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	0.81	0.19	0.00	--	--
BOP-76(i)	8/10/2011	279	1.2	13	4.6	<1.0	<1.1	<1.1	3.59	110	3.8	1.1	10.2	<0.0007	2.37	6.20	0.05	0.64	0.31	0.00	0.00	0.00
BOP-76(i)	11/3/2011	364	1.4	27	1.6	<1.0	--	--	--	--	--	--	--	--	--	--	0.04	0.89	0.07	0.00	--	--
BOP-76(i)	2/8/2012	42	<1.0	2.1	<1.0	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--
BOP-76(i)	5/4/2012	128	<1.0	9.2	1.5	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	0.82	0.18	0.00	--	--
BOP-76(i)	8/9/2012	225	1.1	33	2.2	<1.0	--	--	--	--	--	--	--	--	--	--	0.02	0.90	0.08	0.00	--	--
BOP-76(i)	11/8/2012	84	0.8	9.8	1.7	<0.2	--	--	--	--	--	--	--	--	--	--	0.05	0.77	0.18	0.00	--	--
BOP-76(i)	2/5/2013	173	0.8	11	1.5	<0.2	--	--	--	--	--	--	--	--	--	--	0.05	0.80	0.15	0.00	--	--
BOP-76(i)	5/2/2013	259	1.4	22	1.7	<0.2	--	--	--	--	--	--	--	--	--	--	0.04	0.87	0.09	0.00	--	--
BOP-76(i)	6/17/2013	305	1.1	26	1.9	<0.2	<5.0	<5.0	1.34	75.5	3.7	0.0	11.0	<0.005	1.6	6.18	0.03	0.88	0.09	0.00	0.00	0.00
BOP-76(i)	8/6/2013	28	<0.2	1.0	100	8.3	<5.0	<5.0	2.24	-130.0	<0.10	3.5	<1.0	3.4	111	6.14	0.00	0.01	0.88	0.11	0.00	0.00
BOP-76(i)	11/7/2013	121	2.4	140	37	42	<5.0	<5.0	1.51	-204.2	<0.10	3.5	3.5	11	6.9	6.44	0.01	0.50	0.18	0.31	0.00	0.00
BOP-76(i)	2/5/2014	211	1.0	45	5.8	8.5	--	--	--	--	--	--	--	--	--	--	0.01	0.63	0.11	0.25	--	--
BOP-76(i)	5/7/2014	302	<0.2	7.2	1.2	4.6	--	--	--	--	--	--	--	--	--	--	0.00	0.39	0.09	0.52	--	--
BOP-76(i)	8/13/2014	28	0.3	13	24	4.1	<5.0	<5.0	0.45	1.8	<0.10	7.0	3.2	7.6	170	5.27	0.00	0.24	0.60	0.16	0.00	0.00
BOP-76(i)	11/6/2014	113	<0.2	1.4	9.5	2.1	15	<5.0	0.20	-104.7	0.20	1.5	3.2	21	51.2	5.88	0.00	0.02	0.14	0.05	0.79	0.00
BOP-76(i)	2/5/2015	204	<0.2	1.0	7.0	2.2	30	<5.0	0.23	-154.7	0.21	2.75	5.1	19	12.7	6.08	0.00	0.01	0.06	0.03	0.90	0.00
BOP-76(i)	5/7/2015	295	<0.2	0.6	6.6	3.9	<5.0	<5.0	1.52	-124.1	<0.10	4.0	5.5	20	7.5	6.14	0.00	0.03	0.50	0.46	0.00	0.00
BOP-76(i)	8/10/2015	22	<0.2	2.2	14	2.0	<5.0	<5.0	0.43	-190.8	<0.10	7.0	108	12	659	5.54	0.00	0.09	0.75	0.17	0.00	0.00
BOP-76(i)	11/4/2015	108	<0.2	0.9	14	2.0	<5.0	<5.0	0.83	-86.1	<0.10	7.0	4.0	15	115	6.15	0.00	0.04	0.79	0.17	0.00	0.00
BOP-76(i)	2/3/2016	199	<0.2	1.0	9.8	1.6	<5.0	<5.0	1.13	-85.0	<0.10	7.0	6.3	16	5.0	7.16	0.00	0.06	0.75	0.19	0.00	0.00
BOP-76(i)	5/4/2016	290	<0.2	0.5	10	3.8	<5.0	<5.0	8.65	-227.8	<0.10	7.0	4.5	18	26.4	6.15	0.00	0.02	0.61	0.36	0.00	0.00
BOP-76(i)	8/9/2016	387	<0.2	1.1	11	4.2	<5.0	<5.0	0.81	-136.0	<0.10	7.0	6.7	14	7.8	6.13	0.00	0.04	0.60	0.36	0.00	0.00
BOP-76(i)	11/10/2016	480	<0.2	3.5	7.4	2.5	<5.0	<5.0	0.40	-31.5	<0.10	7.0	21.9	14	3.4	6.14	0.00	0.19	0.53	0.28	0.00	0.00
BOP-76(i)	2/7/2017	569	<0.2	4.8	4.6	1.8	<5.0	<5.0	0.57	-0.4	<0.10	7.0	21.2	12	4.1	6.31	0.00	0.32	0.42	0.26	0.00	0.00
BOP-76(i)	5/16/2017	667	<0.2	2.1	5.3	2.5	<5.0	<5.0	0.75	-12.1	<0.10	3.0	17.8	17	4.6	6.29	0.00	0.14	0.49	0.36	0.00	0.00
BOP-76(i)	8/9/2017	752	<0.2	1.7	5.1	2.5	<5.0	<5.0	1.0	-51.5	<0.10	7.0	16.6	13	4.6	6.1	0.00	0.12	0.50	0.38	0.00	0.00
BOP-76(i)	2/8/2018	16	<0.2	<0.2	0.7	0.8	<5.0	<5.0	0.19	29.3	<0.50	7.0	140	13	6860	5.19	0.00	0.00	0.36	0.64	0.00	0.00
BOP-76(i)	5/15/2018	111	<0.2	0.9	2.1	1.1	<5.0	<5.0	0.54	18.6	0.19	7.0	30.8	20	3670	5.38	0.00	0.15	0.47	0.38	0.00	0.00
BOP-76(i)	8/3/2018	192	<0.2	1.1	2.7	1.8	15	<5.0	0.21	-30.3	0.29	4.5	32.4	14	2970	5.20	0.00	0.13	0.43	0.44	0.00	0.00
BOP-76(i)	11/7/2018	288	<0.2	1.2	2.9	2.1	<5.0	<5.0	10.1	16.9	0.25	7.0	33.1	17	2660	5.3	0.00	0.13	0.41	0.46	0.00	0.00
BOP-76(i)	2/12/2019	384	<0.2	1.5	3.6	2.8	21.1	<5.0	0.3	21.0	<0.50	2.5	<5.0	14	2020	5.0	0.00	0.12	0.40	0.48	0.00	0.00
BOP-76(i)	5/9/2019	471	<0.2	1.5	3.7	4.2	7.7	<5.0	0.35	13.1	<0.10	3.5	<1.0	15	1350	5.35	0.00	0.10	0.33	0.58	0.00	0.00
BOP-76(i)	8/13/2019	566	<0.2	1.1	4.6	2.1	7.8	<5.0	0.54	-52.5	<0.10	2.0	<1.0	15	653	5.64	0.00	0.09	0.53	0.38	0.00	0.00
BOP-76(i)	11/7/2019	653	<0.20	0.6	6	1.4	<5.0	<5.0	0.54	-69.8	0.25	4.0	<1.0	19	310	5.87	0.00	0.05	0.70	0.25	0.00	0.00
BOP-76(i)	2/12/2020	749	<0.2	0.2	3.4	1.5	<5.0	<5.0	0.5	-36.8	0.21	6.0	<1.0	19	370	6.73	0.00	0.03	0.58	0.40	0.00	0.00

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	from Previous Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (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	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-76(i)	5/11/2020	838	<0.2	<0.2	2.9	1.5	78	<5.0	0.75	-54.9	<0.50	5.7	<1.0	15	141	6.22	0.00	0.00	0.55	0.45	0.00	0.00
BOP-76(i)	8/14/2020	29	<0.200	0.332	0.878	8.52	102.4	<5.00	0.39	-70.7	12.3	2.5	67.4	5.36	12700	5.20	0.00	0.02	0.06	0.92	0.00	0.00
BOP-76(i)	11/5/2020	112	<0.200	0.931	1.39	2.73	213.3	<5.00	0.29	-23.2	<0.100	4.00	46.1	12.4	6630	5.24	0.00	0.11	0.22	0.67	0.00	0.00
BOP-76(i)	2/16/2021	215	<0.200	0.4	1.22	9.44	130.8	<5.00	0.99	-77.6	0.1	2.50	1.22	10.8	3470	5.37	0.00	0.02	0.08	0.91	0.00	0.00
BOP-76(i)	5/6/2021	294	<0.200	0.574	0.988	1.6	181.9	<5.00	0.07	41.3	1.7	3.00	<5.00	13	1740	5.47	0.00	0.11	0.25	0.64	0.00	0.00
BOP-76(i)	8/12/2021	393	<0.200	0.379	0.738	0.569	33.26	<5.00	0.00	-77.4	1.57	4.5	<1.00	20.3	770	5.99	0.00	0.15	0.39	0.46	0.00	0.00
BOP-76(i)	11/18/2021	490	<0.200	0.221	0.844	3.35	<5.0	<5.00	0.05	-190.1	<0.250	7.0	4.71	27.2	219	6.37	0.00	0.03	0.14	0.84	0.00	0.00
BOP-76(i)	2/8/2022	572	<0.200	0.237	0.803	0.314	<5.0	<5.00	0.12	101.0	<0.250	7.0	<1.00	16	180	4.22	0.00	0.12	0.55	0.33	0.00	0.00
BOP-76(i)	5/17/2022	671	<0.200	<0.200	0.829	<0.200	<5.0	<5.00	1.72	-26.8	<0.250	5.0	1.45	16.1	88.4	6.63	0.00	0.00	1.00	0.00	0.00	0.00
BOP-77(i)	2/2/2011	90	1.7	88	2.7	<1.0	--	--	--	--	--	--	--	--	--	--	0.01	0.95	0.04	0.00	--	--
Monitoring Well	5/5/2011	182	<1.0	41	3.8	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	0.89	0.11	0.00	--	--
BOP-77(i)	8/10/2011	279	1.8	17	1.6	<1.0	--	--	--	--	--	--	--	--	--	--	0.07	0.83	0.11	0.00	--	--
BOP-77(i)	11/3/2011	364	<1.0	11	6.7	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	0.55	0.45	0.00	--	--
BOP-77(i)	12/1/2011	392	1.1	32	7.1	<1.0	<1.1	<1.1	0.0	-274.8	0.2	0.8	8.4	<0.0007	2.41	6.77	0.02	0.75	0.23	0.00	0.00	0.00
BOP-77(i)	12/28/2011	419	--	--	--	--	--	--	--	--	--	--	--	--	12100	--	--	--	--	--	--	--
BOP-77(i)	12/28/2011	419	--	--	--	--	--	--	--	--	--	--	--	--	13800	--	--	--	--	--	--	--
BOP-77(i)	1/19/2012	22	<20	21	<20	<20	--	--	1.09	-154.4	<1.0	2.1	4.0	--	3800	5.40	0.00	1.00	0.00	0.00	--	--
BOP-77(i)	2/16/2012	50	<1.0	8.4	48	1.8	<1.1	<1.1	0.58	-154.4	<0.5	5.0	<0.5	6.6	884	5.69	0.00	0.11	0.84	0.05	0.00	0.00
BOP-77(i)	3/15/2012	78	<1.0	2.2	120	4.6	<1.1	<1.1	0.72	-261.9	<0.5	4.4	<0.5	10	148	6.96	0.00	0.01	0.93	0.06	0.00	0.00
BOP-77(i)	4/17/2012	111	<3.0	<3.0	21	62	<1.1	<1.1	0.40	-274.5	<0.1	5.6	0.6	12.2	208	7.12	0.00	0.00	0.18	0.82	0.00	0.00
BOP-77(i)	6/12/2012	167	<1.0	1.4	1.2	60	<1.1	<1.1	0.67	-50.4	<0.1	4.3	<0.1	0.314	314	6.36	0.00	0.01	0.01	0.98	0.00	0.00
BOP-77(i)	8/9/2012	225	<1.0	<1.0	<1.0	59	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--
BOP-77(i)	8/16/2012	232	--	--	--	--	--	--	--	--	--	--	--	--	23,800	--	--	--	--	--	--	--
BOP-77(i)	9/18/2012	33	<4.0	<4.0	28	4.1	<5.0	<5.0	0.78	25.8	<0.50	3.8	6.3	9.2	4670	4.66	0.00	0.00	0.81	0.19	0.00	0.00
BOP-77(i)	11/14/2012	90	<0.2	17	150	15	<5.0	<5.0	1.49	160.5	<1.0	3.5	<10.0	22	2270	5.66	0.00	0.07	0.81	0.13	0.00	0.00
BOP-77(i)	2/6/2013	174	<0.4	11	31	3.2	5.5	<5.0	0.35	6.4	<0.10	2.5	4.1	15	1136	5.76	0.00	0.13	0.49	0.08	0.30	0.00
BOP-77(i)	5/7/2013	264	<0.2	18	17	11	13	<5.0	1.52	-74.9	<0.10	2.5	<1.0	23	112	6.15	0.00	0.14	0.184	0.18	0.49	0.00
BOP-77(i)	8/6/2013	28	<0.2	0.7	14	13	8.6	<5.0	1.14	-44.3	<0.10	3.5	<1.0	17	888	5.38	0.00	0.01	0.217	0.31	0.46	0.00
BOP-77(i)	11/7/2013	121	<0.2	<0.2	9.5	19	22	<5.0	0.91	-106.7	<0.10	3.5	<1.0	20	111	6.21	0.00	0.00	0.083	0.26	0.66	0.00
BOP-77(i)	2/20/2014	226	<0.2	2.7	6.1	7.6	22	<5.0	1.14	-8.9	<0.10	3.5	<1.0	19	40	6.29	0.00	0.02	0.064	0.12	0.79	0.00
BOP-77(i)	5/8/2014	303	<0.2	0.2	5.1	14	64.4	<5.0	0.76	-16.4	<0.10	3.0	<1.0	23	36.4	6.41	0.00	0.00	0.021	0.09	0.81	0.08
BOP-77(i)	8/13/2014	28	<0.2	0.6	81	17	24	<5.0	0.88	71.4	<0.50	6.0	2750	15	10100	4.32	0.00	0.00	0.42	0.14	0.43	0.00
BOP-77(i)	11/6/2014	113	<0.2	2.7	200	24	63	<5.0	0.17	-165.8	<0.50	7.0	1850	22	4920	4.13	0.00	0.00	0.44	0.08	0.48	0.00
BOP-77(i)	2/6/2015	205	<0.2	4.2	120	24	58	<5.0	0.83	-38.7	<0.50	7.0	855	26	4330	4.78	0.00	0.01	0.33	0.10	0.56	0.00
BOP-77(i)	5/6/2015	294	<0.2	6.2	220	20	52.6	<5.0	0.98	-85.9	1.0	7.0	519	19	3030	4.84	0.00	0.01	0.50	0.07	0.37	0.04
BOP-77(i)	8/10/2015	22	<0.2	6.2	86	11	81.8	<5.0	0.94	-73.3	<1.0	7.0	3830	15	9110	4.30	0.00	0.01	0.22	0.04	0.67	0.06
BOP-77(i)	11/4/2015	108	<0.2	8.2	72	13	27.1	<5.0	0.59	34.5	<5.0	7.0	2860	15	6350	4.55	0.00	0.03	0.38	0.11	0.40	0.09
BOP-77(i)	2/3/2016	199	<0.2	6.2	61	8.7	21	<5.0	1.87	35.2	<1.0	--	1530	20	4650	5.80	0.00	0.03	0.41	0.09	0.37	0.11
BOP-77(i)	5/4/2016	290	<0.2	4.9	44	6.7	39	<5.0	0.73	-103.0	<1.0	7.0	892.0	17.0	2990	4.71	0.00	0.02	0.23	0.06	0.38	0.31
BOP-77(i)	8/9/2016	387	0.4	2.7	33	2.1	6	<5.0	0.22	-88.5	0.51	7.0	165	16	1450	4.99	0.00	0.03	0.57	0.06	0.00	0.33
BOP-77(i)	11/10/2016	480	<0.2	2.6	15	1.5	8.5	<5.0	0.35	-36.3	0.12	7.0	5.3	29	265	5.53	0.00	0.04	0.31	0.05	0.60	0.00
BOP-77(i)	2/7/2017	570	<0.2	0.3	20	2.2	8	<5.0	0.63	-49.6	<0.10	7.0	<1.0	27	85.1	6.00	0.00	0.00	0.40	0.07	0.00	0.52
BOP-77(i)	5/16/2017	667	<0.2	<0.2	13	2.6	24.6	<5.0	0.71	-60.2	<0.10	1.5	<1.0	17	38.3	6.09	0.00	0.00	0.13	0.04	0.20	0.63
BOP-77(i)	8/9/2017	752	<0.2	<0.2	0.8	4.8	15	<5.0	0.9	-37.3	<0.10	7.0	<1.0	32	39.6	5.9	0.00	0.00	0.01	0.13	0.41	0.45
BOP-77(i)	2/8/2018	16	<0.2	<0.2	1.4	0.7	14	<5.0	0.92	47.7	<0.50	2.0	192	18	9600	4.65	0.00	0.00	0.03	0.02	0.00	0.95
BOP-77(i)	5/15/2018	112	<0.2	0.4	6.3	1.1	12	<5.0	0.62	43.7	0.12	7.0	39.8	19	6260	4.80	0.00	0.01	0.13	0.04	0.00	0.82

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	from Previous Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (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	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-77(i)	8/3/2018	192	<0.2	0.9	8.9	1.7	12	<5.0	0.45	-12.4	0.68	3.0	93.7	15	5600	4.68	0.00	0.01	0.17	0.05	0.00	0.76
BOP-77(i)	11/8/2018	288	<0.2	1.1	6.6	0.6	12	<5.0	2.0	23.4	0.47	7.0	88.7	21	4340	4.76	0.00	0.02	0.14	0.02	0.00	0.82
BOP-77(i)	2/12/2019	384	<0.2	1.1	6.1	0.9	11	<5.0	0.6	144.4	<0.50	1.0	11	5.6	3360	4.66	0.00	0.02	0.14	0.03	0.00	0.81
BOP-77(i)	5/8/2019	470	<0.2	1	5.9	0.6	5.5	<5.0	1.19	69.83	<0.50	7.0	41.9	21	2140	4.90	0.00	0.03	0.23	0.04	0.00	0.70
BOP-77(i)	8/13/2019	566	<0.2	1.1	5.4	0.5	7.2	<5.0	0.64	29.8	0.17	4.0	<1.0	20	943	4.87	0.00	0.03	0.18	0.03	0.00	0.77
BOP-77(i)	11/8/2019	653	<0.20	0.6	5.6	1.1	5.3	<5.0	0.41	-54.9	<0.10	3.5	<1.0	21	1030	5.32	0.00	0.02	0.21	0.07	0.70	0.00
BOP-77(i)	2/11/2020	749	<0.2	0.5	6.5	3.2	8.5	<5.0	0.41	21	0.22	--	2.1	22	703	5.97	0.00	0.01	0.16	0.12	0.71	0.00
BOP-77(i)	5/11/2020	838	<0.2	0.4	17	9.2	17	<5.0	0.58	13.5	<0.50	3.0	<1.0	17	282	4.95	0.00	0.00	0.19	0.16	0.65	0.00
BOP-77(i)	8/14/2020	29	<0.200	<0.200	3.23	1.41	7.85	<5.00	0.73	43.1	90.3	4.5	69.6	9.5	13200	4.52	0.00	0.00	0.11	0.07	0.00	0.82
BOP-77(i)	11/5/2020	113	<0.200	0.326	3.67	1.24	14.59	<5.00	0.36	37.1	<0.100	2.0	29.2	12.8	6990	4.78	0.00	0.00	0.07	0.04	0.46	0.44
BOP-77(i)	2/16/2021	215	<0.200	0.324	2.38	1.17	23.87	<5.00	0.73	5.1	0.958	5.0	33.4	13.7	4140	4.86	0.00	0.00	0.03	0.02	0.69	0.26
BOP-77(i)	5/5/2021	293	<0.200	0.428	5.28	2.34	22.94	<5.00	0.37	52.9	0.151	3.5	<1.00	13.9	2580	4.62	0.00	0.00	0.06	0.04	0.56	0.34
BOP-77(i)	8/12/2021	392	<0.200	0.54	31.4	9.42	11.75	<5.00	0.00	52.0	1.23	6.0	1.21	17.2	1340	4.15	0.00	0.00	0.37	0.17	0.26	0.20
BOP-77(i)	11/18/2021	490	<0.200	<0.200	14	11.2	5.54	<5.00	0.12	-3.1	<0.250	7.0	1.58	22.7	636	4.81	0.00	0.00	0.28	0.35	0.00	0.36
BOP-77(i)	2/8/2022	572	<0.200	0.352	7.99	3.51	19.36	<5.00	-0.21	40.3	<0.250	4.5	1.17	19.5	792	4.12	0.00	0.00	0.10	0.07	0.58	0.25
BOP-77(i)	5/12/2022	666	<0.200	0.371	7.16	2.84	--	<5.00	1.97	21.5	<0.250	6.5	<1.00	15.5	598	5.16	0.00	0.02	0.60	0.37	--	--
BOP-78(i)	11/21/2011	382	1.7	37	6.1	<1.0	--	--	--	--	--	--	--	--	--	--	0.03	0.79	0.18	0.00	--	--
Injection Well	8/9/2012	225	1.1	30	9.3	<1.0	--	--	--	--	--	--	--	--	--	--	0.02	0.69	0.29	0.00	--	--
BOP-78(i)	11/8/2012	84	<0.2	0.3	7.2	51	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.08	0.91	--	--
BOP-78(i)	2/6/2013	174	<0.2	0.3	11	78	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.08	0.92	--	--
BOP-78(i)	5/2/2013	259	<0.2	0.3	0.6	19	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.02	0.97	--	--
BOP-78(i)	8/7/2013	29	0.2	5.5	120	98	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.43	0.55	--	--
BOP-78(i)	11/8/2013	122	<0.2	<0.2	1.1	17	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.04	0.96	--	--
BOP-78(i)	2/5/2014	211	<0.2	1.0	1.3	3.0	--	--	--	--	--	--	--	--	--	--	0.00	0.11	0.19	0.70	--	--
BOP-78(i)	5/7/2014	302	<0.2	3.6	2.7	1.7	--	--	--	--	--	--	--	--	--	--	0.00	0.33	0.34	0.33	--	--
BOP-78(i)	11/5/2014	112	<0.2	1.7	23	2.6	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.81	0.14	--	--
BOP-78(i)	2/5/2015	204	<0.2	3.2	12	1.8	--	--	--	--	--	--	--	--	--	--	0.00	0.14	0.70	0.16	--	--
BOP-78(i)	5/4/2015	292	<0.2	1.0	7.8	2.4	--	--	--	--	--	--	--	--	--	--	0.00	0.06	0.64	0.30	--	--
BOP-78(i)	11/6/2015	110	<0.2	0.2	3.1	1.4	--	--	--	--	--	--	--	--	--	--	0.00	0.03	0.57	0.40	--	--
BOP-78(i)	2/4/2016	200	<0.2	0.3	4.2	2.2	--	--	--	--	--	--	--	--	--	--	0.00	0.03	0.54	0.44	--	--
BOP-78(i)	5/5/2016	291	<0.2	0.4	10	6.1	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.51	0.48	--	--
BOP-78(i)	8/8/2016	386	<0.2	0.9	24	13	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.54	0.45	--	--
BOP-78(i)	11/4/2016	475	<0.2	0.7	12	7.5	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.50	0.48	--	--
BOP-78(i)	2/8/2017	570	<0.2	0.6	10	11	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.36	0.62	--	--
BOP-78(i)	5/16/2017	668	<0.2	0.7	8.8	11	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.33	0.65	--	--
BOP-78(i)	8/9/2017	753	<0.2	1.3	16	18	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.36	0.62	--	--
BOP-78(i)	2/12/2018	20	<0.2	0.3	4	21	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.11	0.89	--	--
BOP-78(i)	5/15/2018	112	<0.2	0.5	6.6	5.5	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.43	0.55	--	--
BOP-78(i)	8/2/2018	191	<0.2	0.5	6.3	6.2	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.39	0.59	--	--
BOP-78(i)	11/7/2018	288	<0.2	0.5	5.4	5.2	--	--	2.0	23.4	--	7.0	--	--	--	--	0.00	0.03	0.39	0.58	--	--
BOP-78(i)	2/8/2019	380	0.2	<0.2	1.2	6.5	--	--	--	--	--	--	--	--	--	--	0.01	0.00	0.11	0.88	--	--
BOP-78(i)	5/7/2019	468	<0.2	0.5	1.8	6.6	--	--	--	--	--	--	--	--	--	--	0.00	0.03	0.15	0.83	--	--
BOP-78(i)	8/16/2019	570	<0.2	0.3	2.9	8.8	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.17	0.81	--	--
BOP-78(i)	11/8/2019	653	<0.20	0.5	6.1	17	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.19	0.80	--	--
BOP-78(i)	2/7/2020	745	<0.2	0.4	4	11	--	--	--	--	--	--	--	--	--	--	0.00	0.01	0.19	0.80	--	--
BOP-78(i)	5/7/2020	835	<0.2	<0.2	3.5	12	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.16	0.84	--	--

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	from Previous Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions					Donor Indicators		Molar Fraction						
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (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	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-78(i)	11/3/2020	111	<0.200	<0.200	5.83	12.3	--	--	--	--	--	--	--	--	--	0.00	0.00	0.23	0.77	--	--	
BOP-78(i)	2/19/2021	218	<0.200	<0.200	10.1	4.44	--	--	--	--	--	--	--	--	--	0.00	0.00	0.59	0.41	--	--	
BOP-78(i)	8/9/2021	389	<0.200	<0.200	5.24	1.79	--	--	--	--	--	--	--	--	--	0.00	0.00	0.65	0.35	--	--	
BOP-78(i)	2/9/2022	573	<0.200	<0.200	17.2	21.2	--	--	--	--	--	--	--	--	--	0.00	0.00	0.34	0.66	--	--	
BOP-78(i)	5/11/2022	665	<1.00	<1.00	11.7	7.7	--	--	--	--	--	--	--	--	--	0.00	0.00	0.49	0.51	--	--	
BOP-79(i)	11/21/2011	382	1.8	42	5.0	<1.0	--	--	--	--	--	--	--	--	--	0.03	0.84	0.13	0.00	--	--	
Injection Well	8/9/2012	225	2.2	95	12	<1.0	--	--	--	--	--	--	--	--	--	0.02	0.84	0.14	0.00	--	--	
BOP-79(i)	11/8/2012	84	<0.2	0.2	3.7	68	--	--	--	--	--	--	--	--	--	0.00	0.00	0.03	0.96	--	--	
BOP-79(i)	2/6/2013	174	<0.2	0.2	0.6	5.7	--	--	--	--	--	--	--	--	--	0.00	0.02	0.06	0.92	--	--	
BOP-79(i)	5/2/2013	259	<0.2	0.4	24	41	--	--	--	--	--	--	--	--	--	0.00	0.00	0.27	0.72	--	--	
BOP-79(i)	8/7/2013	29	<0.2	1.0	37	20	--	--	--	--	--	--	--	--	--	0.00	0.01	0.54	0.45	--	--	
BOP-79(i)	11/8/2013	122	<0.2	1.9	13	16	--	--	--	--	--	--	--	--	--	0.00	0.04	0.33	0.63	--	--	
BOP-79(i)	2/5/2014	211	<0.2	3.4	17	7.2	--	--	--	--	--	--	--	--	--	0.00	0.08	0.55	0.36	--	--	
BOP-79(i)	5/7/2014	302	0.9	58	43	15	--	--	--	--	--	--	--	--	--	0.00	0.39	0.39	0.21	--	--	
BOP-79(i)	11/7/2014	114	<0.2	1.5	21	5.6	--	--	--	--	--	--	--	--	--	0.00	0.04	0.68	0.28	--	--	
BOP-79(i)	2/5/2015	204	<0.2	2.1	10	3.8	--	--	--	--	--	--	--	--	--	0.00	0.09	0.57	0.34	--	--	
BOP-79(i)	5/4/2015	292	<0.2	0.4	2.2	2.0	--	--	--	--	--	--	--	--	--	0.00	0.05	0.39	0.55	--	--	
BOP-79(i)	11/6/2015	110	<0.2	0.5	8.6	4.3	--	--	--	--	--	--	--	--	--	0.00	0.02	0.55	0.43	--	--	
BOP-79(i)	2/4/2016	200	<0.2	0.4	4.5	3.5	--	--	--	--	--	--	--	--	--	0.00	0.03	0.44	0.53	--	--	
BOP-79(i)	5/5/2016	291	<0.2	0.5	3.6	3.6	--	--	--	--	--	--	--	--	--	0.00	0.04	0.38	0.58	--	--	
BOP-79(i)	8/8/2016	386	<0.2	0.7	4.2	3.4	--	--	--	--	--	--	--	--	--	0.00	0.05	0.42	0.53	--	--	
BOP-79(i)	11/4/2016	475	<0.2	0.6	4.7	3.7	--	--	--	--	--	--	--	--	--	0.00	0.04	0.43	0.53	--	--	
BOP-79(i)	2/8/2017	570	<0.2	0.5	3.9	4.0	--	--	--	--	--	--	--	--	--	0.00	0.04	0.37	0.59	--	--	
BOP-79(i)	5/16/2017	668	<0.2	0.7	5.2	4.8	--	--	--	--	--	--	--	--	--	0.00	0.04	0.40	0.57	--	--	
BOP-79(i)	8/9/2017	753	<0.2	0.7	4.0	3.3	--	--	--	--	--	--	--	--	--	0.00	0.05	0.42	0.53	--	--	
BOP-79(i)	2/12/2018	19	<0.2	0.3	4.4	2.5	--	--	--	--	--	--	--	--	--	0.00	0.03	0.52	0.46	--	--	
BOP-79(i)	5/15/2018	112	<0.2	0.5	11.0	8.8	--	--	--	--	--	--	--	--	--	0.00	0.01	0.44	0.55	--	--	
BOP-79(i)	8/2/2018	191	<0.2	0.4	6.6	6.7	--	--	--	--	--	--	--	--	--	0.00	0.02	0.38	0.60	--	--	
BOP-79(i)	11/7/2018	288	<0.2	0.3	5.8	4.4	--	--	--	--	--	--	--	--	--	0.00	0.02	0.45	0.53	--	--	
BOP-79(i)	2/8/2019	380	0.2	<0.2	0.5	1.3	--	--	--	--	--	--	--	--	--	0.04	0.00	0.19	0.77	--	--	
BOP-79(i)	5/7/2019	468	<0.2	<0.2	0.8	1.5	--	--	--	--	--	--	--	--	--	0.00	0.00	0.26	0.74	--	--	
BOP-79(i)	8/16/2019	570	<0.2	<0.2	0.3	0.4	--	--	--	--	--	--	--	--	--	0.00	0.00	0.33	0.67	--	--	
BOP-79(i)	11/8/2019	653	<0.2	<0.2	0.9	0.6	--	--	--	--	--	--	--	--	--	0.00	0.00	0.49	0.51	--	--	
BOP-79(i)	2/7/2020	745	<0.2	0.2	0.7	0.3	--	--	--	--	--	--	--	--	--	0.00	0.11	0.53	0.35	--	--	
BOP-79(i)	5/7/2020	835	<0.2	<0.2	0.4	0.3	--	--	--	--	--	--	--	--	--	0.00	0.00	0.46	0.54	--	--	
BOP-79(i)	11/3/2020	111	<0.200	0.218	2.99	1.35	--	--	--	--	--	--	--	--	--	0.00	0.03	0.57	0.40	--	--	
BOP-79(i)	2/19/2021	218	<0.200	<0.200	2.58	1.14	--	--	--	--	--	--	--	--	--	0.00	0.00	0.59	0.41	--	--	
BOP-79(i)	5/6/2021	294	<0.200	0.306	2.11	1.56	--	--	--	--	--	--	--	--	--	0.00	0.05	0.44	0.51	--	--	
BOP-79(i)	8/9/2021	389	<0.200	<0.200	3.34	4.49	--	--	--	--	--	--	--	--	--	0.00	0.00	0.32	0.68	--	--	
BOP-79(i)	11/16/2021	488	<0.200	<0.200	0.803	1.45	--	--	--	--	--	--	--	--	--	0.00	0.00	0.26	0.74	--	--	
BOP-79(i)	2/9/2022	573	<0.200	<0.200	0.274	0.948	--	--	--	--	--	--	--	--	--	0.00	0.00	0.16	0.84	--	--	
BOP-79(i)	5/11/2022	665	<0.200	<0.200	0.508	1.1	--	--	--	--	--	--	--	--	--	0.00	0.00	0.23	0.77	--	--	
BOP-80(i)	11/21/2011	382	<1.0	2.4	7.0	7.0	--	--	--	--	--	--	--	--	--	0.00	0.09	0.36	0.55	--	--	
Downgradient Well	12/1/2011	392	<1.0	15	6.1	5.3	2.9	<1.1	0.0	-272.8	<0.1	2.4	3.8	3.97	2.43	6.74	0.00	0.31	0.17	0.23	0.28	0.00
BOP-80(i)	1/9/2012	12	<1.0	<1.0	<1.0	1.4	--	--	0.15	-255	0.2	1.7	0.4	--	4.93	6.80	0.00	0.00	0.00	1.00	--	--

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	from Previous Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions					Donor Indicators		Molar Fraction						
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (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	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-80(i)	2/16/2012	50	<1.0	<1.0	<1.0	<1.0	2.2	<1.1	0.29	-237	0.1	2.7	2.4	7.44	3.28	7.14	0.00	0.00	0.00	0.00	0.00	1.00
BOP-80(i)	3/15/2012	78	<1.0	<1.0	<1.0	1.7	4	<1.1	0.43	-241	<0.1	4.0	0.5	7.98	4.72	6.99	0.00	0.00	0.00	0.17	0.35	0.49
BOP-80(i)	4/17/2012	111	<1.0	<1.0	<1.0	<1.0	<1.1	<1.1	0.28	-263.4	<0.1	3.6	1.0	12.8	2.89	7.04	ND	ND	ND	ND	ND	ND
BOP-80(i)	6/12/2012	167	<1.0	<1.0	<1.0	1.7	7.3	<1.1	0.24	12.8	<0.1	2.3	0.1	10.4	2.50	6.01	0.00	0.00	0.00	0.10	0.37	0.53
BOP-80(i)	9/18/2012	33	2.0	160	35	14	7.1	<5.0	0.28	-160.1	<0.10	2.9	1.9	14	13.9	6.35	0.01	0.59	0.18	0.11	0.00	0.12
BOP-80(i)	11/14/2012	90	3.0	610	240	33	6.1	<5.0	1.47	76.0	<0.10	2.5	3.1	7.5	1.5	6.48	0.00	0.59	0.31	0.07	0.00	0.03
BOP-80(i)	2/6/2013	174	<0.2	1.4	<0.2	0.4	5.2	<5.0	0.40	-7.0	0.15	3.0	<1.0	23	1.2	6.44	0.00	0.06	0.00	0.03	0.00	0.91
BOP-80(i)	5/9/2013	266	<0.2	0.8	<0.2	0.7	12	<5.0	0.57	-13.5	0.11	2.5	<1.0	20	1.3	6.31	0.00	0.01	0.00	0.03	0.00	0.96
BOP-80(i)	8/19/2013	41	<0.2	<0.2	<0.2	0.4	9.7	<5.0	1.16	-54.0	0.36	2.5	2.3	17	1.5	5.53	0.00	0.00	0.00	0.02	0.00	0.98
BOP-80(i)	11/11/2013	125	<0.2	<0.2	<0.2	0.2	14	<5.0	0.57	-64.8	<0.10	4.5	<1.0	22	1.4	5.99	0.00	0.00	0.00	0.01	0.00	0.99
BOP-80(i)	2/21/2014	227	2.7	23	0.4	<0.2	<5.0	<5.0	2.59	114.5	3.8	0.5	17.6	0.45	2.6	6.59	0.08	0.90	0.02	0.00	0.00	0.00
BOP-80(i)	5/7/2014	302	<0.2	2.0	<0.2	<0.2	17	<5.0	1.19	-26.0	0.19	2.5	1.0	16	3.8	6.73	0.00	0.03	0.00	0.00	0.00	0.97
BOP-80(i)	8/14/2014	29	<0.2	0.5	1.1	3.1	9	<5.0	1.14	-113.5	0.29	4.0	293	13	909	5.28	0.00	0.01	0.03	0.14	0.00	0.82
BOP-80(i)	11/6/2014	113	0.8	65	360	63	<5.0	<5.0	0.45	-74.0	<0.10	2.5	10.9	2.9	1.4	6.82	0.00	0.09	0.71	0.19	0.00	0.00
BOP-80(i)	2/6/2015	205	<0.2	<0.2	<0.2	0.3	5.6	<5.0	0.30	-121.9	<0.10	7.0	1.4	15	2.7	6.17	0.00	0.00	0.00	0.03	0.00	0.97
BOP-80(i)	5/6/2015	294	<0.2	<0.2	0.2	0.6	15	<5.0	1.54	-73.2	<0.10	4.0	<1.0	21	2.4	6.29	0.00	0.00	0.00	0.02	0.00	0.98
BOP-80(i)	8/10/2015	22	3.0	91	430	11	<5.0	<5.0	0.30	-171.0	<0.10	7.0	8.2	3.6	1.6	6.30	0.00	0.13	0.83	0.03	0.00	0.00
BOP-80(i)	11/4/2015	108	<0.2	<0.2	0.5	2.1	8.9	<5.0	1.20	-58.7	<0.10	7.0	1.6	20	2.3	6.35	0.00	0.00	0.02	0.10	0.00	0.88
BOP-80(i)	2/3/2016	199	<0.2	<0.2	<0.2	0.2	<5.0	<5.0	2.00	-24.2	<0.10	5.0	1.4	27	1.1	6.90	0.00	0.00	0.00	1.00	0.00	0.00
BOP-80(i)	5/4/2016	291	<0.2	<0.2	<0.2	0.4	6.7	<5.0	0.90	-33.2	<0.10	7.0	<1.0	15.0	<1.0	6.15	0.00	0.00	0.00	0.03	0.00	0.97
BOP-80(i)	8/11/2016	389	<0.2	<0.2	0.2	0.7	9	<5.0	0.19	-97.5	<0.10	7.0	<1.0	21	2.5	6.13	0.00	0.00	0.01	0.04	0.00	0.96
BOP-80(i)	11/11/2016	481	<0.2	<0.2	<0.2	0.3	10	<5.0	0.68	-9.2	<0.10	7.0	<1.0	20	2.7	6.19	0.00	0.00	0.00	0.01	0.00	0.99
BOP-80(i)	2/7/2017	570	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	1.07	20.1	<0.10	2.0	<1.0	26	2.8	6.11	ND	ND	ND	ND	ND	ND
BOP-80(i)	5/16/2017	668	<0.2	0.5	0.5	0.6	14	<5.0	0.35	-15.6	<0.10	0.5	<1.0	29	2.8	6.05	0.00	0.01	0.01	0.02	0.00	0.96
BOP-80(i)	8/10/2017	754	<0.2	<0.2	<0.2	0.3	<5.0	<5.0	0.2	32.7	<0.10	2.0	<1.0	18	3.4	6.2	0.00	0.00	0.00	1.00	0.00	0.00
BOP-80(i)	2/8/2018	15	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.14	29.8	<0.10	2.0	1.7	28	41.1	6.33	ND	ND	ND	ND	ND	ND
BOP-80(i)	8/8/2018	196	<0.2	19	150	29	9.5	<5.0	0.42	-34.4	<0.10	3.0	<1.0	22	5.1	6.21	0.00	0.06	0.63	0.19	0.00	0.13
BOP-80(i)	2/14/2019	386	<0.2	<0.2	<0.2	<0.2	6.6	<5.0	0.35	-32.0	<0.10	3.0	<1.0	21	4.5	6.05	0.00	0.00	0.00	0.00	0.00	1.00
BOP-80(i)	8/13/2019	567	<0.2	<0.2	<0.2	<0.2	12	<5.0	0.44	-82.4	<0.10	2.5	<1.0	27	2.6	6.03	0.00	0.00	0.00	0.00	0.00	1.00
BOP-80(i)	2/11/2020	748	<0.2	<0.2	<0.2	<0.2	14	<5.0	0.65	-41.1	<0.10	3.8	<1.0	18	5.1	6.90	0.00	0.00	0.00	0.00	0.00	1.00
BOP-80(i)	8/13/2020	29	<0.200	257	289	23.2	<5.00	<5.00	0.583	-40.8	<0.500	2.0	10.3	3.76	2.91	6.88	0.00	0.37	0.56	0.07	0.00	0.00
BOP-80(i)	2/17/2021	216	<0.200	<0.200	0.341	0.52	<5.00	<5.00	0.93	-108.3	<0.100	2.0	<1.00	18.4	2.38	6.41	0.00	0.00	0.30	0.70	0.00	0.00
BOP-80(i)	8/13/2021	393	<0.200	<0.200	<0.200	<0.200	<5.00	<5.00	0.00	63.2	0.547	3.5	<5.00	16.6	5.36	5.83	ND	ND	ND	ND	ND	ND
BOP-80(i)	2/9/2022	573	<0.200	<0.200	<0.200	<0.200	<5.00	<5.00	0.10	-49.4	<0.250	6.5	4.01	9.65	1.49	6.42	ND	ND	ND	ND	ND	ND
BOP-81(i)	11/21/2011	382	<1.0	<1.0	1.6	6.2	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.14	0.86	--	--
Downgradient Well	12/1/2011	392	<1.0	<1.0	1.0	4.1	4.2	<1.1	0.0	-279.8	<0.1	1.1	0.5	8.3	2.38	6.76	0.00	0.00	0.05	0.30	0.32	0.33
BOP-81(i)	12/28/2011	419	--	--	--	--	--	--	--	--	--	--	--	--	4.71	--	--	--	--	--	--	--
BOP-81(i)	1/9/2012	12	<1.0	<1.0	<1.0	1.9	--	--	0.33	-238.4	0.2	1.5	0.5	--	2.65	6.69	0.00	0.00	0.00	1.00	--	--
BOP-81(i)	2/16/2012	50	<1.0	<1.0	<1.0	<1.0	<1.1	<1.1	0.23	-242.8	<0.1	1.9	0.5	16.4	3.26	7.21	ND	ND	ND	ND	ND	ND
BOP-81(i)	3/15/2012	78	<1.0	<1.0	<1.0	<1.0	<1.1	<1.1	0.31	-245.8	0.1	2.7	0.3	24.7	3.00	6.96	ND	ND	ND	ND	ND	ND
BOP-81(i)	4/17/2012	111	<1.0	<1.0	<1.0	<1.0	<1.1	<1.1	0.28	-270.8	<0.1	2.6	0.2	23.4	2.51	6.77	ND	ND	ND	ND	ND	ND
BOP-81(i)	6/12/2012	167	<1.0	<1.0	<1.0	<1.0	1.8	<1.1	0.36	-1.8	<0.1	4.3	<0.1	20.9	2.34	6.10	0.00	0.00	0.00	0.00	0.00	1.00
BOP-81(i)	8/16/2012	232	--	--	--	--	--	--	--	--	--	--	--	--	3.2	--	--	--	--	--	--	--
BOP-81(i)	9/18/2012	33	<0.2	<0.2	<0.2	0.6	8.4	<5.0	0.21	-125	<0.10	1.7	<1.0	18.0	3.0	6.49	0.00	0.00	0.00	0.03	0.00	0.97
BOP-81(i)	11/14/2012	90	<0.2	<0.2	<0.2	0.5	8.6	<5.0	0.60	42.7	0.11	2.0	1.4	15.0	<1.0	6.49	0.00	0.00	0.00	0.03	0.00	0.97
BOP-81(i)	2/6/2013	174	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.56	-93.4	0.12	2.0	2.0	30.0	<1.0	6.55	ND	ND	ND	ND	ND	ND

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	from Previous Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions					Donor Indicators		Molar Fraction						
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (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	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-81(i)	5/9/2013	266	<0.2	0.3	<0.2	0.5	<5.0	<5.0	2.65	-18.1	0.39	1.5	7.4	7.1	<1.0	6.49	0.00	0.22	0.00	0.78	0.00	0.00
BOP-81(i)	8/19/2013	41	<0.2	<0.2	<0.2	0.9	<5.0	<5.0	3.96	-24.4	1.2	0.0	16.4	3.4	<1.0	6.74	0.00	0.00	0.00	1.00	0.00	0.00
BOP-81(i)	11/11/2013	125	<0.2	<0.2	<0.2	0.4	8.9	<5.0	0.42	-75.1	0.26	4.5	3.8	20.0	1.2	6.04	0.00	0.00	0.00	0.02	0.00	0.98
BOP-81(i)	2/21/2014	227	0.6	0.6	<0.2	<0.2	<5.0	<5.0	3.55	74.1	0.61	0.5	13.5	0.33	1.4	6.14	0.44	0.56	0.00	0.00	0.00	0.00
BOP-81(i)	5/7/2014	302	<0.2	0.2	<0.2	<0.2	5.2	<5.0	0.65	-49.9	<0.10	2.0	2.3	24.0	2.0	6.73	0.00	0.01	0.00	0.00	0.00	0.99
BOP-81(i)	8/14/2014	29	<0.2	<0.2	<0.2	0.4	6	<5.0	1.17	-140.9	<0.10	4.5	49.7	12.0	225	5.76	0.00	0.00	0.00	0.03	0.00	0.97
BOP-81(i)	11/6/2014	113	<0.2	<0.2	<0.2	0.3	11	<5.0	0.50	-85.6	<0.10	2.5	<1.0	25.0	1.5	6.33	0.00	0.00	0.00	0.01	0.00	0.99
BOP-81(i)	2/6/2015	205	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.10	-128.8	<0.10	5.0	6.7	20.0	1.0	6.34	ND	ND	ND	ND	ND	ND
BOP-81(i)	5/6/2015	294	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.82	-74.0	<0.10	7.0	2.5	22.0	<1.0	6.33	ND	ND	ND	ND	ND	ND
BOP-81(i)	8/11/2015	23	<0.2	<0.2	0.6	1.2	<5.0	<5.0	1.49	-130.0	0.14	7.0	4.2	13.0	1.6	6.19	0.00	0.00	0.24	0.76	0.00	0.00
BOP-81(i)	11/4/2015	108	<0.2	<0.2	0.3	0.7	5.4	<5.0	0.54	-42.6	<0.10	6.5	1.7	20.0	1.6	6.34	0.00	0.00	0.02	0.06	0.00	0.93
BOP-81(i)	2/4/2016	200	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	1.93	-4.5	<0.10	5.0	7.1	10	<1.0	6.90	ND	ND	ND	ND	ND	ND
BOP-81(i)	5/4/2016	291	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	2.88	-47.0	<0.10	7.0	3.8	21.0	<1.0	6.15	ND	ND	ND	ND	ND	ND
BOP-81(i)	8/11/2016	389	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.25	-83.7	<0.10	7.0	<1.0	22	2.1	6.12	ND	ND	ND	ND	ND	ND
BOP-81(i)	11/11/2016	481	<0.2	<0.2	<0.2	0.3	<5.0	<5.0	0.51	17.4	<0.10	7.0	1.2	23	1.3	6.22	0.00	0.00	0.00	1.00	ND	ND
BOP-81(i)	2/7/2017	570	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	1.56	4.0	<0.10	1.5	5.4	11	1.5	6.26	ND	ND	ND	ND	ND	ND
BOP-81(i)	5/16/2017	668	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.23	-7	<0.10	1.5	5.2	11	1.3	6.36	ND	ND	ND	ND	ND	ND
BOP-81(i)	8/10/2017	754	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.4	40.1	<0.10	7.0	<1.0	23	1.6	6.2	ND	ND	ND	ND	ND	ND
BOP-81(i)	2/8/2018	15	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.21	63.8	<0.10	2.5	5.1	16	1.4	6.41	ND	ND	ND	ND	ND	ND
BOP-81(i)	8/8/2018	196	<0.2	<0.2	<0.2	0.2	7.8	<5.0	0.47	-28.0	<0.10	3.5	<1.0	23	3.1	6.00	0.00	0.00	0.00	0.01	0.00	0.99
BOP-81(i)	2/14/2019	386	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.29	-47.7	<0.10	6.5	<1.0	22	3.4	6.16	ND	ND	ND	ND	ND	ND
BOP-81(i)	8/14/2019	568	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.12	-43.9	<0.50	3.0	<1.0	19	3.9	6.11	ND	ND	ND	ND	ND	ND
BOP-81(i)	2/11/2020	748	<0.2	<0.2	<0.2	<0.2	<5.0	<5.0	0.59	-47.6	<0.10	3.0	<1.0	20	4.1	6.80	ND	ND	ND	ND	ND	ND
BOP-81(i)	8/13/2020	29	<0.200	<0.200	0.21	0.24	<5.00	<5.00	0.25	-31.5	3.79	2.0	<5.00	18.2	48.9	6.59	0.00	0.00	0.36	0.64	0.00	0.00
BOP-81(i)	2/17/2021	216	<0.200	<0.200	<0.200	<0.200	<5.00	<5.00	1.03	-122.7	<0.100	5.0	4.94	10.9	1.25	6.50	ND	ND	ND	ND	ND	ND
BOP-81(i)	8/13/2021	393	<0.200	<0.200	<0.200	<0.200	<5.00	<5.00	0.06	69.7	0.679	6.0	<5.00	18.4	1.61	5.98	ND	ND	ND	ND	ND	ND
BOP-81(i)	2/10/2022	574	<0.200	<0.200	<0.200	<0.200	<5.00	<5.00	0.38	-55.2	<0.250	3.5	6.99	4.18	2.12	6.30	ND	ND	ND	ND	ND	ND
BOP-82(i)	11/21/2011	382	4.6	91	1.6	<1.0	--	--	--	--	--	--	--	--	--	--	0.04	0.94	0.02	0.00	--	--
Downgradient Well	12/1/2011	392	4.0	66	1.4	<1.0	<1.1	<1.1	0.0	-152.8	3.3	1.1	9.4	<0.0007	<1.50	6.36	0.04	0.93	0.03	0.00	0.00	0.00
BOP-82(i)	12/28/2011	419	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BOP-82(i)	1/9/2012	12	2.6	47	1.0	<1.0	--	--	0.31	-238.8	<0.2	2.1	7.3	--	9.81	6.74	0.04	0.93	0.03	0.00	--	--
BOP-82(i)	2/16/2012	50	1.9	38	6.8	<1.0	<1.1	<1.1	1.61	-196.5	1.7	0.1	10.3	0.0144	4.85	6.94	0.03	0.78	0.19	0.00	0.00	0.00
BOP-82(i)	3/15/2012	78	2.0	36	11	<1.0	<1.1	<1.1	0.82	-183.5	1.3	1.5	10.0	<0.0007	3.25	6.97	0.03	0.69	0.28	0.00	0.00	0.00
BOP-82(i)	4/17/2012	111	1.6	29	4.5	<1.0	<1.1	<1.1	1.29	-219.3	1.8	0.6	10.6	<0.0007	2.46	6.78	0.03	0.80	0.17	0.00	0.00	0.00
BOP-82(i)	6/12/2012	167	1.3	24	2.5	<1.0	<1.1	<1.1	2.76	145.6	1.8	0.1	9.9	<0.0007	2.56	5.54	0.04	0.84	0.12	0.00	0.00	0.00
BOP-82(i)	8/16/2012	232	--	--	--	--	--	--	--	--	--	--	--	--	1.6	--	--	--	--	--	--	--
BOP-82(i)	9/18/2012	33	1.0	19	1.6	0.5	<5.0	<5.0	2.75	-0.5	1.8	1.0	9.9	<0.015	1.4	6.45	0.03	0.83	0.09	0.05	0.00	0.00
BOP-82(i)	11/14/2012	90	1.6	24	1.6	0.3	<5.0	<5.0	3.03	72.7	1.8	0.0	10.3	0.036	<1.0	6.61	0.05	0.86	0.08	0.02	0.00	0.00
BOP-82(i)	2/6/2013	174	1.5	15	1.8	0.4	<5.0	<5.0	3.53	93.9	1.3	0.0	10.7	0.036	<1.0	6.50	0.06	0.77	0.13	0.04	0.00	0.00
BOP-82(i)	5/6/2013	263	1.1	17	0.9	0.3	<5.0	<5.0	4.24	202.8	1.0	0.0	11.6	0.48	<1.0	6.26	0.04	0.86	0.06	0.03	0.00	0.00
BOP-82(i)	8/19/2013	41	1.4	19	0.5	<0.2	<5.0	<5.0	--	14.2	1.1	0.0	11.5	0.11	<1.0	6.24	0.05	0.91	0.03	0.00	0.00	0.00
BOP-82(i)	11/7/2013	121	1.1	17	0.5	<0.2	--	--	--	--	--	--	--	--	--	--	0.05	0.92	0.04	0.00	--	--
BOP-82(i)	2/21/2014	227	1.0	14	0.4	<0.2	<5.0	<5.0	3.15	189.6	0.88	0.5	9.2	1.3	2.5	6.08	0.05	0.91	0.04	0.00	0.00	0.00
BOP-82(i)	5/7/2014	302	0.7	12	0.5	<0.2	<5.0	<5.0	1.29	82.9	0.30	0.0	8.4	1.0	1.9	6.25	0.04	0.91	0.05	0.00	0.00	0.00
BOP-82(i)	8/14/2014	29	1.0	12	0.6	<0.2	<5.0	<5.0	0.45	-135.4	<0.10	7.0	8.8	1.5	36.4	5.82	0.06	0.88	0.06	0.00	0.00	0.00
BOP-82(i)	11/7/2014	114	0.6	8.1	2.7	0.7	--	--	--	--	--	--	--	--	--	--	0.03	0.59	0.27	0.11	--	--

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	from Previous Injection (days)	Volatile Organic Compounds Analytical Results							Aquifer Redox Conditions					Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (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	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-82(i)	2/6/2015	205	0.7	11	1.7	0.5	<5.0	<5.0	0.68	-62.7	0.36	3.0	13.2	3.0	1.8	6.25	0.04	0.74	0.15	0.07	0.00	0.00
BOP-82(i)	5/4/2015	292	0.7	9.7	1.3	<0.2	--	--	--	--	--	--	--	--	--	--	0.05	0.81	0.15	0.00	--	--
BOP-82(i)	8/11/2015	23	0.6	8.6	1.4	0.6	<5.0	<5.0	1.06	-186.1	<0.10	7.0	5.5	7.5	9.5	6.26	0.04	0.70	0.16	0.10	0.00	0.00
BOP-82(i)	11/6/2015	110	0.3	6.0	2.5	1.2	--	--	--	--	--	--	--	--	--	--	0.02	0.49	0.28	0.21	--	--
BOP-82(i)	2/4/2016	200	0.5	8.5	1.4	0.4	<5.0	<5.0	1.83	35.9	0.22	3.0	11.5	2.3	<1.0	7.02	0.03	0.73	0.16	0.07	0.00	0.00
BOP-82(i)	5/3/2016	289	0.6	8.3	0.9	<0.2	--	--	--	--	--	--	--	--	--	--	0.05	0.83	0.12	0.00	--	--
BOP-82(i)	8/11/2016	389	0.6	8.7	0.6	<0.2	<5.0	<5.0	0.75	15.0	0.40	1.5	13.4	1.0	1.3	6.09	0.05	0.87	0.08	0.00	0.00	0.00
BOP-82(i)	11/16/2016	487	0.5	8.7	0.6	<0.2	--	--	--	--	--	--	--	--	--	--	0.04	0.88	0.08	0.00	--	--
BOP-82(i)	2/13/2017	575	0.4	7.1	0.6	<0.2	<5.0	<5.0	0.91	173.5	0.43	2.5	14.8	0.580	1.6	6.50	0.04	0.86	0.10	0.00	0.00	0.00
BOP-82(i)	5/12/2017	664	0.4	7.1	0.5	<0.2	--	--	--	--	--	--	--	--	--	--	0.04	0.88	0.08	0.00	--	--
BOP-82(i)	8/10/2017	754	0.3	5.8	0.7	<0.2	<5.0	<5.0	0.5	60.0	0.63	0.5	16.3	<0.0050	1.1	6.4	0.03	0.83	0.14	0.00	0.00	0.00
BOP-82(i)	2/7/2018	15	0.4	6	0.4	<0.2	<5.0	<5.0	0.33	136.6	<0.10	5.0	8.2	0.35	6.7	6.52	0.05	0.87	0.08	0.00	0.00	0.00
BOP-82(i)	8/8/2018	196	0.3	4.5	0.8	<0.2	<5.0	<5.0	0.49	-24.9	<0.10	1.0	9.5	7.8	4.6	6.03	0.04	0.77	0.19	0.00	0.00	0.00
BOP-82(i)	2/14/2019	386	0.4	4.3	0.6	<0.2	<5.0	<5.0	0.28	-4.3	0.12	1.5	7.6	1.9	1.9	6.06	0.06	0.79	0.15	0.00	0.00	0.00
BOP-82(i)	8/12/2019	565	0.4	4.1	0.5	<0.2	<5.0	<5.0	0.45	13.5	0.11	2.5	10.4	1.2	3.7	6.38	0.06	0.80	0.13	0.00	0.00	0.00
BOP-82(i)	2/11/2020	748	0.3	3.4	0.6	<0.2	5.3	<5.0	0.44	-28.5	0.18	1.0	7.8	0.99	3.4	6.67	0.01	0.12	0.03	0.00	0.00	0.84
BOP-82(i)	8/13/2020	28	<0.200	1.31	1.83	0.398	<5.00	<5.00	0.37	-32.3	<0.500	3.5	10.8	0.926	16.5	6.67	0.00	0.28	0.54	0.18	0.00	0.00
BOP-82(i)	2/17/2021	216	<0.200	0.861	1.55	1.99	<5.00	<5.00	0.81	-102.3	<0.100	5.0	1.7	13.1	2.06	6.50	0.00	0.12	0.29	0.59	0.00	0.00
BOP-82(i)	8/10/2021	390	0.211	2.72	1.76	0.291	<5.00	<5.00	0.42	8.0	<0.500	6.0	7.22	3.24	<1.00	5.83	0.03	0.46	0.41	0.10	0.00	0.00
BOP-82(i)	11/17/2021	489	<0.200	1.01	0.429	<0.2	--	--	--	--	--	--	--	--	--	--	0.00	0.63	0.37	0.00	--	--
BOP-82(i)	2/10/2022	574	<0.200	0.789	3.26	0.823	<5.00	<5.00	0.47	-11.2	<0.250	4.5	4.8	3.6	5.29	6.27	0.00	0.11	0.64	0.25	0.00	0.00
BOP-82(i)	5/17/2022	670	<0.200	1.35	0.368	<0.200	--	--	--	--	--	--	--	--	--	--	0.00	0.73	0.27	0.00	--	--
BOP-83(i)	11/21/2011	382	<1.0	31	<1.0	<1.0	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--
Downgradient Well	12/1/2011	392	<1.0	16	<1.0	<1.0	<1.1	<1.1	0.0	-149.7	8.0	1.0	20.0	<0.0007	<1.50	6.73	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	12/28/2011	419	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BOP-83(i)	1/9/2012	12	1.8	36	<1.0	<1.0	--	--	6.18	-200.7	7.2	0.1	19.7	--	<1.5	6.70	0.04	0.96	0.00	0.00	--	--
BOP-83(i)	2/16/2012	50	2.6	58	2.5	<1.0	<1.1	<1.1	5.38	-181.3	6.6	0.1	24.5	<0.0007	2.73	7.10	0.03	0.91	0.05	0.00	0.00	0.00
BOP-83(i)	3/15/2012	78	1.1	19	<1.0	<1.0	<1.1	<1.1	6.44	-164.7	7.5	0.1	16.7	<0.0007	1.90	6.87	0.04	0.96	0.00	0.00	0.00	0.00
BOP-83(i)	4/17/2012	111	<1.0	7.3	<1.0	<1.0	<1.1	<1.1	3.56	-205.5	5.2	0.1	13.8	<0.0007	<1.50	6.34	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	6/12/2012	167	<1.0	3.1	<1.0	<1.0	<1.1	<1.1	8.16	147.4	6.8	0.1	14.2	<0.015	<1.50	5.98	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	8/16/2012	232	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BOP-83(i)	9/18/2012	33	0.5	9.7	0.3	<0.2	<5.0	<5.0	5.14	65.7	6.6	0.0	13.6	<0.015	1.2	6.07	0.04	0.92	0.04	0.00	0.00	0.00
BOP-83(i)	11/14/2012	90	<0.2	5.3	<0.2	<0.2	<5.0	<5.0	6.95	110.3	6.3	0.0	12.2	0.0064	<1.0	6.69	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	2/6/2013	174	1.2	21	0.9	<0.2	<5.0	<5.0	7.73	152.7	5.9	0.0	11.5	<0.005	<1.0	6.63	0.04	0.91	0.05	0.00	0.00	0.00
BOP-83(i)	5/6/2013	263	0.8	14	0.6	<0.2	<5.0	<5.0	9.40	206.6	6.0	0.0	11.8	<0.005	<1.0	6.32	0.04	0.91	0.05	0.00	0.00	0.00
BOP-83(i)	8/22/2013	44	<0.2	3.4	<0.2	<0.2	<5.0	<5.0	7.13	171.6	5.7	0.0	11.5	<0.005	<1.0	6.35	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	11/7/2013	121	<0.2	2.4	<0.2	<0.2	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--
BOP-83(i)	2/21/2014	227	<0.2	2.3	<0.2	<0.2	<5.0	<5.0	4.09	177.4	5.4	0.5	11.3	<0.005	<1.0	6.33	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	5/7/2014	302	0.4	5.7	0.4	<0.2	<5.0	<5.0	6.91	136.0	4.3	0.0	11.1	0.19	1.2	6.43	0.05	0.87	0.08	0.00	0.00	0.00
BOP-83(i)	8/14/2014	29	<0.2	2.2	<0.2	<0.2	<5.0	<5.0	7.68	-80.8	4.6	0.5	11.6	0.041	1.5	6.05	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	11/11/2014	118	<0.2	2.1	<0.2	<0.2	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--
BOP-83(i)	2/6/2015	205	0.4	12	1.0	<0.2	<5.0	<5.0	7.69	52.6	3.6	0.0	8.9	0.38	<1.0	6.35	0.02	0.88	0.10	0.00	0.00	0.00
BOP-83(i)	5/4/2015	292	<0.2	2.0	<0.2	<0.2	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--
BOP-83(i)	8/11/2015	23	<0.2	2.0	<0.2	<0.2	<5.0	<5.0	7.66	50.1	4.2	0.5	10	0.1	<1.0	6.47	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	11/6/2015	110	<0.2	1.9	<0.2	<0.2	--	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--
BOP-83(i)	2/4/2016	200	<0.2	1.7	<0.2	<0.2	<5.0	<5.0	7.46	51.8	3.3	1.0	7.5	0.36	<1.0	7.33	0.00	1.00	0.00	0.00	0.00	0.00

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	from Previous Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (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	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-83(i)	5/6/2016	292	<0.2	2.4	<0.2	<0.2	--	--	--	--	--	--	--	--	--	0.00	1.00	0.00	0.00	--	--	
BOP-83(i)	8/11/2016	389	<0.2	2.6	<0.2	<0.2	<5.0	<5.0	7.02	89.5	3.3	0.5	9.1	0.0069	<1.0	6.01	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	11/16/2016	487	0.5	10	4.5	<0.2	--	--	--	--	--	--	--	--	0.02	6.61	0.37	0.00	--	--	--	
BOP-83(i)	2/13/2017	575	<0.2	2.7	<0.2	<0.2	<5.0	<5.0	6.24	176.8	2.7	0.5	9.4	<0.005	<1.0	6.56	0.00	1.00	0.00	0.00	0.00	0.00
BOP-83(i)	5/12/2017	664	0.3	3.2	<0.2	<0.2	--	--	--	--	--	--	--	--	0.07	6.93	0.00	0.00	0.00	0.00	0.00	
BOP-83(i)	8/10/2017	754	0.2	3.3	<0.2	<0.2	<5.0	<5.0	3.1	58.6	2.1	0.5	8.9	<0.0050	<1.0	6.4	0.05	0.95	0.00	0.00	0.00	0.00
BOP-83(i)	2/7/2018	15	0.4	8.6	13	0.7	<5.0	<5.0	2.58	252.4	1.3	0.5	5.6	0.055	2	6.27	0.01	0.31	0.63	0.05	0.00	0.00
BOP-83(i)	8/8/2018	197	0.2	3	<0.2	<0.2	<5.0	<5.0	0.87	44.5	3	0.5	9.4	0.052	2.2	4.69	0.05	0.95	0.00	0.00	0.00	0.00
BOP-83(i)	2/14/2019	386	0.2	5.6	14	0.2	<5.0	<5.0	0.65	-6.5	0.54	1.0	3.2	0.76	2.0	5.99	0.01	0.22	0.75	0.02	0.00	0.00
BOP-83(i)	8/15/2019	569	0.2	3.3	7.7	<0.2	<5.0	<5.0	1.78	158.4	1.7	2.0	8.2	0.056	1.9	6.13	0.01	0.24	0.75	0.00	0.00	0.00
BOP-83(i)	2/10/2020	748	<0.2	3.8	16	<0.2	<5.0	<5.0	1.33	-1.5	0.14	0.5	2.2	0.19	3.2	6.41	0.00	0.15	0.85	0.00	0.00	0.00
BOP-83(i)	8/13/2020	28	<0.200	2.27	7.24	<0.200	<5.00	<5.00	2.30	177.7	0.792	0.5	7.39	0.131	1.49	6.63	0.00	0.19	0.81	0.00	0.00	0.00
BOP-83(i)	2/17/2021	216	<0.200	2.64	11.2	<0.200	<5.00	<5.00	1.46	34.0	0.566	1.0	3.29	1.82	1.19	6.37	0.00	0.15	0.85	0.00	0.00	0.00
BOP-83(i)	8/10/2021	391	<0.200	1.19	0.286	<0.200	<5.00	<5.00	2.69	92.2	1.63	5.5	8.81	0.0724	<1.00	5.60	0.00	0.75	0.25	0.00	0.00	0.00
BOP-83(i)	2/10/2022	574	<0.200	1.86	9.53	<0.200	<5.00	<5.00	2.14	95.7	0.763	2.0	4.47	0.751	3.27	6.20	0.00	0.13	0.87	0.00	0.00	0.00
BOP-84(i)	2/8/2012	42	<1.0	7.1	55	1.4	--	--	--	--	--	--	--	--	--	--	0.00	0.08	0.88	0.03	--	--
Injection Well	5/4/2012	128	<1.0	<1.0	1.8	150	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.01	0.99	--	--
BOP-84(i)	6/12/2012	167	<1.0	<1.0	1.2	14	13.6	<1.1	0.65	-37.3	<0.1	3.7	<0.1	9.82	16.7	6.33	0.00	0.00	0.02	0.31	0.67	0.00
BOP-84(i)	8/9/2012	225	<1.0	<1.0	1.3	8.4	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.09	0.91	--	--
BOP-84(i)	8/16/2012	232	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
BOP-84(i)	9/19/2012	34	<0.4	4.1	69	2.9	<5.0	<5.0	0.28	17.7	<0.10	3.5	<1.0	14	2620	4.57	0.00	0.04	0.90	0.06	0.00	0.00
BOP-84(i)	11/8/2012	84	<0.2	0.5	11	35	5.7	<5.0	--	--	<0.10	--	<1.0	22	276	--	0.00	0.00	0.13	0.65	0.00	0.22
BOP-84(i)	11/9/2012	85	--	--	--	--	--	--	0.81	131.2	--	3.0	--	--	--	6.36	--	--	--	--	--	--
BOP-84(i)	2/5/2013	173	<0.2	0.5	0.7	2.3	<5.0	<5.0	0.97	-43.9	<0.10	2.0	<1.0	26	80.5	6.29	0.00	0.08	0.15	0.77	0.00	0.00
BOP-84(i)	5/6/2013	263	<0.2	0.4	0.5	1.6	<5.0	<5.0	1.92	-75.2	<0.10	2.0	<1.0	21	102	6.12	0.00	0.09	0.15	0.76	0.00	0.00
BOP-84(i)	8/7/2013	29	<0.2	2.2	18	15	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.42	0.54	--	--
BOP-84(i)	11/8/2013	122	<0.2	0.7	3.3	1.3	--	--	--	--	--	--	--	--	--	--	0.00	0.09	0.57	0.35	--	--
BOP-84(i)	2/5/2014	211	<0.2	0.2	2.5	0.6	<5.0	<5.0	2.03	-118.7	<0.10	5.5	<1.0	19	378	6.54	0.00	0.04	0.70	0.26	0.00	0.00
BOP-84(i)	5/8/2014	303	<0.2	<0.2	2.0	1.9	7.4	<5.0	1.16	-32.6	<0.10	--	<1.0	14	40.1	6.61	0.00	0.00	0.07	0.10	0.84	0.00
BOP-84(i)	11/7/2014	114	<0.2	<0.2	8.0	2.9	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.64	0.36	--	--
BOP-84(i)	2/3/2015	202	<0.2	0.5	15	3.4	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.73	0.26	--	--
BOP-84(i)	5/4/2015	292	<0.2	0.3	8.9	3.1	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.64	0.35	--	--
BOP-84(i)	11/6/2015	110	<0.2	<0.2	2.8	2.1	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.46	0.54	--	--
BOP-84(i)	2/4/2016	200	<0.2	<0.2	3.4	2.0	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.52	0.48	--	--
BOP-84(i)	5/5/2016	291	<0.2	<0.2	3.8	2.2	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.53	0.47	--	--
BOP-84(i)	8/8/2016	386	<0.2	<0.2	4.6	1.7	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.64	0.36	--	--
BOP-84(i)	11/4/2016	475	<0.2	<0.2	4.6	1.5	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.66	0.34	--	--
BOP-84(i)	2/8/2017	571	<0.2	0.2	4.0	2.3	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.52	0.46	--	--
BOP-84(i)	5/16/2017	668	<0.2	0.3	4.3	2.1	--	--	--	--	--	--	--	--	--	--	0.00	0.03	0.55	0.42	--	--
BOP-84(i)	8/9/2017	753	<0.2	0.2	4.1	1.5	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.62	0.35	--	--
BOP-84(i)	2/12/2018	19	<0.2	<0.2	0.9	0.7	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.45	0.55	--	--
BOP-84(i)	5/17/2018	114	<0.2	0.2	1.9	0.8	--	--	--	--	--	--	--	--	--	--	0.00	0.04	0.58	0.38	--	--
BOP-84(i)	8/2/2018	191	<0.2	0.2	1.8	0.8	--	--	--	--	--	--	--	--	--	--	0.00	0.05	0.56	0.39	--	--
BOP-84(i)	2/8/2019	380	<0.2	0.2	1.4	3.1	--	--	--	--	--	--	--	--	--	--	0.00	0.02	0.22	0.76	--	--
BOP-84(i)	5/7/2019	468	<0.2	<0.2	1.3	4.2	--	--	--	--	--	--	--	--	--	--	0.00	0.00	0.17	0.83	--	--
BOP-84(i)	8/16/2019	570	0.2	<0.2	1.2	1.6	--	--	--	--	--	--	--	--	--	--	0.03	0.00	0.32	0.65	--	--

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	from Previous Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions					Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (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	PCE	TCE	cDCE	VC	Ethene
BOP-84(i)	11/8/2019	654	<0.20	<0.20	0.8	1.1	--	--	--	--	--	--	--	--	--	0.00	0.00	0.32	0.68	--	--
BOP-84(i)	2/7/2020	745	<0.2	<0.2	0.6	0.9	--	--	--	--	--	--	--	--	--	0.00	0.00	0.30	0.70	--	--
BOP-84(i)	5/7/2020	835	<0.2	<0.2	0.5	0.7	--	--	--	--	--	--	--	--	--	0.00	0.00	0.32	0.68	--	--
BOP-84(i)	11/3/2020	111	<0.200	<0.200	2.13	1.3	--	--	--	--	--	--	--	--	--	0.00	0.00	0.51	0.49	--	--
BOP-84(i)	2/19/2021	218	<0.200	<0.200	2.49	1.06	--	--	--	--	--	--	--	--	--	0.00	0.00	0.60	0.40	--	--
BOP-84(i)	5/6/2021	294	<0.200	0.236	3.05	0.752	--	--	--	--	--	--	--	--	--	0.00	0.04	0.69	0.27	--	--
BOP-84(i)	8/9/2021	389	<0.200	<0.200	2.96	0.574	--	--	--	--	--	--	--	--	--	0.00	0.00	0.77	0.23	--	--
BOP-84(i)	11/19/2021	491	<0.200	1.69	2.33	1.6	--	--	--	--	--	--	--	--	--	0.00	0.21	0.38	0.41	--	--
BOP-84(i)	2/15/2022	579	<0.200	<0.200	1.79	0.684	--	--	--	--	--	--	--	--	--	0.00	0.00	0.63	0.37	--	--
BOP-84(i)	5/18/2022	672	<0.200	<0.200	0.949	0.489	--	--	--	--	--	--	--	--	--	0.00	0.00	0.56	0.44	--	--
BOP-85(i)	2/8/2012	42	1.6	33	6.5	<1.0	--	--	--	--	--	--	--	--	--	0.03	0.77	0.20	0.00	--	--
Injection Well	5/4/2012	128	<1.0	29	6.5	<1.0	--	--	--	--	--	--	--	--	--	0.00	0.77	0.23	0.00	--	--
BOP-85(i)	8/9/2012	225	1.2	32	5.7	<1.0	--	--	--	--	--	--	--	--	--	0.02	0.79	0.19	0.00	--	--
BOP-85(i)	11/8/2012	84	0.9	20	4.3	<0.2	--	--	--	--	--	--	--	--	--	0.03	0.75	0.22	0.00	--	--
BOP-85(i)	2/6/2013	174	0.8	37	7.0	<0.2	--	--	--	--	--	--	--	--	--	0.01	0.79	0.20	0.00	--	--
BOP-85(i)	5/2/2013	259	1.1	30	5.8	<0.2	--	--	--	--	--	--	--	--	--	0.02	0.77	0.20	0.00	--	--
BOP-85(i)	8/7/2013	29	0.5	1.5	22	0.8	--	--	--	--	--	--	--	--	--	0.01	0.04	0.89	0.05	--	--
BOP-85(i)	11/8/2013	122	<0.2	0.2	2.4	2.1	--	--	--	--	--	--	--	--	--	0.00	0.03	0.41	0.56	--	--
BOP-85(i)	2/5/2014	211	<0.2	<0.2	<0.2	1.3	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--
BOP-85(i)	5/7/2014	302	<0.2	<0.2	<0.2	1.5	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--
BOP-85(i)	11/5/2014	112	<0.2	1.6	3.4	0.4	--	--	--	--	--	--	--	--	--	0.00	0.23	0.65	0.12	--	--
BOP-85(i)	2/3/2015	202	<0.2	1.4	5.2	0.3	--	--	--	--	--	--	--	--	--	0.00	0.15	0.78	0.07	--	--
BOP-85(i)	5/4/2015	292	<0.2	0.8	5.1	0.4	--	--	--	--	--	--	--	--	--	0.00	0.09	0.81	0.10	--	--
BOP-85(i)	11/6/2015	110	<0.2	<0.2	0.4	0.3	--	--	--	--	--	--	--	--	--	0.00	0.00	0.46	0.54	--	--
BOP-85(i)	2/4/2016	200	<0.2	<0.2	0.7	0.5	--	--	--	--	--	--	--	--	--	0.00	0.00	0.47	0.53	--	--
BOP-85(i)	5/5/2016	291	<0.2	<0.2	1.0	0.9	--	--	--	--	--	--	--	--	--	0.00	0.00	0.42	0.58	--	--
BOP-85(i)	8/8/2016	386	<0.2	0.3	1.3	0.9	--	--	--	--	--	--	--	--	--	0.00	0.08	0.45	0.48	--	--
BOP-85(i)	11/4/2016	474	<0.2	0.3	1.3	0.9	--	--	--	--	--	--	--	--	--	0.00	0.08	0.45	0.48	--	--
BOP-85(i)	2/8/2017	571	<0.2	0.3	1.3	1.1	--	--	--	--	--	--	--	--	--	0.00	0.07	0.40	0.53	--	--
BOP-85(i)	5/16/2017	668	<0.2	0.3	1.5	1.1	--	--	--	--	--	--	--	--	--	0.00	0.06	0.44	0.50	--	--
BOP-85(i)	8/9/2017	753	<0.2	0.4	1.4	0.9	--	--	--	--	--	--	--	--	--	0.00	0.10	0.45	0.45	--	--
BOP-85(i)	2/12/2018	20	<0.2	<0.2	0.3	<0.2	--	--	--	--	--	--	--	--	--	0.00	0.00	1.00	0.00	--	--
BOP-85(i)	5/15/2018	111	<0.2	0.2	0.6	0.3	--	--	--	--	--	--	--	--	--	0.00	0.12	0.49	0.38	--	--
BOP-85(i)	8/2/2018	191	<1.0	<1.0	<1.0	<1.0	--	--	--	--	--	--	--	--	--	ND	ND	ND	ND	--	--
BOP-85(i)	11/7/2018	288	<0.2	0.2	0.8	0.5	--	--	--	--	--	--	--	--	--	0.00	0.09	0.46	0.45	--	--
BOP-85(i)	2/8/2019	380	<0.2	0.2	0.9	0.8	--	--	--	--	--	--	--	--	--	0.00	0.06	0.39	0.54	--	--
BOP-85(i)	5/6/2019	468	<0.2	0.3	0.9	0.6	--	--	--	--	--	--	--	--	--	0.00	0.11	0.44	0.45	--	--
BOP-85(i)	8/16/2019	569	<0.2	0.3	1.1	0.7	--	--	--	--	--	--	--	--	--	0.00	0.09	0.46	0.45	--	--
BOP-85(i)	11/8/2019	654	<0.20	0.4	1.1	0.9	--	--	--	--	--	--	--	--	--	0.00	0.11	0.39	0.50	--	--
BOP-85(i)	2/7/2020	745	<0.2	0.3	0.9	0.9	--	--	--	--	--	--	--	--	--	0.00	0.09	0.36	0.55	--	--
BOP-85(i)	5/7/2020	835	<0.2	0.3	0.9	1.1	--	--	--	--	--	--	--	--	--	0.00	0.08	0.32	0.60	--	--
BOP-85(i)	11/3/2020	111	<0.200	<0.200	<0.200	0.403	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--
BOP-85(i)	2/19/2021	218	<0.200	<0.200	0.318	0.526	--	--	--	--	--	--	--	--	--	0.00	0.00	0.28	0.72	--	--
BOP-85(i)	5/6/2021	294	<0.200	<0.200	0.301	0.654	--	--	--	--	--	--	--	--	--	0.00	0.00	0.23	0.77	--	--
BOP-85(i)	8/9/2021	389	<2.00	<2.00	<2.00	<2.00	--	--	--	--	--	--	--	--	--	ND	ND	ND	ND	--	--
BOP-85(i)	11/16/2021	488	<2.00	<2.00	<2.00	0.746	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	from Previous Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions					Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (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	PCE	TCE	cDCE	VC	Ethene
BOP-85(i)	2/15/2022	579	<2.00	<2.00	<2.00	<2.00	--	--	--	--	--	--	--	--	--	ND	ND	ND	ND	--	--
BOP-85(i)	5/18/2022	671	<2.00	<2.00	<2.00	<2.00	--	--	--	--	--	--	--	--	--	ND	ND	ND	ND	--	--
BOP-86(i)	2/8/2012	42	1.2	21	17	<1.0	--	--	--	--	--	--	--	--	--	0.02	0.47	0.51	0.00	--	--
Injection Well	5/4/2012	128	<1.0	28	5.2	<1.0	--	--	--	--	--	--	--	--	--	0.00	0.80	0.20	0.00	--	--
BOP-86(i)	8/9/2012	225	1.0	39	7.7	<1.0	--	--	--	--	--	--	--	--	--	0.02	0.78	0.21	0.00	--	--
BOP-86(i)	11/8/2012	84	0.9	20	4.6	0.5	--	--	--	--	--	--	--	--	--	0.03	0.71	0.22	0.04	--	--
BOP-86(i)	2/6/2013	174	0.6	31	6.2	<0.2	--	--	--	--	--	--	--	--	--	0.01	0.78	0.21	0.00	--	--
BOP-86(i)	5/2/2013	259	0.7	35	7.4	<0.2	--	--	--	--	--	--	--	--	--	0.01	0.77	0.22	0.00	--	--
BOP-86(i)	8/7/2013	29	0.6	9.1	15	1.0	--	--	--	--	--	--	--	--	--	0.01	0.28	0.64	0.07	--	--
BOP-86(i)	11/8/2013	122	<0.2	1.4	2.0	2.6	--	--	--	--	--	--	--	--	--	0.00	0.15	0.28	0.57	--	--
BOP-86(i)	2/5/2014	211	0.3	0.4	0.4	0.6	--	--	--	--	--	--	--	--	--	0.10	0.16	0.22	0.52	--	--
BOP-86(i)	5/7/2014	302	<0.2	0.4	1.3	0.8	--	--	--	--	--	--	--	--	--	0.00	0.10	0.46	0.44	--	--
BOP-86(i)	11/5/2014	112	<0.2	0.6	4.6	3.0	--	--	--	--	--	--	--	--	--	0.00	0.05	0.47	0.48	--	--
BOP-86(i)	2/3/2015	202	<0.2	0.9	5.5	3.5	--	--	--	--	--	--	--	--	--	0.00	0.06	0.47	0.47	--	--
BOP-86(i)	5/4/2015	292	<0.2	3.5	5.0	2.8	--	--	--	--	--	--	--	--	--	0.00	0.22	0.42	0.36	--	--
BOP-86(i)	11/6/2015	110	<0.2	0.3	1.6	2.8	--	--	--	--	--	--	--	--	--	0.00	0.04	0.26	0.70	--	--
BOP-86(i)	2/4/2016	200	<0.2	0.3	1.9	2.2	--	--	--	--	--	--	--	--	--	0.00	0.04	0.34	0.62	--	--
BOP-86(i)	5/5/2016	291	<0.2	0.4	2.0	<0.2	--	--	--	--	--	--	--	--	--	0.00	0.13	0.87	0.00	--	--
BOP-86(i)	8/8/2016	386	<0.2	0.6	2.5	1.7	--	--	--	--	--	--	--	--	--	0.00	0.08	0.45	0.47	--	--
BOP-86(i)	11/4/2016	474	<0.2	0.6	2.3	1.6	--	--	--	--	--	--	--	--	--	0.00	0.08	0.44	0.48	--	--
BOP-86(i)	2/8/2017	571	<0.2	0.6	2.2	1.3	--	--	--	--	--	--	--	--	--	0.00	0.10	0.47	0.43	--	--
BOP-86(i)	5/16/2017	668	<0.2	0.7	2.4	0.9	--	--	--	--	--	--	--	--	--	0.00	0.12	0.56	0.32	--	--
BOP-86(i)	8/9/2017	753	<0.2	0.6	2.0	0.9	--	--	--	--	--	--	--	--	--	0.00	0.12	0.52	0.36	--	--
BOP-86(i)	2/12/2018	19	<0.2	<0.2	0.4	0.2	--	--	--	--	--	--	--	--	--	0.00	0.00	0.56	0.44	--	--
BOP-86(i)	5/15/2018	111	<0.2	0.5	0.6	0.5	--	--	--	--	--	--	--	--	--	0.00	0.21	0.34	0.44	--	--
BOP-86(i)	8/2/2018	191	<0.2	1.1	0.4	0.5	--	--	--	--	--	--	--	--	--	0.00	0.41	0.20	0.39	--	--
BOP-86(i)	2/8/2019	380	<0.2	2.3	1.0	0.7	--	--	--	--	--	--	--	--	--	0.00	0.45	0.26	0.29	--	--
BOP-86(i)	5/7/2019	468	<0.2	2.6	1.1	0.5	--	--	--	--	--	--	--	--	--	0.00	0.51	0.29	0.20	--	--
BOP-86(i)	8/16/2019	569	<0.2	2.1	0.9	0.4	--	--	--	--	--	--	--	--	--	0.00	0.50	0.29	0.20	--	--
BOP-86(i)	11/8/2019	654	<0.20	1.3	0.7	0.4	--	--	--	--	--	--	--	--	--	0.00	0.42	0.31	0.27	--	--
BOP-86(i)	2/7/2020	745	<0.2	0.7	0.5	0.4	--	--	--	--	--	--	--	--	--	0.00	0.32	0.31	0.38	--	--
BOP-86(i)	5/7/2020	835	<0.2	0.6	0.4	0.5	--	--	--	--	--	--	--	--	--	0.00	0.27	0.25	0.48	--	--
BOP-86(i)	11/3/2020	111	<0.200	0.248	<0.200	0.488	--	--	--	--	--	--	--	--	--	0.00	0.19	0.00	0.81	--	--
BOP-86(i)	2/19/2021	218	<0.200	0.299	0.366	0.43	--	--	--	--	--	--	--	--	--	0.00	0.18	0.29	0.53	--	--
BOP-86(i)	5/6/2021	294	<0.200	0.278	0.44	0.473	--	--	--	--	--	--	--	--	--	0.00	0.15	0.32	0.53	--	--
BOP-86(i)	8/9/2021	389	<0.200	0.296	0.507	0.412	--	--	--	--	--	--	--	--	--	0.00	0.16	0.37	0.47	--	--
BOP-86(i)	11/16/2021	488	<0.200	0.318	0.598	0.495	--	--	--	--	--	--	--	--	--	0.00	0.15	0.37	0.48	--	--
BOP-86(i)	2/15/2022	579	<0.200	0.304	0.499	0.345	--	--	--	--	--	--	--	--	--	0.00	0.18	0.40	0.43	--	--
BOP-86(i)	5/17/2022	671	<0.200	0.298	0.578	0.377	--	--	--	--	--	--	--	--	--	0.00	0.16	0.42	0.42	--	--
BOP-87(i)	2/8/2012	42	1.3	14	1.8	<1.0	--	--	--	--	--	--	--	--	--	0.06	0.80	0.14	0.00	--	--
Injection Well	5/4/2012	128	<1.0	24	1.4	<1.0	--	--	--	--	--	--	--	--	--	0.00	0.93	0.07	0.00	--	--
BOP-87(i)	8/9/2012	225	2.2	52	2.6	<1.0	--	--	--	--	--	--	--	--	--	0.03	0.91	0.06	0.00	--	--
BOP-87(i)	11/8/2012	84	1.2	9.7	1.6	<0.2	--	--	--	--	--	--	--	--	--	0.07	0.76	0.17	0.00	--	--
BOP-87(i)	2/6/2013	174	0.4	8.5	1.2	<0.2	--	--	--	--	--	--	--	--	--	0.03	0.81	0.16	0.00	--	--
BOP-87(i)	5/2/2013	259	0.2	7.1	1.2	<0.2	--	--	--	--	--	--	--	--	--	0.02	0.80	0.18	0.00	--	--

**Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland**

Well	Date	from Previous Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions					Donor Indicators		Molar Fraction						
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (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	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-87(i)	8/7/2013	29	0.7	21	6.3	0.3	--	--	--	--	--	--	--	--	--	0.02	0.68	0.28	0.02	--	--	
BOP-87(i)	11/8/2013	122	<0.2	0.6	6.2	0.6	--	--	--	--	--	--	--	--	--	0.00	0.06	0.82	0.12	--	--	
BOP-87(i)	2/5/2014	211	<0.2	0.3	1.2	1.0	--	--	--	--	--	--	--	--	--	0.00	0.07	0.40	0.52	--	--	
BOP-87(i)	5/7/2014	302	<0.2	<0.2	0.3	0.5	--	--	--	--	--	--	--	--	--	0.00	0.00	0.28	0.72	--	--	
BOP-87(i)	11/5/2014	112	<0.2	0.6	1.5	0.8	--	--	--	--	--	--	--	--	--	0.00	0.14	0.47	0.39	--	--	
BOP-87(i)	2/3/2015	202	<0.2	2.1	2.2	0.9	--	--	--	--	--	--	--	--	--	0.00	0.30	0.43	0.27	--	--	
BOP-87(i)	5/4/2015	292	<0.2	1.4	2.8	0.7	--	--	--	--	--	--	--	--	--	0.00	0.21	0.57	0.22	--	--	
BOP-87(i)	11/6/2015	110	<0.2	<0.2	0.3	0.5	--	--	--	--	--	--	--	--	--	0.00	0.00	0.28	0.72	--	--	
BOP-87(i)	2/4/2016	200	<0.2	<0.2	0.5	0.6	--	--	--	--	--	--	--	--	--	0.00	0.00	0.35	0.65	--	--	
BOP-87(i)	5/5/2016	291	<0.2	0.2	0.6	1.0	--	--	--	--	--	--	--	--	--	0.00	0.06	0.26	0.67	--	--	
BOP-87(i)	8/8/2016	386	<0.2	0.3	0.9	0.8	--	--	--	--	--	--	--	--	--	0.00	0.09	0.38	0.53	--	--	
BOP-87(i)	11/4/2016	474	<0.2	0.3	1.0	0.8	--	--	--	--	--	--	--	--	--	0.00	0.09	0.41	0.50	--	--	
BOP-87(i)	2/8/2017	571	<0.2	0.4	1.3	1.1	--	--	--	--	--	--	--	--	--	0.00	0.09	0.39	0.52	--	--	
BOP-87(i)	5/16/2017	668	<0.2	0.5	1.9	1	--	--	--	--	--	--	--	--	--	0.00	0.10	0.50	0.41	--	--	
BOP-87(i)	8/9/2017	753	<0.2	0.4	1.6	0.9	--	--	--	--	--	--	--	--	--	0.00	0.09	0.49	0.42	--	--	
BOP-87(i)	2/12/2018	20	<0.2	<0.2	0.2	<0.2	--	--	--	--	--	--	--	--	--	0.00	0.00	1.00	0.00	--	--	
BOP-87(i)	5/15/2018	112	<0.2	<0.2	1.1	0.5	--	--	--	--	--	--	--	--	--	0.00	0.00	0.59	0.41	--	--	
BOP-87(i)	8/2/2018	191	<0.2	<0.2	0.8	4.2	--	--	--	--	--	--	--	--	--	0.00	0.00	0.11	0.89	--	--	
BOP-87(i)	11/7/2018	288	<0.2	0.2	0.6	3.7	--	--	--	--	--	--	--	--	--	0.00	0.02	0.09	0.88	--	--	
BOP-87(i)	2/8/2019	380	<0.2	0.3	0.9	30	--	--	--	--	--	--	--	--	--	0.00	0.00	0.02	0.98	--	--	
BOP-87(i)	5/7/2019	468	<0.2	0.5	1.2	68	--	--	--	--	--	--	--	--	--	0.00	0.00	0.01	0.99	--	--	
BOP-87(i)	8/16/2019	570	<0.2	0.3	1.8	65	--	--	--	--	--	--	--	--	--	0.00	0.00	0.02	0.98	--	--	
BOP-87(i)	11/8/2019	654	<0.20	0.4	2.1	86	--	--	--	--	--	--	--	--	--	0.00	0.00	0.02	0.98	--	--	
BOP-87(i)	2/27/2020	764	<0.2	<0.2	3.7	62	--	--	--	--	--	--	--	--	--	0.00	0.00	0.04	0.96	--	--	
BOP-87(i)	5/7/2020	835	<0.2	0.5	5.3	82	--	--	--	--	--	--	--	--	--	0.00	0.00	0.04	0.96	--	--	
BOP-87(i)	11/3/2020	111	<0.200	<0.200	<0.200	19.1	--	--	--	--	--	--	--	--	--	0.00	0.00	0.00	1.00	--	--	
BOP-87(i)	2/19/2021	218	<0.200	<0.200	3.81	24.3	--	--	--	--	--	--	--	--	--	0.00	0.00	0.09	0.91	--	--	
BOP-87(i)	5/6/2021	294	<1.00	<1.00	7.03	23.8	--	--	--	--	--	--	--	--	--	0.00	0.00	0.16	0.84	--	--	
BOP-87(i)	8/9/2021	389	<1.00	<1.00	11.8	24.6	--	--	--	--	--	--	--	--	--	0.00	0.00	0.24	0.76	--	--	
BOP-87(i)	11/16/2021	488	<0.200	<0.200	<0.200	<0.200	--	--	--	--	--	--	--	--	--	ND	ND	ND	ND	--	--	
BOP-87(i)	2/11/2022	575	<1.00	<1.00	9.69	19.4	--	--	--	--	--	--	--	--	--	0.00	0.00	0.24	0.76	--	--	
BOP-87(i)	5/18/2022	672	<1.00	<1.00	7.04	13.9	--	--	--	--	--	--	--	--	--	0.00	0.00	0.25	0.75	--	--	
BOP-88(i)	2/8/2012	42	2.0	26	2.2	<1.0	--	--	--	--	--	--	--	--	--	0.05	0.85	0.10	0.00	--	--	
Injection Well	5/4/2012	128	<1.0	19	2.5	<1.0	--	--	--	--	--	--	--	--	--	0.00	0.85	0.15	0.00	--	--	
BOP-88(i)	8/9/2012	225	2.8	130	8.9	<1.0	--	--	--	--	--	--	--	--	--	0.02	0.90	0.08	0.00	--	--	
BOP-88(i)	11/8/2012	84	1.2	11	1.5	<0.2	--	--	--	--	--	--	--	--	--	0.07	0.79	0.15	0.00	--	--	
BOP-88(i)	2/6/2013	174	0.9	11	1.4	0.2	--	--	--	--	--	--	--	--	--	0.05	0.78	0.14	0.03	--	--	
BOP-88(i)	5/2/2013	259	0.6	14	2.2	1.2	--	--	--	--	--	--	--	--	--	0.02	0.70	0.15	0.13	--	--	
BOP-88(i)	8/7/2013	29	0.8	7.8	11	0.2	<5.0	<5.0	1.19	-133.4	<0.10	2.0	<1.0	1.9	294	5.88	0.03	0.33	0.63	0.02	0.00	0.00
BOP-88(i)	11/11/2013	125	<0.2	0.2	85	4.1	<5.0	<5.0	1.21	-90.1	<0.10	4.0	<1.0	17	458	6.20	0.00	0.00	0.93	0.07	0.00	0.00
BOP-88(i)	2/5/2014	211	<0.2	0.9	3.0	27	--	--	--	--	--	--	--	--	--	0.00	0.01	0.07	0.92	--	--	
BOP-88(i)	5/7/2014	302	<0.2	1.0	3.5	7.7	--	--	--	--	--	--	--	--	--	0.00	0.05	0.22	0.74	--	--	
BOP-88(i)	11/11/2014	118	<0.2	1.9	30	4.2	<5.0	<5.0	1.36	-208.2	<1.0	4.0	276	13	3150	4.56	0.00	0.04	0.79	0.17	0.00	0.00
BOP-88(i)	2/9/2015	208	0.3	12	90	4.0	<5.0	<5.0	0.46	-94.9	<1.0	7.0	243	12	3990	4.90	0.00	0.08	0.86	0.06	0.00	0.00
BOP-88(i)	5/6/2015	294	1.0	28	150	8.5	7.4	<5.0	0.82	-97.0	<1.0	7.0	138	16	3370	4.82	0.00	0.10	0.71	0.06	0.12	0.00
BOP-88(i)	11/4/2015	108	<0.2	0.8	8.7	2.4	--	--	--	--	--	--	--	--	--	0.00	0.05	0.67	0.29	--	--	

Table 2
Bioremediation Progress Results
Former Vapor Degreaser Source Area
Boeing Portland

Well	Date	from Previous Injection (days)	Volatile Organic Compounds Analytical Results						Aquifer Redox Conditions						Donor Indicators		Molar Fraction					
		Source Zone Wells + PRB Injection	PCE (µg/L)	TCE (µg/L)	cDCE (µg/L)	VC (µg/L)	E+E (µg/L)	Acetylene (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	PCE	TCE	cDCE	VC	Ethene	Ethane
BOP-88(i)	2/4/2016	200	<0.2	1.6	24	4.1	7.2	<5.0	1.68	58.4	<1.0	7.0	2270	11	8570	5.64	0.00	0.02	0.43	0.11	0.44	0.00
BOP-88(i)	5/5/2016	291	<0.2	3.3	65	6.8	7.9	<5.0	1.12	9.7	<1.0	7.0	2370	15.0	8780	4.67	0.00	0.02	0.62	0.10	0.26	0.00
BOP-88(i)	8/9/2016	387	<0.2	8.9	100	7.0	9.3	<5.0	0.39	-43.7	4.8	7.0	2330	14	10000	4.67	0.00	0.04	0.67	0.07	0.21	0.00
BOP-88(i)	11/8/2016	478	<0.4	6.2	110	7.4	11	<5.0	0.92	115.1	1.1	7.0	2620	12	9830	4.44	0.00	0.03	0.67	0.07	0.23	0.00
BOP-88(i)	2/8/2017	570	0.3	11	120	8.9	14	<5.0	4.62	113.1	<1.0	6.0	2510	13	9030	4.45	0.00	0.04	0.63	0.07	0.25	0.00
BOP-88(i)	5/17/2017	669	<0.4	6.3	120	6.1	11	<5.0	3.69	111.6	1.5	7.0	2600	13	9290	4.79	0.00	0.03	0.70	0.05	0.22	0.00
BOP-88(i)	8/9/2017	753	<0.4	2.1	41	4.8	18	<5.0	0.6	58.6	1.3	7.0	2330	18	8410	4.6	0.00	0.01	0.37	0.07	0.55	0.00
BOP-88(i)	2/20/2018	27	<0.4	3	10	0.9	8.3	<5.0	0.18	29.1	<0.50	5.0	90	13	7760	4.90	0.00	0.05	0.24	0.03	0.68	0.00
BOP-88(i)	5/15/2018	112	<0.4	6.8	35	2.9	9.4	<5.0	0.38	51.5	<0.10	7.0	91	14	3980	5.03	0.00	0.07	0.45	0.06	0.42	0.00
BOP-88(i)	8/9/2018	198	<0.4	2	12	1.1	8.8	<5.0	0.12	-0.13	<1.0	5.0	239	11	10900	4.95	0.00	0.03	0.26	0.04	0.67	0.00
BOP-88(i)	11/8/2018	288	<0.4	3.9	19	2.6	18	<5.0	0.85	21.1	<0.50	7.0	207	15	13600	4.84	0.00	0.03	0.22	0.05	0.71	0.00
BOP-88(i)	2/14/2019	386	<0.4	6.0	36	5.7	29	<5.0	0.69	-21.5	<2.0	7.0	225	15	16000	4.84	0.00	0.03	0.24	0.06	0.67	0.00
BOP-88(i)	5/9/2019	471	<0.4	8.5	53	6.6	14	<5.0	0.41	33.15	<1.0	7.0	224	8.8	15600	4.79	0.00	0.05	0.45	0.09	0.41	0.00
BOP-88(i)	8/14/2019	568	<0.4	9.9	72	7.2	38	<5.0	0.51	100.8	<2.0	7.0	9.9	20	15200	4.81	0.00	0.03	0.32	0.05	0.59	0.00
BOP-88(i)	11/7/2019	653	0.7	24	160	22	48	<5.0	0.59	40.8	1.6	5.5	286	12	16100	4.76	0.00	0.05	0.42	0.09	0.44	0.00
BOP-88(i)	2/12/2020	750	0.9	24	140	23	49	<5.0	3.72	44.3	2.1	6.5	290	15	17000	5.04	0.00	0.05	0.39	0.10	0.47	0.00
BOP-88(i)	11/5/2020	113	<0.400	0.933	43.5	3.67	162.3	<5.00	0.24	-129.3	0.888	2.5	162	9.64	20100	5.77	0.00	0.00	0.07	0.01	0.57	0.34
BOP-88(i)	2/16/2021	215	<20.0	<20.0	<20.0	<20.0	88.2	<5.00	0.94	-167.0	<50.0	3.5	486	12.5	24900	5.53	0.00	0.00	0.00	0.00	0.52	0.48
BOP-88(i)	5/5/2021	293	<2.00	<2.00	40.9	3.18	51.1	<5.00	0.23	-26.5	<1.00	3	367	9.12	23900	5.55	0.00	0.00	0.19	0.02	0.52	0.27
BOP-88(i)	8/10/2021	390	<2.00	<2.00	78.1	4.78	98	<5.00	0.07	-119.2	<0.500	7.0	442	21.1	26100	5.71	0.00	0.00	0.19	0.02	0.53	0.27
BOP-88(i)	11/18/2021	490	<2.00	<2.00	139	10.3	148.9	<5.00	0.01	-57.3	<2.50	5.0	449	17.8	25300	5.50	0.00	0.00	0.21	0.02	0.46	0.30
BOP-88(i)	2/9/2022	573	<0.200	<0.200	107	9.15	121.7	<5.00	-0.17	-68.9	<1.25	5.0	528	12.8	24900	5.58	0.00	0.00	0.20	0.03	0.57	0.21
BOP-88(i)	5/17/2022	671	<10.0	<10.0	16.5	<10.0	--	--	--	--	--	--	--	--	--	--	0.00	0.00	1.00	0.00	--	--

Table 2
Bioremediation Progress Results
Former Degreaser Source Area
Boeing Portland
Gresham, Oregon

Notes:

-- Data not collected or analyzed

Boxed results indicate concentrations are above the respective cleanup levels.

Blue highlighted values indicate the compound with the highest micromoles per event, ethene and ethane combined are considered for maximum molar fraction. Compounds with 2 percent of maximum compound are also highlighted due to potential laboratory variability

Injection Notes:

November 4-9, 2010: Conduct pilot injection test at BOP-72(i) with 900 gal of water mixed with 3/4 drum of Wilclear sodium lactate.

December 28, 2011: PRB injection at BOP-74(i). Injected 15 drums of LactOil, Newman Zone vegetable oil emulsion, and Wilclear sodium lactate with 15,000 gallons of water. Injection rates were between 70 to 80 gpm.

August 18, 2012: Conducted PRB injection at BOP-74(i) with 30,000 gallons of lactoil and water mixture.

July 2-9, 2013: Conducted gravity injection at seven source area zone injection wells (BOP-78, 79, 84, 85, 86, 87, 88). Injection of 10,000 gallons total lactoil donor and water. Average injection rates ranged from 4.8 to 11.7 gpm.

July 12-16, 2014: Conducted source area zone injection by gravity flow to seven multi-purpose injection wells and pump flow to PRB well BOP-74(i). Injection consisted of 50,000-gallon mixture of water, Textrol BR, glycerin, and ferrous sulfate.

June 8-19, 2015: Conducted source area zone injection by gravity flow to seven multi-purpose injection wells and pump flow to PRB well BOP-74(i). Injection consisted of 50,000-gallon mixture of water, Textrol BR, glycerin, and ferrous sulfate.

January 15-24, 2018: Conducted source area zone injection by pump flow to eight multi-purpose injection wells and PRB well BOP-74(i). Injection consisted of 53,898-gallon mixture of water, HRO and glycerin.

July 2-16, 2020: Conducted source area zone injection by pump flow to seven multi-purpose injection wells and PRB well BOP-74(i). Injection consisted of 46,138-gallon mixture of water, HRO and glycerin. Select wells received sulfated zero valent iron.

Abbreviations/Acronyms:

cis = 1,2-dichloroethene

Diss = dissolved

DO = dissolved oxygen

gpm = gallons per minute

µg/L = micrograms per liter

mg/L = milligrams per liter

NS = not sampled

ORP = oxygen reduction potential

PCE = tetrachloroethene

PRB = permeable reactive barrier

TOC = total organic carbon

TCE = trichloroethene

VC = vinyl chloride

Table 3
Injection Design
Former Vapor Degreaser Source Area
Boeing Portland

Well ID	Injection Solution Composition										Combined Injection Solution Volume (gallons) (b)	Resulting Injection Fluid Concentrations		
	HRO (gallons)	HRO (totes)	Glycerin (gallons)	Glycerin (totes)	ZVI (gallons) (a)	ZVI (drums)	Yeast Extract (lb)	MAP (lb)	CAN-27 (lb)	Potable Water (gallons)		HRO (%vol)	Glycerin (%vol) (c)	ZVI (%vol)
BOP-74(i)	650	2.50	960	3.66	---	---	19	120.0	173.5	17,490	19,100	3.4%	5.0%	---
BOP-78(i)	130	0.50	205	0.78	44	1.3	4	15.0	25.5	3,621	4,000	3.3%	5.1%	1.1%
BOP-87(i)	130	0.50	205	0.78	44	1.3	4	15.0	25.5	3,621	4,000	3.3%	5.1%	1.1%
BOP-88(i)	130	0.50	205	0.78	44	1.3	4	15.0	25.5	3,621	4,000	3.3%	5.1%	1.1%
Totals	1,040	4.0	1,574	6.0	133	4.0	31	165	250	28,352	31,100			

Abbreviations and Acronyms:

% = percent
HRO = high-retention oil
ID = identification
lb = pounds
vol = volume
wt = weight
ZVI = zero-valent iron

Notes:

- (a) Added for the first time during 2020 injection. Does not include pre- and post-injection potable water flushes.
(b) Does not include pre- and post-injection potable water flushes.
(c) The glycerin vendor changed from Whole Energy to SeSequential, resulting in a crude glycerin concentration difference. The volume required was scaled up to match previous concentrations used.

Table 4
Bioremediation Monitoring Parameters
Former Vapor Degreaser Source Area
Boeing Portland

Field Parameters	Information Provided
Dissolved Oxygen (DO) [field meter] (a)	Aquifer is considered anaerobic at DO concentrations less than 1.0 milligram per liter (mg/L).
Oxidation Reduction Potential (Redox) [field meter] (a)	Negative values indicate reducing conditions.
pH [field meter] (a)	May decrease due to injected donor. Considered acceptable for reductive dechlorination when greater than 4.0 at injection wells and greater than 5 at monitoring wells (Suthersan et al. 2002).
Iron (II) [Hach test kit]	Concentrations above background indicate iron reducing conditions.
Laboratory Analyses	Information Provided
Volatile Organic Compounds (VOCs) [Method 8260][3-40 mL VOA-HCl] (b)	Concentrations of chlorinated VOCs and breakdown products are indicative of reductive dechlorination and pathways.
Total Organic Carbon (TOC) [Method SM 5310 C-2000][250 mL Amber-H2SO4]	Levels will increase due to arrival of volatile fatty acids released from injected donor substrate.
Nitrate (c) [IC Method E300][500 mL poly]	Decreasing concentrations indicate nitrate-reducing conditions.
Sulfate [IC Method E300][500 mL poly]	Decreasing concentrations indicate sulfate-reducing conditions.
Ethene/Ethane/Methane/Acetylene [Method 8015 Mod][3-40 mL VOA] (b)	Concentrations of ethene and ethane are indicative of reductive dechlorination and pathways. Increasing methane concentrations indicate methanogenic aquifer redox conditions. Presence of acetylene is definitive evidence of destruction of TCE and cDCE by abiotic degradation pathway (reductive elimination).
Total and Dissolved Iron [Method SW 846 6010C][2-250 mL poly-NHO3]	Increasing concentrations will complex with sulfide and precipitate resulting in abiotic degradation.

Abbreviations and Acronyms:

AFCEE = Air Force Center for Environmental Excellence
cDCE = cis-1,2-dichloroethene
ESTCP = Environmental Security Technology Certification Program
mL = milliliter
TCE = trichloroethene

Notes:

- (a) Measured using a flow-through cell.
(b) Care to be taken during sample collection to minimize aeration and volatilization. Sample collected with no headspace.
(c) Nitrate sample can be combined with sulfate sample; nitrate analysis to be performed within 48 hour holding time.

Information Sources:

Suthersan, S.S., C.C. Lutes, P.L. Palmer, F. Lenzo, F.C. Payne, D.S. Liles, and J. Burdick. 2002. *Final Technical Protocol for Using Soluble Carbohydrates to Enhance Reductive Dechlorination of Chlorinated Aliphatic Hydrocarbons*. Submitted to ESTCP and AFCEE under Contract #41624-99-C-8032. December 19.