

Other Area 9 Interim Measure – Second Semiannual Report

Boeing Plant 2 Seattle/Tukwila, Washington

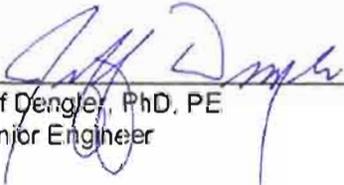
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January 29, 2010

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ACRONYMS

bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
COC	contaminant of concern
°C	degrees Celsius
DPT	direct-push technology
EPA	United States Environmental Protection Agency
EPI	Environmental Partners, Inc.
EAD	enhanced aerobic degradation
IM	Interim Measure
mg/L	milligrams per liter
mV	millivolts
mS/cm	milliSiemens per centimeter
µg/L	micrograms per liter
NTU	nephelometric turbidity units
OA	Other Area
ORP	oxidation-reduction potential
RCRA	Resource Conservation and Recovery Act
SAP	Sampling and Analysis Plan
SCFH	standard cubic feet per hour
SWMU	Solid Waste Management Unit
TPH	total petroleum hydrocarbons
TPH-D	total petroleum hydrocarbons – diesel range
TPH-G	total petroleum hydrocarbons – gasoline range
UST	underground storage tank
VOC	volatile organic compound

1.0 INTRODUCTION

This second semiannual report presents information and data on the Interim Measure (IM) at Other Area 9 (OA-9) located in the 2-60s Area at Boeing Plant 2. The report covers data generated during the time period from May 2009 through October 2009.

In a letter dated August 18, 2008 from the United States Environmental Protection Agency Region X (EPA) to Boeing, EPA gave approval to implement the *Interim Measure Work Plan for Other Area 9* (Environmental Partners, Inc. [EPI], 2008). This work plan presented details for remediation of total petroleum hydrocarbon (TPH) impacts to soil and groundwater in an area associated with Resource Conservation and Recovery Act (RCRA) Unit OA-9 and Solid Waste Management Unit 2-78.6 (SWMU 2-78.6). OA-9 consists of three former underground storage tanks (USTs) identified as PL-16, PL-17, and PL-18. SWMU 2-78.6 is a nearby former oil-water separator. The impacted vadose soil and groundwater associated with these units are being addressed together and are referred to as OA-9. Figure 1 presents a general location map of Plant 2 and Figure 2 is a site representation showing the location of the OA-9 IM at Plant 2.

Based on the *2-60s Area Data Gap Investigation Report* (EPI, 2006), contaminants of concern (COCs) for vadose zone soil at OA-9 are gasoline-range petroleum hydrocarbons (TPH-G) and the volatile organic compounds (VOCs) benzene and ethylbenzene. Groundwater COCs are TPH-G and the VOC benzene. Detailed drawings showing the locations of the soil detections and groundwater plumes are presented in the OA-9 IM Work Plan (EPI, 2008). Figures 3 and 4 present diagrams of the approximate extent of impacted soil and groundwater, respectively, at OA-9. The area of impacted groundwater shown in Figure 4 is defined by the benzene plume, which coincides with and extends beyond the TPH-G plume.

2.0 INTERIM MEASURE IMPLEMENTATION

Bioventing was selected as the IM soil treatment technology for vadose soil and enhanced aerobic degradation (EAD) was selected as the IM groundwater treatment technology. These two technologies complement each other and are being implemented together to introduce oxygen into the subsurface soil and groundwater. The increased available oxygen is intended to enhance aerobic bacteria populations, which destroy contaminant hydrocarbons and VOCs through aerobic metabolism of the organic contaminant molecules.

Bioventing is an *in situ* soil remedial technology that introduces oxygen in air into the open pore spaces of vadose zone soil by using a blower to inject air at relatively low flow rates into the soil through a series of injection wells. The oxygen introduced into the soil stimulates indigenous microorganisms to metabolize and destroy organic compounds adsorbed to soil particles.

EAD is an *in situ* groundwater remedial technology that introduces chemically bound oxygen into groundwater, which stimulates the growth of indigenous microorganisms. The enhanced microbial populations metabolize and destroy petroleum hydrocarbons and benzene in groundwater. The oxygen-release compound used at OA-9 is a proprietary product by Adventus Americas, Inc., named EHC-O™. More detailed descriptions of these remedial technologies and their applicability and limitations are presented in the OA-9 IM Work Plan (EPI, 2008).

Prior to this IM remedial work at OA-9 included excavation and removal of contaminated vadose zone soil; however, buildings and extensive subsurface utilities in the area prevented the removal of all contaminated soil. Bioventing remediation was implemented to remediate these remaining pockets of impacted vadose soil. Bioventing is complimentary, but not directly related, to the OA-9 groundwater cleanup.

In September 2008 six new bioventing wells were installed to facilitate cleanup of impacted vadose zone soil. During October and November, pipe trenches were dug and 2-inch diameter PVC pipe was installed to all nine bioventing wells. A blower, trailer, pipe manifold, and electrical power were then installed and connected to supply air to the bioventing wells. Details of the wells and bioventing system installation are presented in the First Semiannual Report (EPI, 2009). The bioventing system blower was started on December 15, 2008. Respirometry testing is performed quarterly to monitor bioventing status.

During October and November 2008, a solution of 5,000 pounds of EHC-O™ and potable water was injected into a grid of 20 points by direct-push technology (DPT). The injections were made over the depth interval from 10 to 30 feet below ground surface (bgs). Details of the injection process are presented in the First Semiannual Report (EPI, 2009). Groundwater is monitored quarterly to assess the progress of the groundwater remediation. Figure 5 is a general representation of the bioventing system and EAD injection locations at OA-9.

3.0 PERFORMANCE MONITORING METHODOLOGY

The primary objective of the OA-9 IM is to destroy TPH and the non-chlorinated VOC mass in vadose zone soil and groundwater through EAD. Performance monitoring is performed quarterly to evaluate remedial treatment progress. Performance monitoring data are compared to baseline and previous performance monitoring data to determine reductions in contaminant concentrations and trends in subsurface geochemical conditions. There are two components of performance monitoring for the OA-9 IM: respirometry testing for vadose zone soil remediation and groundwater sampling for groundwater remediation. Procedures for both monitoring components are described below.

3.1 Respirometry Test Methodology

Respirometry testing is not a direct measure of soil remediation, but it does indicate the rate at which microorganisms are consuming available oxygen in the soil pore spaces. Results of respirometry testing provide an indirect measure of the rate of contaminant degradation. Respirometry testing is performed quarterly in combination with groundwater performance monitoring.

Respirometry testing consists of turning off the bioventing blower, collecting pore space air samples from selected wells, and measuring the subsequent decline in oxygen concentration as microorganisms consume oxygen. Test wells were selected based on historical analytical data indicating that they are installed in areas with high concentrations of petroleum hydrocarbons. Test wells in these areas are anticipated to yield measurable test responses.

Pore space vapor samples are collected from test wells approximately 1, 2, 3, 4, 6, and 8 hours after the blower is turned off. A high-volume air sampling pump is used to evacuate atmospheric air in the well casing, followed by pore space gas sample collection. Samples are collected into 5-liter Tedlar™ bags and measured for oxygen content using a QRAe multi-parameter gas meter. The oxygen concentration versus time for each tested well is plotted to produce an oxygen-decline curve that is mathematically converted to a rate of petroleum degradation using standard bioventing assumptions.

3.2 Groundwater Sampling Methodology

Groundwater samples are collected quarterly from the six A-level monitoring wells at the OA-9 IM. The six sampled wells are listed below and their locations are shown in Figure 5.

- PL2-310A
- PL2-311A
- PL2-332A
- PL2-604A
- PL2-605AR
- PL2-606A

Groundwater samples are collected using the methods and procedures presented in the Sampling and Analysis Plan (SAP), which is Appendix A of the OA-9 IM Work Plan (EPI, 2008). Groundwater samples are analyzed for TPH-G by Method NWTPH-Gx; diesel- and heavier-range petroleum hydrocarbons by Method NWTPH-Dx; and benzene, toluene, ethylbenzene, and xylenes (BTEX) compounds by EPA Method 8260C. Tables in the SAP present specifications for reporting limits, containers, preservation, and holding times.

4.0 PERFORMANCE MONITORING RESULTS

4.1 Third Quarter

Third quarter respirometry testing was performed on July 14, 2009. Respirometry test results are presented in Table 1 and test data and plots are presented in Attachment A. Groundwater monitoring was performed on July 27, 2009. Groundwater performance monitoring analytical results are presented in Table 2 and Attachment B. Field parameter data measured during well purging prior to sampling are presented in Attachment C.

The third quarter respirometry test was performed using wells PL2-311A, PL2-604A, and PL2-606A. Estimated oxygen consumption rates of 1.46, 0.04, and 0.05 percent per hour were calculated for PL2-311A, PL2-604A, and PL2-606A, respectively. The oxygen consumption rates verify ongoing vadose zone microbial activity at PL2-311A and lower rates of vadose zone microbial activity at PL2-606A and PL2-604A.

Groundwater analytical results for the third quarter indicated detections of TPH-G at concentrations greater than the Plant 2 screening level of 800 micrograms per liter ($\mu\text{g/L}$) in samples from PL2-310A and PL2-311A. TPH-G was detected in samples from PL2-604A and PL2-605AR at concentrations below the Plant 2 screening level and was not detected in samples from PL2-332A and PL2-606A.

TPH-D was detected in the duplicate sample from PL2-310A at a concentration of 260 $\mu\text{g/L}$, which is less than its Plant 2 screening level of 500 $\mu\text{g/L}$. Results for all other wells were non-detect for TPH-D. Data from all wells were non-detect for oil-range petroleum hydrocarbons.

Benzene was detected in groundwater samples from five wells: PL2-310A, PL2-311A, PL2-604A, PL2-605AR, and PL2-606A, and was at concentrations greater than its Plant 2 screening level of 4.48 $\mu\text{g/L}$ in samples from two wells, PL2-310A and PL2-311A. Benzene was not detected in the sample from PL2-332A. The remaining detections of BTEX constituents were predominantly in samples from PL2-310A and PL2-311A and were at concentrations less than their respective screening levels.

4.2 Fourth Quarter

Fourth quarter respirometry test was performed on October 13, 2009. Respirometry test results are summarized in Table 1 and test data and plots are presented in Attachment A. Groundwater monitoring was performed on October 27, 2009. Groundwater performance analytical results are presented in Table 3 and Attachment B. Field parameter data measured during well purging prior to sampling are presented in Attachment C.

The fourth quarter respirometry test was performed using wells PL2-311A, PL2-604A, and PL2-606A. Estimated oxygen consumption rates of 1.71, 0.05, and 0.09 percent per hour were calculated for PL2-311A, PL2-604A, and PL2-606A, respectively. The oxygen consumption rates verify ongoing vadose zone microbial activity at PL2-311A and lower rates of vadose zone microbial activity at PL2-606A and PL2-604A.

Groundwater analytical results for the fourth quarter indicated detections of TPH-G at concentrations greater than the Plant 2 screening level of 800 µg/L in samples from PL2-310A and PL2-311A. TPH-G was detected in samples from PL2-604A and PL2-605AR at concentrations less than screening levels and was not detected in samples from PL2-332A and PL2-606A.

TPH-D was detected in the groundwater sample from PL2-310A at a concentration below its screening level. Results for all other wells were non-detect for TPH-D. Data from all wells were non-detect for oil-range petroleum hydrocarbons.

Benzene was detected in groundwater samples from five wells: PL2-310A, PL2-311A, PL2-604A, PL2-605AR, and PL2-606A, and was at a concentration greater than its Plant 2 screening level in samples from two wells, PL2-310A and PL2-311A. The remaining detections of BTEX constituents were predominantly in samples from PL2-310A and PL2-311A and were at concentrations less than their respective screening levels. Other VOC detections are presented in Attachment B.

4.3 Data Summary

Table 4 presents TPH, BTEX, and field parameter data for baseline and all four quarters of groundwater performance monitoring. TPH-G and benzene concentrations are greater than Plant 2 screening levels at PL2-310A and PL2-311A, but are trending downward. TPH-D has been detected in these same two wells, but at concentrations below the screening level. Contaminants have not been detected in samples from downgradient well PL2-332A demonstrating that the EHC-O™ injection at OA-9 has not caused downgradient impacts.

During baseline sampling, benzene was detected at a concentration greater than the Plant 2 screening level in the sample from PL2-606A. Following EHC-O™ injection, all benzene data have been at concentrations significantly less than the Plant 2 screening level. TPH-G and benzene were also detected in samples from PL2-604A and PL2-605AR, but at concentrations below the screening level and which show no trend.

Toluene, ethylbenzene, m,p-xylene, and o-xylene were detected in several wells at concentrations below screening levels (when applicable) and most results for these compounds were generally decreasing in trend.

Successful remediation has been demonstrated based on analytical data documenting decreases in contaminant concentrations in groundwater. Field measured dissolved oxygen and oxidation-

reduction potential (ORP) measurements are not at optimal levels for continued EAD. However, plans are being made for excavation of source area soil as a part of site deconstruction.

Table 1 respirometry test data indicates rapid oxygen consumption at PL2-322A, which likely indicates a high rate of aerobic bioactivity that is degrading organic compounds. The measured oxygen consumption rates at PL2-604A and PL2-606A are lower indicating slower rates of bioactivity in the vicinity of these two wells.

Attachment D contains complete field logbook notes for both groundwater sampling and respirometry test events and Attachment E contains data validation reports.

5.0 CONCLUSIONS

TPH and BTEX concentrations in groundwater performance samples have declined in most wells after one year of remedial treatment. Samples from wells PL2-310A and PL2-311A exhibit declining concentrations of most constituents but concentrations of TPH-G and benzene remain above Plant 2 screening levels. The treatment has not appeared to affect the groundwater downgradient of the OA-9 IM as demonstrated by the consistent non-detect analytical data in samples from well PL2-332A.

Respirometry test data are also somewhat variable, likely as a result of the heterogeneous distribution of contaminants in the vadose zone. When the three USTs and oil-water separator were removed from the OA-9 IM area, some contaminated soil was inaccessible and was left in place due to numerous subsurface utilities. As a result, impacted soil occurs in discrete areas next to and within utility corridors, which makes the subsurface distribution of contaminant sources at OA-9 very heterogeneous. Backfill material and underground utilities provide increased heterogeneity by forming both barriers and preferential pathways to subsurface air distribution by the bioventing system. The oxygen decline curve and oxygen consumption rate at PL2-311A is significant, while the oxygen decline curves for PL2-604A and PL2-606A are less significant. Because historical soil analytical data indicate relatively high TPH and BTEX concentrations at PL2-311A, intermediate contamination concentrations at PL2-606A, and lesser contaminant concentrations at PL2-604A, the differences in oxygen decline curves are expected. However, the large differences in oxygen consumption rates estimated among the wells makes it difficult to interpret results and calculate an accurate mass of TPH destroyed.

The data collected indicate that, after four quarters of operation, bioventing and EAD remedial mechanisms are operating as planned and appear to be successfully remediating OA-9 vadose zone soil and groundwater. Subsurface heterogeneity of air flow pathways and contaminant source areas increases the variability of respirometry and performance monitoring data, making data evaluation more challenging. Continued quarterly performance monitoring is expected to provide additional data to verify and further quantify the remedial progress already noted in groundwater at the OA-9 IM.

6.0 SCHEDULE

The schedule below gives the dates of future performance monitoring and reporting events for the OA-9 IM. Per the OA-9 IM work plan, Boeing will conduct performance monitoring events on a quarterly schedule. The schedule may be modified based on results of previous quarterly performance monitoring events and a modified schedule may be presented in the Third Semiannual Report, which is due July 2010.

Schedule for OA-9 IM

5 th Quarter	January 2010	Performance Monitoring
6 th Quarter	April 2010	Performance Monitoring
Reporting	July 2010	3rd Semiannual Report
7 th Quarter	July 2010	Performance Monitoring
8 th Quarter	October 2010	Performance Monitoring

7.0 REFERENCES

- EPI, 2006 Environmental Partners, Inc. “2-60s Area Data Gap Investigation Report.”
Boeing Plant 2. Seattle/Tukwila, Washington. August 2006.
- EPI, 2008 Environmental Partners, Inc. “Interim Measure Work Plan for Other Area 9.”
Boeing Plant 2. Seattle/Tukwila, Washington. July 7, 2008.
- EPI, 2009 Environmental Partners, Inc. “Other Area 9 Interim Measure – First Semiannual
Report.” Boeing Plant 2. Seattle/Tukwila, Washington. June 26, 2009.

TABLES

Table 1. OA-9 IM Respirometry Test Results

Event	Date	Injection Air Flow Rate (SCFH)*	Well Tested and Oxygen Consumption Rate					
			Well	% / hour	Well	% / hour	Well	% / hour
System Start	12/15/08	40	NA	NA	NA	NA	NA	NA
Baseline Test	1/12/09	40	PL2-310A	anomalous results	PL2-311A	0.15	PL2-606A	0.23
1st Quarter Test	1/30/09	40	PL2-604A	0	PL2-311A	2.07	PL2-606A	0.19
Operating Adjustment	3/3/09	90	NA	NA	NA	NA	NA	NA
2nd Quarter Test	4/29/09	90	PL2-604A	0	PL2-311A	1.59	PL2-606A	0.07
3rd Quarter Test	7/14/09	90	PL2-604A	0.04	PL2-311A	1.46	PL2-606A	0.05
4th Quarter Test	10/13/09	90	PL2-604A	0.05	PL2-311A	1.71	PL2-606A	0.09

Notes:

* air rate injected into each of nine bioventing wells

NA = not applicable

SCFH = standard cubic feet per hour

Table 2. OA-9 IM 3rd Quarter Groundwater Analytical Data Summary (July 2009)

Well	Date	NWTPH-Gx (mg/L)	NWTPH-Dx (mg/L)		BTEX VOCs (µg/L)				
			Diesel	Motor oil	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene
PL2-310A	7/27/09	7.5	<0.25	<0.50	17	6.2	180	19	2.6
PL2-310A (dup)	7/27/09	7.6	0.26	<0.50	17	6.2	170	19	2.7
PL2-311A	7/27/09	6.5	<0.25	<0.50	150	11	98	72	20
PL2-332A	7/27/09	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2
PL2-604A	7/27/09	0.36	<0.25	<0.50	0.6	<0.2	0.6	<0.4	<0.2
PL2-605AR	7/27/09	0.58	<0.25	<0.50	0.3	0.5	2.5	1.6	<0.2
PL2-606A	7/27/09	<0.25	<0.25	<0.50	0.4	<0.2	0.4	<0.4	<0.2
Screening Level (2004)		0.8	0.5	0.5	4.48	*	2,100	*	*

Notes:

* = not a COC at Plant 2

< = not detected at the value indicated

mg/L = milligrams per liter

µg/L = micrograms per liter

BTEX = benzene, toluene, ethylbenzene, and xylene

NWTPH-Dx = Northwest Total Petroleum hydrocarbons – diesel range extended

NWTPH-Gx = Northwest total Petroleum Hydrocarbons – gasoline range

Table 3. OA-9 IM 4th Quarter Groundwater Analytical Data Summary (October 2009)

Well	Date	NWTPH-Gx (mg/L)	NWTPH-Dx (mg/L)		BTEX VOCs (µg/L)				
			Diesel	Motor oil	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene
PL2-310A	10/27/09	7.4	0.29	<0.50	16	3.3	360	10	<2.0
PL2-311A	10/27/09	6.1	<0.25	<0.50	150	11	200	76	20
PL2-332A	10/27/09	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2
PL2-604A	10/27/09	0.56	<0.25	<0.50	4.1	<0.2	<0.2	<0.4	<0.2
PL2-605AR	10/27/09	0.51	<0.25	<0.50	0.6	0.3	0.3	1.3	<0.2
PL2-606A	10/27/09	<0.25	<0.25	<0.50	0.5	<0.2	0.4	<0.4	<0.2
PL2-606A (dup)	10/27/09	<0.25	<0.25	<0.50	0.5	<0.2	0.4	<0.4	<0.2
Screening Level (2004)		0.8	0.5	0.5	4.48	*	2,100	*	*

Notes:

* = not a COC at Plant 2

< = not detected at the value indicated

mg/L = milligrams per liter

µg/L = micrograms per liter

BTEX = benzene, toluene, ethylbenzene, and xylene

NWTPH-Dx = Northwest Total Petroleum hydrocarbons – diesel range extended

NWTPH-Gx = Northwest total Petroleum Hydrocarbons – gasoline range

Table 4. OA-9 IM Groundwater Monitoring Analytical and Field Parameter Data Summary

Well	Event	Date	NWTPH-Gx (mg/L)	NWTPH-Dx (mg/L)		BTEX VOCs (µg/L)					Field Parameters							
				Diesel	Motor oil	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	pH	Dissolved Oxygen (mg/L)	ORP (mV)	Temp (°C)	Turbidity (NTU)	Specific Conductance (mS/cm)	Depth to Water (feet)	
PL2-310A	Baseline	9/25/08	5.6	<0.25	<0.50	28	2.3	310	2.7	0.4	6.35	0.1	-26	17.4	30.5	10.06	11.35	
	1st Quarter	1/27/09	14.0	<0.25	<0.50	39	10	340	48	13	5.92	0.5	-135	12.4	12.1	0.89	10.84	
	2nd Quarter	4/27/09	11	0.44	<0.50	27	12	540	50	6.4	6.37	0.3	-175	12.9	14.7	1.75	10.82	
	3rd Quarter	7/27/09	7.5	<0.25	<0.50	17	6.2	180	19	2.6	6.67	0.2	-37	17.4	0.2	3.10	11.30	
	3rd Quarter (dup)	7/27/09	7.6	0.26	<0.50	17	6.2	170	19	2.7	---	---	---	---	---	---	---	---
	4th Quarter	10/27/09	7.4	0.29	<0.50	16	3.3	360	10	<2.0	6.43	0.6	-91	18.1	1.3	6.89	11.09	
PL2-311A	Baseline	9/25/08	15	0.40	<0.50	19	27	730	700	140	6.19	0.1	-48	17.0	9.4	10.29	10.87	
	1st Quarter	1/27/09	11	0.29	<0.50	190	28	310	300	43	10.67*	0.5	-182	14.8	11.5	5.02	10.55	
	1st Quarter (dup)	1/27/09	14	0.26	<0.50	200	27	310	300	45	---	---	---	---	---	---	---	
	2nd Quarter	4/27/09	8.4	0.32	<0.50	440	23	340	250	38	6.90	0.3	-176	16.0	9.6	7.85	10.75	
	2nd Quarter (dup)	4/27/09	8.7	0.35	<0.50	430	23	360	250	38	---	---	---	---	---	---	---	
	3rd Quarter	7/27/09	6.5	<0.25	<0.50	150	11	98	72	20	7.19	0.2	-113	17.2	8.2	3.18	11.19	
PL2-332A	Baseline	9/26/08	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	6.64	0.1	51	17.1	0.0	0.39	11.12	
	1st Quarter	1/27/09	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	5.33	0.8	-8	13.9	0.4	0.47	10.78	
	2nd Quarter	4/27/09	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	5.45	0.6	16	13.1	0.8	1.00	11.91	
	3rd Quarter	7/27/09	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	6.22	0.4	104	16.1	0.0	0.58	11.21	
	4th Quarter	10/27/09	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	5.88	1.7	72	17.0	0.9	0.61	10.82	
	PL2-604A	Baseline	9/25/08	0.50	<0.25	<0.50	0.5	<0.2	<0.2	<0.4	<0.2	6.92	0.1	-43	16.1	14.6	3.03	11.37
1st Quarter		1/27/09	<0.25	<0.25	<0.50	25	<0.6	<0.6	<1.2	<0.6	6.11	0.4	-156	13.4	28.7	1.19	11.00	
2nd Quarter		4/27/09	0.33	<0.25	<0.50	26	0.6	0.3	0.5	<0.2	6.42	6.3	-137	13.1	10.0	2.42	10.96	
3rd Quarter		7/27/09	0.36	<0.25	<0.50	0.6	<0.2	0.6	<0.4	<0.2	7.06	0.2	-125	15.7	3.3	1.23	11.47	
4th Quarter		10/27/09	0.56	<0.25	<0.50	4.1	<0.2	<0.2	<0.4	<0.2	7.00	0.7	-113	16.8	5.4	2.74	11.24	
PL2-605AR		Baseline	9/25/08	0.30	<0.25	<0.50	0.5	<0.2	<0.2	<0.4	<0.2	6.61	0.1	15	16.3	7.5	3.80	11.16
	Baseline (dup)	9/25/08	0.31	<0.25	<0.50	0.5	<0.2	<0.2	<0.4	<0.2	---	---	---	---	---	---	---	
	1st Quarter	1/29/09	<0.25	<0.25	<0.50	<0.2	<0.2	<0.2	<0.4	<0.2	7.64	17.0**	94	14.2	12.1	1.37	10.50	
	2nd Quarter	4/27/09	0.43	<0.25	<0.50	0.6	0.5	4.7	1.8	<0.2	6.29	0.2	-111	14.6	68.4	4.18	10.72	
	3rd Quarter	7/27/09	0.58	<0.25	<0.50	0.3	0.5	2.5	1.6	<0.2	6.98	0.2	-99	15.8	33.2	2.34	11.22	
	4th Quarter	10/27/09	0.51	<0.25	<0.50	0.6	0.3	0.3	1.3	<0.2	7.05	0.5	-86	16.1	13.9	2.83	11.00	
PL2-606A	Baseline	9/26/08	1.9	<0.25	<0.50	17	3.7	110	17	2.5	6.91	0.2	-38	16.5	0.0	1.02	11.17	
	1st Quarter	1/29/09	<0.25	<0.25	<0.50	0.6	<0.2	2.8	0.6	<0.2	8.21	11.4**	23	15.9	18.5	0.95	11.30	
	2nd Quarter	4/27/09	<0.25	<0.25	<0.50	0.6	<0.2	1.3	0.5	<0.2	9.36	3.6	-81	15.3	8.0	1.88	10.75	
	3rd Quarter	7/27/09	<0.25	<0.25	<0.50	0.4	<0.2	0.4	<0.4	<0.2	8.34	3.6	41	16.6	2.8	0.77	11.39	
	4th Quarter	10/27/09	<0.25	<0.25	<0.50	0.5	<0.2	0.4	<0.4	<0.2	10.07	15.3	74	16.5	24.8	0.85	11.12	
	4th Quarter (dup)	10/27/09	<0.25	<0.25	<0.50	0.5	<0.2	0.4	<0.4	<0.2	---	---	---	---	---	---	---	
Screening Level (2004)			0.8	0.5	0.5	4.48	*	2,100	*	*								

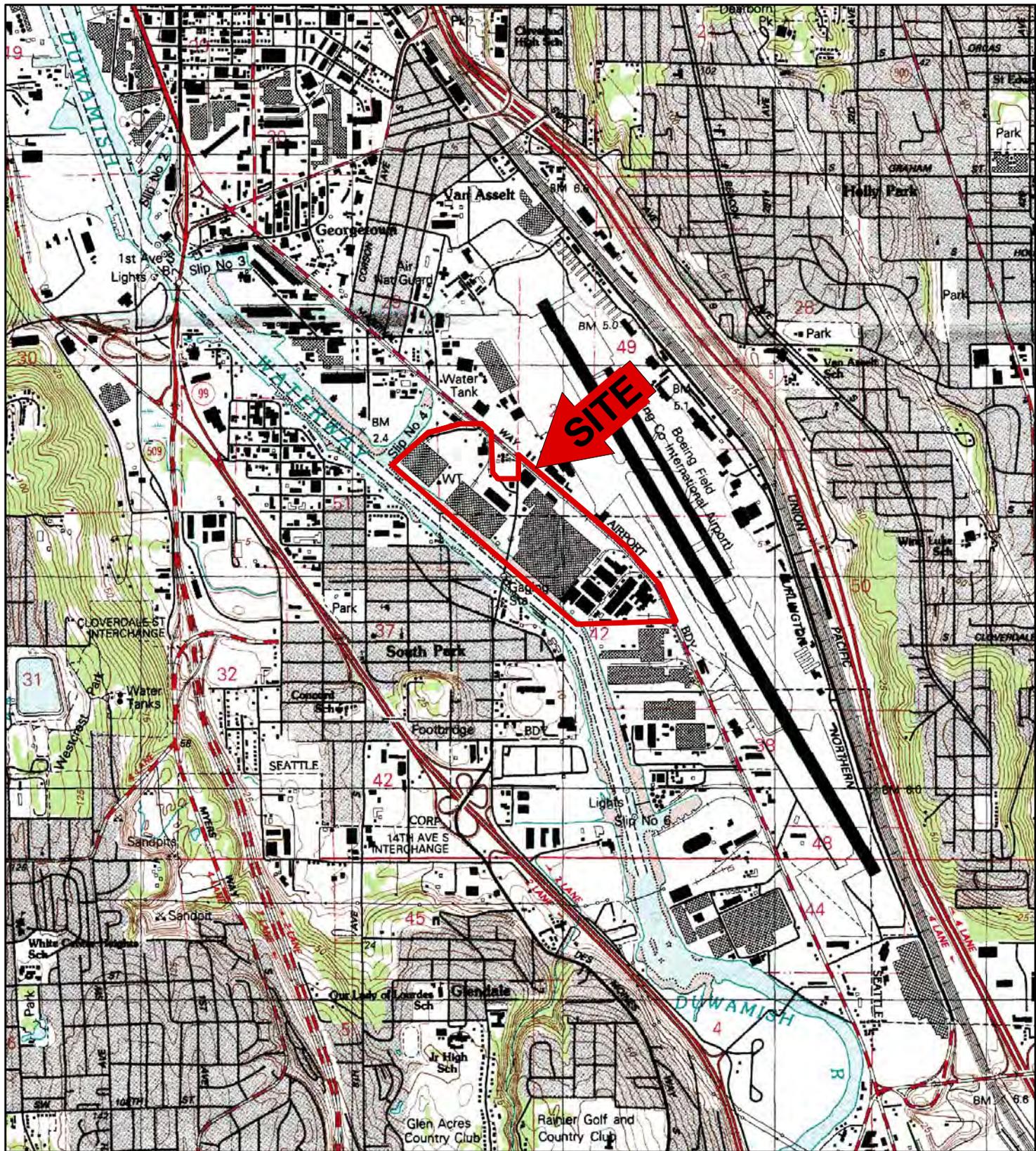
Groundwater Notes:

* = not a groundwater COC at Plant 2
 < = not detected at the reporting limit indicated
 mg/L = milligrams per liter
 µg/L = micrograms per liter
 BTEX = benzene, toluene, ethylbenze, and xylene
 NWTPH-Gx = Northwest Total Petroleum Hydrocarbons – gasoline range
 NWTPH-Dx = Northwest Total Petroleum hydrocarbons – diesel range extended
 VOC = volatile organic compound

Field Parameter Notes:

* reading verified by second instrument
 ** water was effervescing, may have been supersaturated
 --- duplicate sample
 °C = degrees Celsius
 mg/L = milligrams per liter
 mS/cm - milliSiemens per centimeter
 mV = millivolts
 BTEX = benzene, toluene, ethylbenze, and xylene
 NTU = nephelometric turbidity units
 ORP = oxidation-reduction potential
 VOC = volatile organic compound

FIGURES



KEY:

SOURCE: USGS 7.5 MINUTE QUADRANGLE
(TOPOGRAPHIC)

SEATTLE SOUTH
1983

SCALE = 1:25,000

ept ENVIRONMENTAL PARTNERS INC
295 NE Gilman Boulevard, Suite 201
Issaquah, Washington 98027

FIGURE 1
BOEING PLANT 2
GENERAL LOCATION

PROJECT	OA-9 IM SEMIANNUAL REPORT		
PREPARED FOR	THE BOEING COMPANY		
LOCATION	BOEING PLANT 2 SEATTLE/TUKWILA, WASHINGTON		
SHEET	DRAWN BY	REVIEWED BY	DATE
1 of 1	ARM	JLD	01/13/10



KEY:



- OA-9 IM LOCATION
- PLANT 2 BOUNDARY



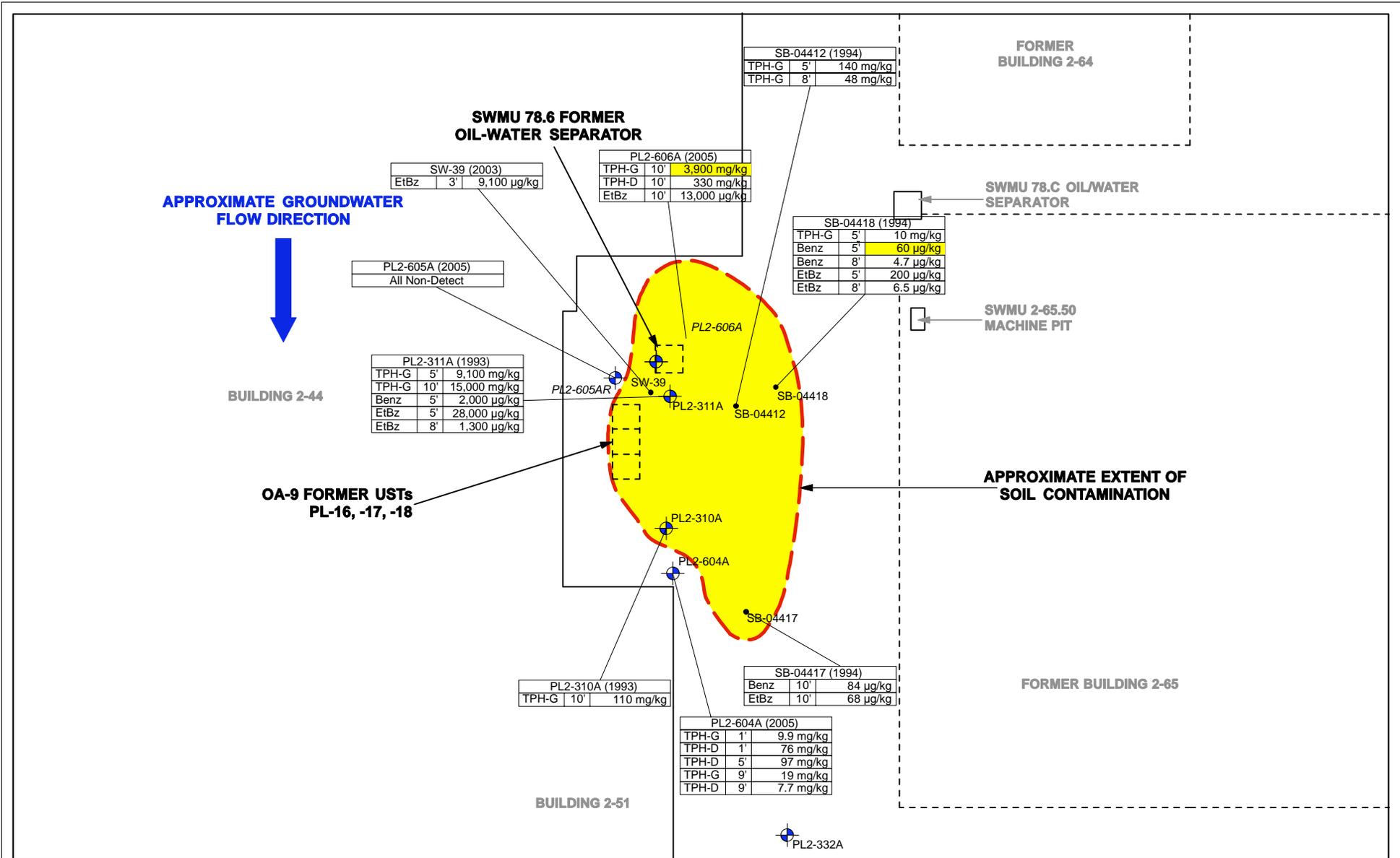
ENVIRONMENTAL PARTNERS INC

295 NE Gilman Boulevard, Suite 201
Issaquah, Washington 98027

FIGURE 2

GENERAL LOCATION OF THE
OA-9 IM

PROJECT	OA-9 IM SEMIANNUAL REPORT		
PREPARED FOR	THE BOEING COMPANY		
LOCATION	BOEING PLANT 2 SEATTLE/TUKWILA, WASHINGTON		
SHEET 1 of 1	DRAWN BY ARM	REVIEWED BY JLD	DATE 01/05/10



APPROXIMATE GROUNDWATER FLOW DIRECTION



BUILDING 2-44

**OA-9 FORMER USTs
PL-16, -17, -18**

**SWMU 78.6 FORMER
OIL-WATER SEPARATOR**

**FORMER
BUILDING 2-64**

**SWMU 78.C OIL/WATER
SEPARATOR**

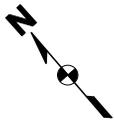
**SWMU 2-65.50
MACHINE PIT**

**APPROXIMATE EXTENT OF
SOIL CONTAMINATION**

FORMER BUILDING 2-65

BUILDING 2-51

KEY:



MONITORING WELL



SOIL BORING

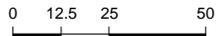
WELL OR BORING (SAMPLE DATE)		
ANALYTE	DEPTH	BGS RESULTS

TPH-G = TPH GASOLINE
TPH-D = TPH DIESEL
Benz = BENZENE
EtBz = ETHYLBENZENE

mg/kg = MILLIGRAMS PER KILOGRAM
µg/kg = MICROGRAMS PER KILOGRAM



APPROXIMATE EXTENT OF SOIL CONTAMINATION



SCALE: 1" = 50'



**ENVIRONMENTAL
PARTNERS INC**

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Issaquah, Washington 98027

FIGURE 3

**OA-9 IM
APPROXIMATE EXTENT OF
SOIL CONTAMINATION**

PROJECT

OA-9 IM SEMIANNUAL REPORT

**PREPARED
FOR**

THE BOEING COMPANY

LOCATION

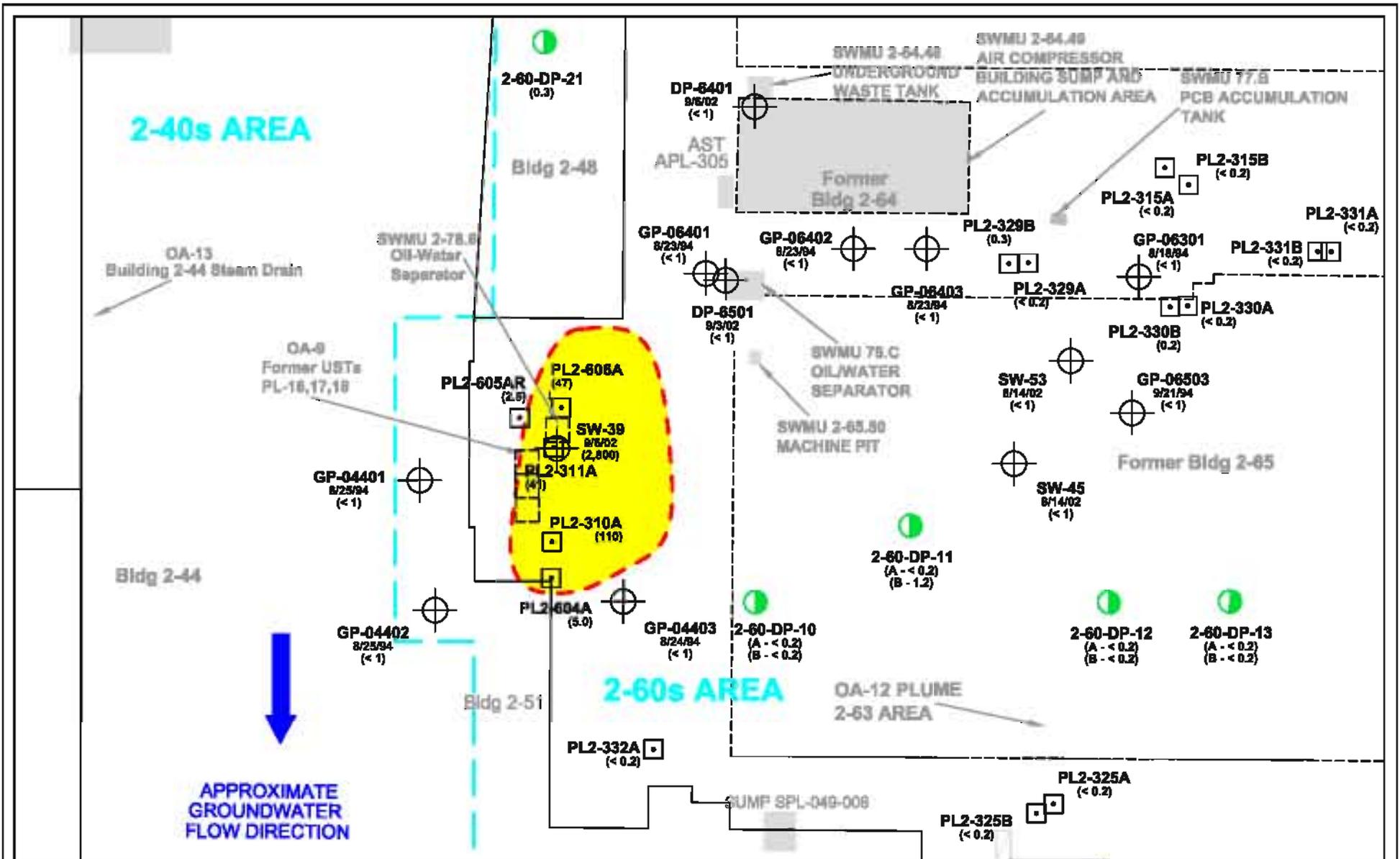
BOEING PLANT 2
SEATTLE/TUKWILA, WASHINGTON

SHEET
1 of 1

DRAWN BY
ARM

REVIEWED BY
JLD

DATE
12/08/09



KEY:

- MONITORING WELL SAMPLED FOR 2-80s AREA DATA GAP ANALYSIS (CONSTITUENT CONCENTRATION, µg/L)
 - DIRECT-PUSH PROBE LOCATION FOR 2-60s AREA DATA GAP ANALYSIS (CONSTITUENT CONCENTRATION, µg/L)
 - HISTORICAL SAMPLING LOCATION, SAMPLE DATE, AND CONCENTRATION (CONSTITUENT CONCENTRATION, µg/L)
 - AREA BOUNDARY
 - AREA OF A-LEVEL GROUNDWATER ABOVE BENZENE SCREENING LEVEL
 - NA - NOT ANALYZED
- SCALE: 1" = 80'

epi ENVIRONMENTAL PARTNERS INC
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 Issaquah, Washington 98027

FIGURE 4
OA-9 IM APPROXIMATE EXTENT OF BENZENE IMPACTS IN GROUNDWATER

PROJECT	OA-9 IM SEMIANNUAL REPORT		
PREPARED FOR	THE BOEING COMPANY		
LOCATION	BOEING PLANT 2 SEATTLE/TUKWILA, WASHINGTON		
SHEET	DRAWN BY	REVIEWED BY	DATE
1 of 1	ARM	JLD	12/08/09

APPROXIMATE GROUNDWATER
FLOW DIRECTION

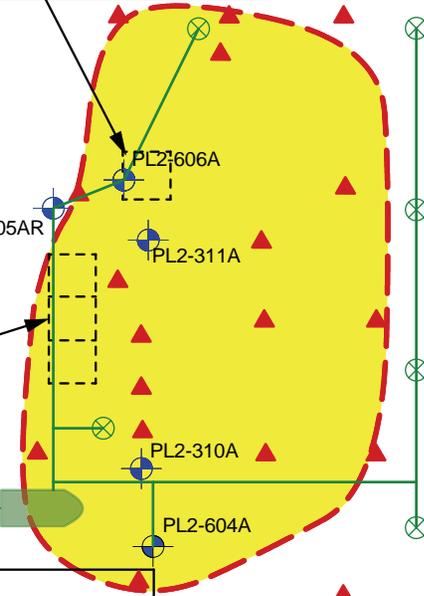


BUILDING 2-44

OA-9 FORMER USTs
PL-16, -17, -18

BIOVENTING
BLOWER
TRAILER

BUILDING 2-51

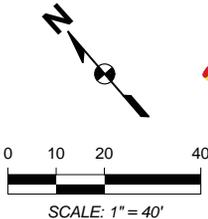


SWMU 78.C OIL/WATER
SEPARATOR

SWMU 2-65.50
MACHINE PIT

FORMER BUILDING 2-65

PL2-332A



- MONITORING WELL AND/OR BIOVENTING WELL
- EAD DIRECT-PUSH INJECTION POINT
- APPROXIMATE EXTENT OF GROUNDWATER IMPACTS (2006 CMS)
- BIOVENTING WELL
- BIOVENTING PIPE NETWORK

epl ENVIRONMENTAL PARTNERS INC
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FIGURE 5

OA-9 IM GROUNDWATER IMPACTS,
EAD INJECTION LOCATIONS, AND
BIOVENTING SYSTEM

PROJECT	OA-9 IM SEMIANNUAL REPORT		
PREPARED FOR	THE BOEING COMPANY		
LOCATION	BOEING PLANT 2 SEATTLE/TUKWILA, WASHINGTON		
SHEET 1 of 1	DRAWN BY ARM	REVIEWED BY JLD	DATE 01/05/10

ATTACHMENT A
RESPIROMETRY TEST DATA AND OXYGEN CURVES

**OA-9 IM, Boeing Plant 2
3rd Quarter Respirometry Test Data and Analysis**

3rd Quarter Test - 7/14/09

Time	Measured % Oxygen		
	PL2-311A	PL2-604A	PL2-606A
0	20.9	20.9	20.9
1	14.0	20.9	20.9
2	9.4	20.9	20.9
3	8.3	20.9	20.9
4	10.0	20.9	20.7
6	8.7	20.7	20.6
8	9.2 (red)	20.6 (green)	20.5 (blue)

Bioventing start date > 12/15/2008
3rd Quarter test date > 7/14/2009

PL2-606A

<u>Well</u>	<u>Comment</u>
PL2-311A	The data are similar to the previous tests. Use the data, but consider that it is suspect. Based on 2nd Quarter information, this area is likely not fully aerated. An oxygen consumption rate will be calculated, but applied to only a small area of the site.
PL2-604A	There is a slight oxygen decline over 8 hours. There may be only a small amount of vadose soil contamination at this well. An oxygen consumption rate can be calculated.
PL2-606A	There is a slight oxygen decline over 8 hours. There may be only a small amount of vadose soil contamination at this well. An oxygen consumption rate can be calculated.

Note: On March 3, 2009 the air injection rate was increased from 40 SCFH to 90 SCFH.

<u>Oxygen Consumption Rate (0 to 6 hours)</u>					
PL2-311A	1.46	%O ₂ /hour	(red)	use this rate for 10% of contaminated volume	0.1
PL2-604A	0.04	%O ₂ /hour	(green)		
PL2-606A	0.05	%O ₂ /hour	(blue)	use this rate for 90 % of contaminated volume	0.9

<u>Bioventing Operation Data</u>			<u>OA-9 IM Site Data (soil)</u>		
Run Time > (incremental)	93	days	Contaminated Width	80	feet
(from 4/13/09)	2232	hours	Contaminated Length	120	feet
Air Injection Rate (avg.) >	40	ft ³ /hour	Contaminated Depth	10	feet
	90	ft ³ /hour	(until 3/3/09)		
			(after 3/3/09)		
Number of Inj. Wells >	9	wells	Contaminated Volume	96,000	feet ³
Air Density >	0.0743	lb air/ft ³	Air-filled Pore Fraction	0.25	
Total Inj. Air >	134,328	lb air	Air-filled Pore Volume	24,000	feet ³
Total Inj. O ₂ >	28,075	lb O ₂	Pore Volume O ₂	373	lbs
			O ₂ Consumed	0.31	lb O ₂ consumed/hour

OA-9 IM, Boeing Plant 2
4th Quarter Respirometry Test Data and Analysis

4th Quarter Test - 10/13/09

Time	Measured % Oxygen		
	PL2-311A	PL2-604A	PL2-606A
0	20.9	20.9	20.9
1	12.3	20.6	20.9
2	8.8	20.5	20.9
3	8.7	20.5	20.5
4	7.8	20.5	20.4
6	7.3	20.5	20.5
8	7.2 (red)	20.5 (green)	20.2 (blue)

Bioventing start date > 12/15/2008
 4th Quarter test date > 10/13/2009

PL2-606A

<u>Well</u>	<u>Comment</u>
PL2-311A	The data are similar to the previous tests. Use the data, but consider that it is suspect. Based on information from previous quarter, this area may not be fully aerated. An oxygen consumption rate will be calculated, but applied to only a small area of the site.
PL2-604A	There is a slight oxygen decline over 8 hours. There may be only a small amount of vadose soil contamination at this well. An oxygen consumption rate can be calculated.
PL2-606A	There is a slight oxygen decline over 8 hours. There may be only a small amount of vadose soil contamination at this well. An oxygen consumption rate can be calculated.

Note: On March 3, 2009 the air injection rate was increased from 40 SCFH to 90 SCFH.

<u>Oxygen Consumption Rate (0 to 6 hours)</u>					
PL2-311A	1.71	%O ₂ /hour	(red)	use this rate for 10% of contaminated volume	0.1
PL2-604A	0.05	%O ₂ /hour	(green)		
PL2-606A	0.09	%O ₂ /hour	(blue)	use this rate for 90 % of contaminated volume	0.9

<u>Bioventing Operation Data</u>			<u>OA-9 IM Site Data (soil)</u>		
Run Time > (incremental)	91	days	Contaminated Width	80	feet
(from 7/14/09)	2184	hours	Contaminated Length	120	feet
Air Injection Rate (avg.) >	40	ft ³ /hour	Contaminated Depth	10	feet
	90	ft ³ /hour	(until 3/3/09)		
			(after 3/3/09)		
Number of Inj. Wells >	9	wells	Contaminated Volume	96,000	feet ³
Air Density >	0.0743	lb air/ft ³	Air-filled Pore Fraction	0.25	
Total Inj. Air >	131,440	lb air	Air-filled Pore Volume	24,000	feet ³
Total Inj. O ₂ >	27,471	lb O ₂	Pore Volume O ₂	373	lbs
			O ₂ Consumed	0.46	lb O ₂ consumed/hour

ATTACHMENT B
GROUNDWATER VOC ANALYTICAL DATA – ALL DETECTIONS

**Table B1. OA-9 Interim Measure 3rd Quarter Analytical Data - All Detections
Boeing, Plant 2**

Groundwater - all results in µg/L

Constituent	Analytical Method	2004 Screening Level	Laboratory Reporting Limit	PL2-310A 7/27/2009	PL2-311A (dup) 7/27/2009	PL2-311A 7/27/2009	PL2-332A 7/27/2009	PL2-604A 7/27/2009	PL2-605AR 7/27/2009	PL2-606A 7/27/2009
Petroleum Hydrocarbons										
TPH-Gasoline	NWTPH-Gx	800	250	7.5	7.6	6.5	<0.25	0.36	0.58	<0.25
TPH-Diesel	NWTPH-Dx	500	250	<0.25	0.26	<0.25	<0.25	<0.25	<0.25	<0.25
TPH-Oil	NWTPH-Dx	500	500	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
VOCs										
Benzene	EPA 8260C	4.48	0.2	17	17	150	<0.2	0.6	0.3	0.4
Toluene	EPA 8260C	NA	0.2	6.2	6.2	11	<0.2	<0.2	0.5	<0.2
Ethylbenzene	EPA 8260C	2,100	0.2	180	170	98	<0.2	0.6	2.5	0.4
m,p-Xylenes	EPA 8260C	NA	0.4	19	19	72	<0.4	<0.4	1.6	<0.4
o-Xylene	EPA 8260C	40,100	0.2	2.6	2.7	20	<0.2	<0.2	<0.2	<0.2
Vinyl chloride	EPA 8260C	0.731	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.2	<0.2
Acetone	EPA 8260C	NA	5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	13
Carbon disulfide	EPA 8260C	34,300	0.2	<0.2	<0.2	0.3	<0.2	<0.2	<0.2	<0.2
cis-1,2-Dichloroethene	EPA 8260C	1,550	0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.6	<0.2
Chloroform	EPA 8260C	56.1	0.2	<0.2	<0.2	<0.2	0.8	<0.2	<0.2	<0.2

Notes:

NA = not applicable

< = not detected at the listed reporting limit

µg/L= micrograms per liter

**Table B2. OA-9 Interim Measure 4th Quarter Analytical Data - All Detections
Boeing, Plant 2**

Groundwater - all results in µg/L

Constituent	Analytical Method	2004 Screening Level	Laboratory Reporting Limit	PL2-310A 10/27/2009	PL2-311A 10/27/2009	PL2-332A 10/27/2009	PL2-604A 10/27/2009	PL2-605AR 10/27/2009	PL2-606A 10/27/2009	PL2-606A (dup) 10/27/2009
Petroleum Hydrocarbons										
TPH-Gasoline	NWTPH-Gx	800	250	7.4	6.1	<0.25	0.56	0.51	<0.25	<0.25
TPH-Diesel	NWTPH-Dx	500	250	0.29	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
TPH-Oil	NWTPH-Dx	500	500	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
VOCs										
Benzene	EPA 8260C	4.48	0.2	16	150	<0.2	4.1	0.6	0.5	0.5
Toluene	EPA 8260C	NA	0.2	3.3	11	<0.2	<0.2	0.3	<0.2	<0.2
Ethylbenzene	EPA 8260C	2,100	0.2	360	200	<0.2	<0.2	0.3	0.4	0.4
m,p-Xylenes	EPA 8260C	NA	0.4	10	76	<0.4	<0.4	1.3	<0.4	<0.4
o-Xylene	EPA 8260C	40,100	0.2	<2.0	20	<0.2	<0.2	<0.2	<0.2	<0.2
Vinyl chloride	EPA 8260C	0.731	0.2	<2.0	<0.2	<0.2	<0.2	0.3	<0.2	<0.2
Acetone	EPA 8260C	NA	5.0	<50	<5.0	6.5	5.4	<5.0	22	23
Carbon disulfide	EPA 8260C	34,300	0.2	<2.0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
cis-1,2-Dichloroethene	EPA 8260C	1,550	0.2	<2.0	<0.2	<0.2	<0.2	0.5	<0.2	<0.2
Chloroform	EPA 8260C	56.1	0.2	<2.0	<0.2	0.8	<0.2	<0.2	<0.2	<0.2
2-Butanone	EPA 8260B	NA	5.0	<50	<50	<5.0	<5.0	<5.0	5.2	5.2

Notes:

NA = not applicable

< = not detected at the listed reporting limit

µg/L= micrograms per liter

ATTACHMENT C
FIELD PARAMETER DATA

Performance Monitoring - 3rd Quarter Field Parameter Measurements (7/2009)

OA-9 IM - EAD

Well ID	pH	Dissolved Oxygen (mg/L)	ORP (mV)	Temp (°C)	Turbidity (NTU)	Specific Conductance (mS/cm)	Depth to Water (ft)
PL2-310A	6.67	0.16	-37	17.4	0.2	3.10	11.30
PL2-311A	7.19	0.24	-113	17.2	8.2	3.18	11.19
PL2-332A	6.22	0.39	104	16.1	0.0	0.58	11.21
PL2-604A	7.06	0.17	-125	15.7	3.3	1.23	11.47
PL2-605AR	6.98	0.17	-99	15.8	33.2	2.34	11.22
PL2-606A	8.34	3.59	41	16.6	2.8	0.77	11.39

Notes:

mg/L = milligrams per liter

ORP = oxidation-reduction potential

mV = millivolts

°C = degrees Celsius

NTU = nephelometric turbidity units

mS/cm - milliSiemens per centimeter

Performance Monitoring - 4th Quarter Field Parameter Measurements (10/2009)

OA-9 IM - EAD

Well ID	pH	Dissolved Oxygen (mg/L)	ORP (mV)	Temp (°C)	Turbidity (NTU)	Specific Conductance (mS/cm)	Depth to Water (ft)
PL2-310A	6.43	0.63	-91	18.1	1.3	6.89	11.09
PL2-311A	7.34	0.90	-96	17.6	8.8	4.48	10.97
PL2-332A	5.88	1.70	72	17.0	0.9	0.61	10.82
PL2-604A	7.00	0.70	-113	16.8	5.4	2.74	11.24
PL2-605AR	7.05	0.53	-86	16.1	13.9	2.83	11.00
PL2-606A	10.07	15.29	74	16.5	24.8	0.85	11.12

Notes:

mg/L = milligrams per liter

ORP = oxidation-reduction potential

mV = millivolts

°C = degrees Celsius

NTU = nephelometric turbidity units

mS/cm - milliSiemens per centimeter

ATTACHMENT D
FIELD NOTES

Location OA-9 Boeing Plant 2 Date 7/14/09

Project / Client Boeing OA-9 IM

Respirometry Testing

0643 K. Addis onsite to conduct Respirometry Testing at OA-9. System shut down. All valves in trailer moved to closed position. Well valves moved to closed position.

0712 GasAlert Micro 5 PID Not functioning properly. Call to INW to reserve 4 gas meter

0743 Call M. Mogg to request pick-up of 4 gas meter

0800 Call INW + speak with Shawn concerning 4 gas meter, will sample in 20 bags

0940 Monica Mogg onsite with 4 Gas Meter
 SN # 0812036-350
 INW Rental # 9115
 Calibrated by INW (M. Mogg witness)
 All gases pass calibration

1130 M. Mogg offsite

1500 Last air samples taken. Bioventing valves are opened after sampling was completed. Wells locked + secured. Manifolds valves opened prior to system restart

Location OA-9 Boeing Plant 2 Date 7/14/09

Project / Client Boeing OA-9 IM

Respirometry Testing

Time	Well	RO2
0800	606A	20.9
	311A	14.0
	604A	20.9
0900	606A	20.9
	311A	9.4
	604A	20.9
1000	606A	20.9
	311A	8.3
	604A	20.9
1100	606A	20.7
	311A	10.0
	604A	20.9
1300	606A	20.6
	311A	8.7
	604A	20.7
1500	606A	20.5
	311A	9.2
	604A	20.6

1534 K. Addis offsite
 1630 Arrive at ABI
 Return 4 gas meter
 1500 At office
 KJA 7/14/09

Location Boeing - OA-9 Performance ^{600 Sampling} Date 7/27/09

Project / Client Boeing
Sunny HOT

- 0540 KAddis onsite to barricade off OA-9 area for Performance Sampling event. Cars & Trucks have been Parking over OA-9 wells recently. Existing vehicles were removed by owners when EPI requested access to area for today.
- 0600 Conduct water levels. See sampling booklet for information
- 0630 Calibrate equipment - See sampling booklet.
- 0650 K.Addis onsite to pick-up bottles & coolers from ARI.
- 0702 K.Addis onsite; Fill coolers with ice.
- 0740 Begin purge on PL2-332A (MS/MSD)
- 0915 K.Addis onsite to purchase battery for turbidity meter. Dropped off T. Sparley & J. Anderson's badges at badge office.
- 0949 K.Addis onsite
- 0951 Resume purge at PL2-604A.
- 1150 Begin purge at PL2-606A.

Location Boeing OA-9 Performance Date 7/27/09

Project / Client Boeing
Sunny HOT ~90°

- 1151 Purgewater at PL2-606A is very Dark orange and contains a substantial amount of chunky stuff. Will take occasional parameter while well is clearing.
- 1642 Last sample collected
All equipment decontaminated using Alconox & Distilled water.
All purgewater was transferred by using 5 gallon buckets to the treatment tank in the 2-49 Building.
K.Addis onsite
At ARI to turn in samples, ARI
Leave ARI
At storage shed-unload equipment.
A4 EPI office
- ~~Kuat - Addis
7/27/09~~

Location Boeing Plant 2 Date 10/12/09
 Project / Client OA-9 Respirirometry Test
Cloudy, cool

0700 K. Addis onsite
 Notice PL2-311A is not
 accessible due to truck
 parked over. 4 Trucks
 parked in OA-9 well access
 area.
 K. Addis offsite
 1600 K. Addis onsite - Set up
 barricade in OA-9 parking
 area. Use caution flags.
 Caution flagging.
 K. Addis offsite
 1700 AT office

~~K. Addis
 10/12/09~~

22 Location Boeing Plant 2 Date 10/13/09
 Project / Client OA-9 Respirirometry Test
Cool, Windy, Cloudy

0650 K. Addis onsite
 0700 Blower system shot down
 All valves at wells 606A & 604A
 closed. All valves in trailer closed.
 0710 Water Levels 1 Vol 3 Vol 9d (Air)
 604A 11.30 1.8 5.4 20.4 Liters
 606A 11.08 1.8 5.4 20.4 Liters
 311A 10.98 1.75 5.3 20.1 Liters
 0734 Pump rate = 5 L / 1 min
 Will purge air for 4 ~~30~~ minutes
 Prior to sampling air. 5 gas Cal = OK
 606A 311A 604A
 0 hr - - -
 1 hr 20.9 12.3 20.9
 2 hr 20.9 8.8 20.6
 3 hr 20.5 8.7 20.5
 4 hr 20.4 7.8 20.5
 6 hr 20.5 7.3 20.5
 8 hr 20.2 7.2 20.5
 1520 All valves open. Wells secured.
 1525 System Start up. Breakdown Barricaded
 1535 K. Addis offsite
 1615 AT office

~~K. Addis
 10/13/09~~

Location Beeing Plant Z Date 10/27/09
Project / Client OA-9 4th Qtr Sampling

1003 Turbidity meter calibration
 1010 Began purge at 842-332A @ 0754
 See sampling booklet for all gw parameters + sample times.
 1050 Empty purge water in treatment tank in 2-49. All purge water generated today will be placed in treatment tank along with decon water.
 1300 Using Z peristaltic pumps for purging due to high volume of water needed before parameters stabilize. See 2nd & 3rd Qtr GW parameter data.
 1638 Last sample collected at PL2-311A.
 1650 Empty all remaining purge water + decon water in 2-49 tank.
 1710 Deliver samples to AFEI
 1720 Unload equipment at conex
 1740 K. Addis onsite - to storage (EPI)
 1830 K. Addis at office.
K. Addis 10/27/09

Location Beeing Plant Z Date 10/27/09
Project / Client OA-9 4th Qtr GW Sampling

0800 K. Addis onsite to collect 4th Qtr GW Samples
 Lead equipment traffic cones
 0820 Setup Boeving did not block off requested parking as requested.
 0830 Open wells to equilibrate prior to water levels.
 Shut blower valves on appropriate wells.
 0840 J. Flaherty onsite - Discuss parking not being blocked off.
 0848 J. Flaherty offsite
 Water Levels

Time	Well	W.L.
0924	332A	10.82
0926	604A	11.24
0927	310A	11.09
0929	605AR	11.00
0930	606A	11.12
0931	J. Parsons onsite	
0945	311A	10.97
1000	YSI Calibration - See Sampling Booklet	

OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PLZ-332A-	Date	7/27/09
Sample: ID	GW-D90727-PLZ-332A-0	Field Team: (Initials)	KA
Field Conditions	Sunny		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	19.00
Initial Depth to Water (ft.)	11.21
Depth of Water Column	7.79
3 Casing Volumes	3.74
1 Casing Volume	1.25

Purge Method : Submersible pump	
Bladder Pump	
<u>Peristaltic Pump</u>	
Other: :	
Start Time	0740
End Time	0835
Total Gallons Purged	3.3

Time	Gallons	pH	Conductivity	NTU	DO mg/L	Temp.	ORP	Appearance
0753	1.5	6.08	0.562	0.21	0.64	16.17	116.1	clear, colorless
0756	1.8	6.11	0.572	0.10	0.50	16.13	112.3	clear, colorless
0759	2.1	6.15	0.578	0.00	0.47	16.14	111.7	clear, colorless
0802	2.4	6.15	0.574	0.00	0.61	16.10	109.7	clear, colorless
0805	2.7	6.19	0.580	0.00	0.42	16.08	107.7	clear, colorless
0808	3.0	6.20	0.578	0.00	0.40	16.10	105.4	clear, colorless
0811	3.3	6.22	0.577	0.00	0.39	16.13	104.0	clear, colorless

Sample Information

Sample Method(s) Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	0813	3) 40-mL VOA	HCl, cool to 4°C	MS/MSD
NWTPH-Gx	0813	3) 40-mL VOA	HCl, cool to 4°C	MS/MSD
NWTPH-Dx	0813	2) 0.5 L Amber Glass	cool to 4°C	MS/MSD

End Time 0835

Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-604A	Date	7/27/09
Sample: ID	GW-090727-PL2-604A-0	Field Team: (Initials)	KA
Field Conditions	Clear, Hot 180°F		

Purge Information

Well Diameter (in.)	2"	Purge Method : Submersible pump	
Well Depth (ft.)	22.00	Bladder Pump	
Initial Depth to Water (ft.)	11.47	Peristaltic Pump	
Depth of Water Column	10.53	Other: _____	
3 Casing Volumes	5.1	Start Time	0857
1 Casing Volume	1.7	End Time	1027
		Total Gallons Purged	4.4

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
0905	1.0	7.06	1.240	38.6	0.30	15.58	-89.0	Yellow, cloudy
0908	1.25	7.04	1.254	25.8	0.22	15.59	-95.2	Yellow, slightly cloudy
0911	1.5	7.02	1.255	ERR1	0.20	15.49	-102.7	Yellow, sl cloudy
		Turbidity meter battery dead		stop purge		Resume 0951		
0959	2.6	7.14	1.226	16.9	0.62	15.81	-114.2	Yellow, clearing
1002	3.0	7.13	1.239	11.9	0.51	15.72	-118.4	Yellow-orange, clearing
1005	3.25	7.10	1.251	7.61	0.37	15.67	-121.3	Clear
1008	3.5	7.08	1.249	6.19	0.26	15.69	-122.7	clear
1011	3.75	7.06	1.238	7.60	0.22	15.69	-123.5	clear
1014	4.0	7.06	1.231	3.83	0.19	15.75	-124.4	clear
1017	4.25	7.06	1.229	3.30	0.17	15.70	-125.2	clear

Sample Information

Sample Method(s) **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1019	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	1019	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	1019	(2) 0.5 L Amber Glass	cool to 4°C	

End Time **1027**

Comments / Exceptions:

Presence of floating product? YES NO Presence of sinking product? YES NO

Slight Petro-like odor

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-310A	Date	7/27/09
Sample: ID	GW-090727-PL2-310A-0	Field Team: (Initials)	KA
Field Conditions	Sunny HOT		GW-090727-PL2-310A-1

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	19.50
Initial Depth to Water (ft.)	11.30
Depth of Water Column	8.2
3 Casing Volumes	3.9
1 Casing Volume	1.3

Purge Method : Submersible pump
Bladder Pump
Peristaltic Pump
Other: _____

Start Time	1040
End Time	1131
Total Gallons Purged	3.5 KA 3.3

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1051	1.1	7.14	2.995	2.83	0.52	17.54	-31.1	clear, odor Petro?
1054	1.3	7.00	2.997	1.50	0.77	17.41	-31.0	clear, odor
1057	1.6	6.89	3.030	1.35	0.39	17.120	-31.9	clear, odor
1100	1.9	6.82	3.059	1.17	0.24	17.15	-31.9	clear, odor
1103	2.2	6.78	3.085	0.72	0.19	17.13	-32.7	clear, odor
1106	2.6	6.74	3.093	0.53	0.17	17.33	-34.5	clear, odor
1109	2.9	6.71	3.101	0.60	0.17	17.32	-35.2	clear, odor
1112	3.3	6.67	3.103	0.21	0.16	17.37	-36.8	clear, odor

Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1114	(3) 40-mL VOA	HCl, cool to 4°C	Duplicate
NWTPH-Gx	1114	(3) 40-mL VOA	HCl, cool to 4°C	Duplicate
NWTPH-Dx	1114	(2) 0.5 L Amber Glass	cool to 4°C	Duplicate

End Time 1131

Comments / Exceptions:

Presence of floating product? YES / **NO** Presence of sinking product? YES / **NO**

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-606A GOSAR <i>J.A.</i>	Date	7/27/09
Sample: ID	GW-090727-PL2-606A-0	Field Team: (Initials)	KA
Field Conditions	Sunny HOT ~90°F		

Purge Information

Well Diameter (in.)	<u>2"</u>	Purge Method :	Submersible pump
Well Depth (ft.)	<u>22</u>		Bladder Pump
Initial Depth to Water (ft.)	<u>11.22</u>		Peristaltic Pump
Depth of Water Column	<u>10.78</u>	Other: :	
3 Casing Volumes	<u>4.2</u>	Start Time	<u>1150</u>
1 Casing Volume	<u>1.7</u>	End Time	<u>1306</u>
		Total Gallons Purged	<u>6.4</u>

GOSAR J.A.

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1200	1.0	7.31	3.196	154	0.18	15.87	-58.9	orange, cloudy
1216	2.5	6.93	3.180 3.180	83.5	3.00	15.99	-63.4	light orange, clearing
1230	4.0	7.23	2.395	53.9	0.17	15.75	-93.5	light orange, clearing
1233	4.3	7.12	2.387	51.8	0.11	15.74	-94.3	light orange, clear
1236	4.6	7.05	2.393	49.6	0.11	15.81	-95.8	light orange, clear
1239	4.9	6.99	2.385	40.4	0.10	15.87	-97.1	light orange
1242	5.2	6.98	2.384	44.9	0.11	15.80	-99.5	light orange, clear
1245	5.5	7.00	2.368	38.0	0.13	15.80	-98.8	light orange, clear
1248	5.8	6.99	2.353	33.9	0.14	15.75	-98.4	light orange, clear
1251	6.1	7.00	2.343	35.2	0.17	15.75	-98.7	light orange, clear
1254	6.4	6.98	2.337	33.2	0.17	15.83	-99.4	light orange

Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1256	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	1256	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	1256	(2) 0.5 L Amber Glass	cool to 4°C	

End Time 1306

Comments / Exceptions:

Presence of floating product? *slight sheen* YES / NO Presence of sinking product? YES / **NO**

Dark orange chunky stuff in dark orange water when pump initially began.

slight sheen

slight odor

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

8/6/09 Sample name changed to GW-090727-PL2-606AR-0
KA
GOSAR
(J.A.)

OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-605A LOGA (9.2)	Date	7/27/09
Sample: ID	GW-090727-PL2-605A-0	Field Team: (Initials)	KA
Field Conditions	Sunny HOT ~93°F		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	22.0
Initial Depth to Water (ft.)	11.39
Depth of Water Column	10.61
3 Casing Volumes	5.1
1 Casing Volume	1.7

Purge Method : Submersible pump
 Bladder Pump
 Peristaltic Pump
 Other: _____

Start Time	1315
End Time	1448
Total Gallons Purged	7.25

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1325	1.3	8.59	1.595	5.52	11.60	17.18	27.3	clear w/white floaties
			Double check pH calibration					
1349	3.8	9.60	1.171	7.58	7.49	16.97	3.8	clear w/white floating debris
1352	4.1	9.51	1.056	8.28	7.35	16.75	11.3	clear w/white stuff
1355	4.4	9.43	1.030	5.84	6.98	16.84	17.3	clear w/white stuff
1358	4.7	9.38	0.949	2.10	6.08	16.91	22.2	clear w/white stuff
1401	5.0	9.40	0.918	2.34	5.75	16.98	22.8	clear w/white
1404	5.2	9.41	0.891	1.84	5.57	17.00	23.3	clear w/white
1407	5.4	9.46	0.885	5.69	5.43	17.03	23.5	clear less floaties
Recalibrate pH								
1422	6.0	9.01	0.836	2.22	4.67	16.82	28.9	clear
1425	6.2	8.61	0.813	2.24	4.31	16.67	33.1	clear

Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

See next page
→

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1439	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	1439	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	1439	(2) 0.5 L Amber Glass	cool to 4°C	

End Time 1448

Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

Floating white flakes in purgewater - Floating E/HCO remnants

Recalibrated YSI 2xs with 3 point calibrations

Appears to be reading properly

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

*Continued

OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-605A 605A	Date	7/27/09
Sample: ID	GW-090727-PL2-605A-0	Field Team: (Initials)	KA
Field Conditions	Sunny HOT 605A 9D.		

Purge Information

Well Diameter (in.)	2.4
Well Depth (ft.)	22.0
Initial Depth to Water (ft.)	11.39
Depth of Water Column	10.61
3 Casing Volumes	5.1
1 Casing Volume	1.7

Purge Method : Submersible pump
 Bladder Pump
Peristaltic Pump
 Other: _____

Start Time	1315
End Time	1448
Total Gallons Purged	7.25

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1428	6.4	8.49	0.800	2.66	3.99	16.71	35.6	clear
1431	6.7	8.47	0.789	2.95	4.00	16.65	36.5	clear
1434	7.0	8.40	0.780	5.97	3.80	16.62	39.1	clear
1437	7.25	8.34	0.768	2.75	3.59	16.61	40.7	clear

Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1439	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	1439	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	1439	(2) 0.5 L Amber Glass	cool to 4°C	

End Time 1448

Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

OA-9-IM Groundwater Sampling Field Data

(KA) Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-X-311A	Date	7/27/09
Sample: ID	GW-090728-PL2-311A-0	Field Team: (Initials)	KA
Field Conditions	Sunny HOT ~93°F		

Purge Information

Well Diameter (in.)	2"	Purge Method : Submersible pump	
Well Depth (ft.)	18.5	Bladder Pump	
Initial Depth to Water (ft.)	11.19	Peristaltic Pump	
Depth of Water Column	7.31	Other: :	
3 Casing Volumes	3.6	Start Time	1520
1 Casing Volume	1.2	End Time	1642
		Total Gallons Purged	5.6

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1537	1.8	8.40	3.758	32.5	0.14	17.26	-123.6	Black, odor, cloudy
1540	2.1	7.98	3.640	16.1	0.11	17.10	-129.5	Black, odor, cloudy
1543	2.4	7.70	3.620	15.9	0.09	17.00	-128.5	Black, odor, cloudy
1546	2.7	7.63	3.538	14.8	0.08	16.98	-120.3	Gray, odor, cloudy
1549	3.0	7.60	3.511	13.5	0.08	17.00	-114.8	Gray, odor, clearing
1552	3.3	7.52	3.436	13.2	0.08	16.98	-114.3	Gray, odor, clearing
1555	3.6	7.44	3.386	15.0	0.08	16.95	-112.6	Gray, odor, clearing
1558	3.9	7.41	3.389	11.5	0.09	16.93	-112.3	Gray, odor,
1601	4.2	7.38	3.338	9.70	0.10	16.94	-112.1	Gray, clear
1604	4.5	7.34	3.327	8.78	0.11	16.87	-112.3	Gray, clear
1607	4.7	7.32	3.310	15.6	0.11	16.89	-113.6	Gray,
1610	4.8	7.28	3.253	15.9	0.19	17.14	-113.3	Black

Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

* See next page →

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1624	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	1624	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	1624	(2) 0.5 L Amber Glass	cool to 4°C	

End Time 1642

Comments / Exceptions:

Presence of floating product? YES / **(NO)** Presence of sinking product? YES / **(NO)**

Black purgewater after initial pumping began. Strong odor. Appears to have some silt in purgewater.

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

3.227
3.211

* Continued from previous page

OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-311A	Date	7/27/09
Sample: ID	GW-090727-PL2-311A-0	Field Team: (Initials)	KA
Field Conditions	Sunny HOT		

Purge Information

Well Diameter (in.)	2"
Well Depth (ft.)	18.5
Initial Depth to Water (ft.)	11.19
Depth of Water Column	7.31
3 Casing Volumes	3.6
1 Casing Volume	1.2

Purge Method : Submersible pump
 Bladder Pump
 Peristaltic Pump
 Other: _____

Start Time	1520
End Time	1642
Total Gallons Purged	5.6

Time	Gallons	pH	Conductivity	NTU	DO mg/L	Temp.	ORP	Appearance
1613	5.0	7.26	3.233	13.9	0.25	17.13	-113.0	Gray
1616	5.2	7.23	3.194	11.8	0.29	17.21	-113.1	Gray
1619	5.4	7.21	3.182	8.45	0.28	17.23	-113.2	Gray, clear
1622	5.6	7.19	3.179	8.16	0.24	17.18	-113.1	Gray, clear

Sample Information

Sample Method(s) Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1624	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	1624	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	1624	(2) 0.5 L Amber Glass	cool to 4°C	

End Time 1642

Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

0.09582

OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	Ph2-332A	Date	10/27/09
Sample: ID	GW-C91027-PL2-332A-10	Field Team: (Initials)	KN
Field Conditions	Mostly Cloudy		

Purge Information

Well Diameter (in.)	2"	Purge Method :	Submersible pump
Well Depth (ft.)	19.00		Bladder Pump
Initial Depth to Water (ft.)	10.82 @ 0924		Peristaltic Pump
Depth of Water Column	3.18	Other :	
3 Casing Volumes	3.9	Start Time	0954
1 Casing Volume	1.3	End Time	1048
		Total Gallons Purged	3.4

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1010	2.25	6.24	0.600	0.83	2.14	16.91	80.3	clear, colorless
1013	2.4	6.23	0.607	0.69	2.13	16.92	81.2	clear, colorless
1016	2.6	6.22	0.610	0.75	1.96	16.98	78.6	clear, colorless
1019	2.8	5.84	0.610	0.83	1.78	17.01	69.6	clear, colorless
1022	3.0	5.84	0.611	0.82	1.63	16.98	74.7	clear, colorless
1025	3.2	5.87	0.611	1.08	1.68	16.94	73.6	clear, colorless
1028	3.4	5.88	0.607	0.86	1.70	16.96	72.1	clear, colorless

Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1030 1027	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	1030 1027	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	1030 1027	(2) 0.5 L Amber Glass	cool to 4°C	

End Time 1048

Comments / Exceptions:

Presence of floating product? YES / **NO** Presence of sinking product? YES / **NO**

No odor

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-604A	Date	10/27/09
Sample: ID	BO-091027-PL2-604A-0	Field Team: (Initials)	KCA
Field Conditions	Partly Cloudy, Sun breaks		

Purge Information

Well Diameter (in.)	2.11	Purge Method : Submersible pump	
Well Depth (ft.)	22.00	Bladder Pump	
Initial Depth to Water (ft.)	11.24 @ 0920	<u>Peristaltic Pump</u>	
Depth of Water Column	10.76	Other: _____	
3 Casing Volumes	5.2	Start Time	1100
1 Casing Volume	1.7	End Time	1210
		Total Gallons Purged	4.0

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1105	0.5	6.91	3.424	15.5	1.65	17.22	-52.5	clear, colorless
1108	0.8	6.94	3.569	15.7	1.12	16.91	-77.9	clear, colorless
1111	1.3	6.96	3.491	16.2	1.04	16.86	-97.5	clear, colorless
1114	1.5	6.97	3.471	14.4	0.95	16.89	-101.9	clear, colorless
1117	1.7	6.97	3.421	13.6	0.90	17.03	-104.8	clear, colorless
1120	2.0	6.98	3.287	11.3	0.78	16.90	-103.3	clear, colorless
1123	2.2	6.97	3.214	10.73	0.77	16.90	-96.0	clear, colorless
1126	2.4	6.97	3.125	8.75	0.73	17.00	-85.0	clear, colorless
1129	2.7	6.96	3.089	9.71	0.84	16.93	-91.2	clear, colorless
1132	3.0	6.97	3.000	6.78	0.77	16.90	-86.4	clear, colorless
1135	3.2	6.97	2.990	7.26	0.74	16.90	-84.8	clear, colorless
1138	3.4	6.97	2.866	6.10	0.77	16.92	-90.6	clear, colorless

1141	3.6	6.99	3.134	9.79	0.76	16.92	-105.0	"
1144	3.8	6.99	2.771	6.22	0.70	16.96	-109.2	"
Sample Information								
Sample Method(s)	Peristaltic pump / Submersible pump / Bladder Pump / Other							
1147	4.0	7.05	2.736	5.35	0.70	16.82	-112.8	"

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1149	(3) 40-mL VOA	HCl, cool to 4°C	MS/MSD
NWTPH-Gx	1149	(3) 40-mL VOA	HCl, cool to 4°C	MS/MSD
NWTPH-Dx	1149	(2) 0.5 L Amber Glass	cool to 4°C	MS/MSD

End Time 1210

Comments / Exceptions:

Presence of floating product? YES NO Presence of sinking product? YES NO

Slight odor

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-310A	Date	10/22/09
Sample: ID	CW-091027-PL2-310A-0	Field Team: (Initials)	KA
Field Conditions	Sunny		

Purge Information

Well Diameter (in.)	2"	Purge Method :	Submersible pump
Well Depth (ft.)	19.5		Bladder Pump
Initial Depth to Water (ft.)	11.09 (09127)		Peristaltic Pump
Depth of Water Column	8.41	Other :	
3 Casing Volumes	4.03	Start Time	1140
1 Casing Volume	1.34	End Time	1244
		Total Gallons Purged	3.4

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1203	2.25	6.42	6.784	8.44	0.81	18.01	-89.9	clear, colorless
1211	2.4	6.43	6.796	5.62	0.78	18.11	-85.7	clear, colorless
1214	2.6	6.43	6.831	2.68	0.71	18.33	-87.4	clear, colorless
1217	2.8	6.42	6.850	1.54	1.13	18.28	-87.8	clear, colorless
1220	3.0	6.42	6.874	1.35	0.70	18.13	-89.3	clear, colorless
1223	3.2	6.43	6.893	1.16	0.65	18.05	-89.7	clear, colorless
1226	3.4	6.43	6.887	1.29	0.63	18.06	-91.1	clear, colorless

Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1228	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	1228	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	1228	(2) 0.5 L Amber Glass	cool to 4°C	

End Time 1244

Comments / Exceptions:

Presence of floating product? YES / **NO** Presence of sinking product? YES / **NO**

Moderate odor

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-311A	Date	10/22/09
Sample: ID	GW-091027-PL2-311A-0	Field Team: (Initials)	KA
Field Conditions	Cloudy		

Purge Information

Well Diameter (in.)	2"	Purge Method :	Submersible pump
Well Depth (ft.)	18.5		Bladder Pump
Initial Depth to Water (ft.)	10.97 0945		Peristaltic Pump
Depth of Water Column	7.53	Other: :	
3 Casing Volumes	3.61	Start Time	1550
1 Casing Volume	1.20	End Time	1638
		Total Gallons Purged	2.7

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1606	1.5	7.46	4.497	26.6	0.95	17.53	-92.5	Black
1609	1.8	7.42	4.486	18.4	0.88	17.59	-94.9	clearing
1612	2.1	7.39	4.483	12.4	0.89	17.56	-95.6	clearing
1615	2.4	7.36	4.476	9.82	0.92	17.56	-95.0	clear
1618	2.7	7.34	4.46 (KA)	8.83	0.90	17.55	-96.2	clear
			4.476					

Sample Information

Sample Method(s) **Peristaltic pump** Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1620	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	1620	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	1620	(2) 0.5 L Amber Glass	cool to 4°C	

End Time 1638

Comments / Exceptions:

Presence of floating product? YES / **NO** Presence of sinking product? YES / **NO**

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.



OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station
Sample: ID
Field Conditions

PL2-605AR	Date	10/29/09
CLW-0910Z7-PL2-605AR-1	Field Team: (Initials)	KA
Partly Cloudy		

Purge Information

Well Diameter (in.)
Well Depth (ft.)
Initial Depth to Water (ft.)
Depth of Water Column
3 Casing Volumes
1 Casing Volume

2'
72.0
11.50 0929
11.00
5.28
1.76

Purge Method : Submersible pump

Bladder Pump

Peristaltic Pump

Other :

Start Time	1302
End Time	1424
Total Gallons Purged	6.3

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1316	1.25	6.98	5,132	110	1.36	16.26	-49.3	orange, cloudy
1328	2.5	7.00	4,206	75.1	0.75	16.12	-64.3	orange, cloudy
1331	2.8	7.01	4,009	49.3	0.69	16.08	-67.6	orange, cloudy
1334	3.1	7.01	3,787	46.4	0.63	16.10	-71.3	orange, cloudy
1337	3.5	7.02	3,660	44.5	0.62	16.10	-74.0	orange, cloudy
1340	3.8	7.04	3,550	42.7	0.61	16.11	-75.8	orange, cloudy
1350	4.4	7.05	3,164	26.4	0.57	16.10	-83.5	clearing
1353	4.7	7.05	3,077	23.7	0.57	16.05	-84.4	clearing
1356	5.1	7.05	3,001	20.5	0.56	16.10	-86.1	clear
1359	5.4	7.06	2,954	21.0	0.56	16.08	-86.0	clear
1402	5.7	7.06	2,895	16.4	0.54	16.10	-85.1	clear
1405	6.0	7.06	2,858	14.5	0.56	16.12	-84.0	clear

Sample Information

Sample Method(s) Peristaltic pump Submersible pump / Bladder Pump / Other

* Parameters Continued →

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1413	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	1413	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	1413	(2) 0.5 L Amber Glass	cool to 4°C	

End Time 1424

Comments / Exceptions:

Presence of floating product? YES / NO Presence of sinking product? YES / NO

Slight odor
Dark orange when pumping began @ 1302

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

* Parameters Continued →

**Continued*

OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-605AR	Date	10/27/09
Sample: ID	GW-091027-PL2-605AR	Field Team: (Initials)	KA
Field Conditions	Partly Cloudy		

Purge Information

Well Diameter (in.)	2"	Purge Method : Submersible pump Bladder Pump Peristaltic Pump Other: .
Well Depth (ft.)	22.0'	
Initial Depth to Water (ft.)	11.00 @ 0929	Start Time
Depth of Water Column	11.00	End Time
3 Casing Volumes	5.28	Total Gallons Purged
1 Casing Volume	1.76	

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1408	6.2	7.06	2.844	14.3	0.54	16.13	-85.2	clear
1411	6.5	7.05	2.829	13.9	0.53	16.06	-86.3	clear

Sample Information

Sample Method(s) : **Peristaltic pump** / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1413	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	1413	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	1413	(2) 0.5 L Amber Glass	cool to 4°C	

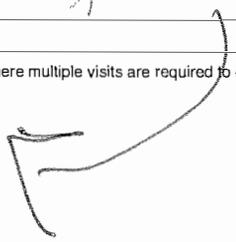
End Time 1424

Comments / Exceptions:

Presence of floating product? YES / **(NO)** Presence of sinking product? YES / **(NO)**

** See previous page*

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.



OA-9 IM Groundwater Sampling Field Data

Boeing Plant 2, Seattle/Tukwila, Washington

Station	PL2-606A	Date	10/27/07
Sample: ID	GW-071027-PL2-606A-0	Field Team: (Initials)	KA
Field Conditions	Partly Cloudy occasional showers		

Purge Information

Well Diameter (in.)	2"	Purge Method :	Submersible pump
Well Depth (ft.)	22.0		Bladder Pump
Initial Depth to Water (ft.)	11.12 @ 09:30		<u>Peristaltic Pump</u>
Depth of Water Column	10.88	Other: :	
3 Casing Volumes	5.22	Start Time	1304
1 Casing Volume	1.74	End Time	1512
		Total Gallons Purged	6.4

Time	Gallons	pH	Conductivity	NTU	DO	Temp.	ORP	Appearance
1430	5.8	10.52	0.927	26.5	17.31	16.38	63.1	clearing
1433	5.9	10.33	0.881	33.6	16.86	16.38	71.4	clearing
1436	6.0	10.21	0.863	26.9	16.50	16.40	75.1	clearing
1439	6.1	10.14	0.858	23.1	16.42	16.43	77.9	clear
1442	6.2	10.11	0.856	25.0	15.28	16.43	80.5	clear
1445	6.3	10.07	0.848	24.8	15.29	16.49	73.7	clear

Sample Information

Sample Method(s) : Peristaltic pump / Submersible pump / Bladder Pump / Other

Analysis	Time	Bottle Type	Preservative/Filtration	Comments
Volatiles (8260B)	1447	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Gx	1447	(3) 40-mL VOA	HCl, cool to 4°C	
NWTPH-Dx	1447	(2) 0.5 L Amber Glass	cool to 4°C	

End Time 1512

Comments / Exceptions:

Presence of floating product? YES / (NO) Presence of sinking product? YES / (NO)

Slow purge, well low recharge than others.

No odor

Notes: Where multiple visits are required to complete sampling, parameters are to be checked prior to sampling for each visit. Enter data under field comments.

Chain of Custody Record & Laboratory Analysis Request

ARI Assigned Number: _____ of _____
 ARI Client Company: Boeing Phone: _____
 Client Contact: Will Ernst
 Client Project Name: OA-9 IM Performance Sampling
 Client Project #: 17511.2 OA-9 Samplers: K. Addis



Analytical Resources, Incorporated
 Analytical Chemists and Consultants
 4611 South 134th Place, Suite 100
 Tukwila, WA 98168
 206-695-6200 206-695-6201 (fax)

Page: 1 of 1
 Date: 10/27/09 Ice Present? Yes
 No. of Coolers: 2 Cooler Temps: 5.5, 3.4

Sample ID	Date	Time	Matrix	No. Containers	Analysis Requested			Notes/Comments
					VOC 8260C	NWTPH-GX	NWTPH-DX	
GW-091027-PL2-332A-0	10/27/09	1030	GW	8	X	X		
GW-091027-PL2-604A-0	1149			8	X	X		MS/MSD
GW-091027-PL2-310A-0	1228			8	X	X		
GW-091027-PL2-605AR-0	1413			8	X	X		
GW-091027-PL2-606A-0	1447			8	X	X		
GW-091027-PL2-606A-1	1447			8	X	X		
GW-091027-PL2-311A-0	1620			8	X	X		
Trip Blank				2	X			

Comments/Special Instructions: _____
 Relinquished by: Kristin L. Addis (Signature) Received by: J. Peterson (Signature)
 Printed Name: Kristin L. Addis Company: ARI Date & Time: 10/27/09 1710
 Printed Name: J. Peterson Company: ARI Date & Time: 10/27/09 1710

Limits of Liability: ARI will perform all requested services in accordance with appropriate methodology following ARI Standard Operating Procedures and the ARI Quality Assurance Program. This program meets standards for the industry. The total liability of ARI, its officers, agents, employees, or successors, arising out of or in connection with the requested services, shall not exceed the invoiced amount for said services. The acceptance by the client of a proposal for services by ARI release ARI from any liability in excess thereof, not withstanding any provision to the contrary in any contract, purchase order or co-signed agreement between ARI and the Client.

Sample Retention Policy: All samples submitted to ARI will be appropriately discarded no sooner than 90 days after receipt or 60 days after submission of hardcopy data, whichever is longer, unless alternate retention schedules have been established by work-order or contract.

ATTACHMENT E
DATA VALIDATION REPORTS



TECHNICAL MEMORANDUM

Date: 10/26/2009
To: Will Ernst
From: Jill Lamberts, Staff Environmental Scientist
Kent Angelos, Principal and Project Director
cc: Doug Kunkel, and Jeff Dengler, EPI
RE: **BOEING PLANT 2 – INTERIM MEASURE GROUNDWATER MONITORING FOR OTHER AREA 9 (OA 9) – DATA VALIDATION QA/QC REVIEW**

Project No.: 013-1646-009.300.06
Company: The Boeing Company
Email: jill_lamberts@golder.com

1.0 INTRODUCTION

A total of 8 water samples (including 1 field duplicate and 1 trip blank) were collected July 27 of 2009 as part of the Boeing Plant 2 Groundwater Interim Measures Work Plan for Other Area 09 (OA 09) (July, 2008). These samples are for the Quarterly Sampling Program. Samples were analyzed by Analytical Resources Incorporated (ARI) of Tukwila, Washington for the following parameters:

- Volatile Organic Compounds (VOCs) by EPA Method 8260C
- Total petroleum hydrocarbons – gas, diesel and diesel extended range by Washington State Method NWTPH-G and NWTPH-Dx

Samples were analyzed in accordance with procedures described in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (USEPA SW-846, 3rd edition)* and *Washington State Department of Ecology*.

2.0 SAMPLE DELIVERY GROUPS, SAMPLES AND ANALYSES

Samples were analyzed and results reported by the laboratory in batch numbers as summarized below:

PI20 (VOCs, NWTPH-G, NWTPH-Dx):

GW-090727-PL2-332A-0	GW-090727-PL2-310A-1	GW-090727-PL2-311A-0
GW-090727-PL2-604A-0	GW-090727-PL2-605AR-0	Trip Blank
GW-090727-PL2-310A-0	GW-090727-PL2-606A-0	

Quality assurance/quality control (QA/QC) reviews of laboratory data were performed in the laboratory in accordance with the laboratory quality assurance program plan. The data validation QA/QC review focused primarily on laboratory result summary sheets and quality control summary sheets to ensure that work plan data quality objectives were met for the project.

Data validation was conducted in accordance with the criteria outlined in the National Functional Guidelines for Organic Data Review (EPA 1999) modified to include method-specific requirements of the laboratory analytical methods. Raw data sheets were reviewed as necessary to confirm conditions reported and to support application of qualifiers to analytical results.

The validation level for the data is Level 1, as described in the QAPP (EPI, 2008). The following is a summary of quality control elements associated with each analytical fraction and the status of that element as a result of the data validation process.

3.0 SAMPLING, DOCUMENTATION AND REPORTING

Sample acknowledgements, chain-of-custody, request forms and data package completeness were evaluated with the following noted:

- SDGs PI20: Cooler receipt form indicates that the VOC vials for the Trip Blank had one pea-sized bubble in one of the vials. No action was required since the samples were all analyzed within 7 days and the other vial was ok.
- SDG PI20: ARI was notified of a sample ID discrepancy by EPI staff. Samples listed on the chain of custody (COC) as GW-090727-PL2-606A-0 and GW-090727-PL2-605A-0 were renamed GW-090727-PL2-605AR-0, and GW-090727-PL2-606A-0, respectively.
- SDG PI20: PL2-605A was listed in the work plan, but PL2-605AR was listed on the COC. EPI was contacted and they responded that “PL2-605A was replaced after it was damaged beyond repair while installing a bioventing system. PL2-605AR is the correct well number for all OA 9 sampling events.” [personal comm., D. Kunkel].
- SDG PI20: The work plan lists PL2-311B as one of the locations that require sampling as part of OA 9. EPI was contacted and they responded that “there is no well PL2-311B, only PL2-311A. Table A5 of the work plan is incorrect and should say PL2-311A.” [personal comm., D. Kunkel].
- Results for volatile organic compound 1, 1, 2-trichloro-1, 2, 2-trifluoroethane are reported in a truncated format (1, 1, 2-trichloro-1, 2, 2-trifluoroe) due to ARI report format. No action was taken.

4.0 VOLATILE ORGANIC COMPOUNDS

Level 1 summary data packages were provided for the VOC analysis. The items reviewed during validation are summarized below.

4.1 Analytical Methods – *acceptable*

Samples for VOC analysis were analyzed by gas chromatography/mass spectrometry (GC/MS) using EPA SW846 Method 8260C. The QAPP lists the method for VOCs as 8260B. ARI recently updated their methods due to a NELAP audit and a memo dated 6/1/2009 was sent to Boeing, EPI, and Golder Project Managers informing them of the change.

4.2 Sample Holding Times and Preservations – *acceptable*

All samples were prepared and analyzed within 14 days of sample collection (preserved water samples) or within 7 days of sample collection (unpreserved water samples) with the following exceptions:

- SDG PI20: ARI sample receiving noted that there was a pea-sized bubble in one of the two HCl VOA vials for the Trip Blank. No action was taken other than to note since the other vial was ok and the sample was analyzed in < 7days.

4.3 Laboratory Reporting Limits

The laboratory achieved the reporting limits (RLs) required by the approved quality assurance project plan (EPI, 2008) with the following exceptions:

- Quality assurance project plan (QAPP) reporting limits were not met for nine compounds. A review of current ARI detection limits shows that both method and reporting limits were recently updated (as of 6/1/2009). Compounds that do not meet QAPP stipulated reporting levels (RLs) are identified in the following table:

TABLE 1
OA12 Reporting Limits

Compound	QAPP Table 5 RLs (µg/L)	Lab Reported RLs (µg/L)
Chloromethane	0.2	0.5
Bromomethane	0.2	0.5
Methylene Chloride	0.3	0.5
Acetone	3	5.0
2-Butanone	2	5.0
Vinyl Acetate	0.5	1.0
2-Chloroethylvinylether	0.5	1.0
4-Methyl-2-Pentanone	2	5.0
2-Hexanone	2	5.0

- No action was taken; this change in the RLs was sent by ARI to Boeing, EPI, and Golder Project Managers on June 1, 2009 and subsequently approved and implemented as part of the June 2009 QAPP compendium (Golder, 2009).
- Trichloroethene is listed twice in QAPP Table 5. No action was taken.
- The reporting limits were not met in cases in which the samples were analyzed at dilutions due to high concentrations of target compounds.

4.4 Instrument Calibration – *acceptable*

Calibration review is not required under the QAPP; however, the lab provided information on the calibration performance in the case narratives. All of the calibration criteria were met.

4.5 Blank Contamination – *acceptable*

The method blanks and trip blanks were free of contamination

4.6 Surrogate Recovery

All surrogate recoveries were within control limits with the following exceptions:

- SDG PI20: Surrogate d4-1,2-dichloroethane (DCE) was out of control low on the Trip Blank. The validator qualified associated non-detected compounds as estimated (UJ).

4.7 Matrix Spike Compound Recovery – *acceptable*

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) analysis was performed on GW-090727-PL2-332A-0 in SDG PI20. In SDGs where MS/MSD data are not available refer to LCS/LCSD and field duplicate data for precision and accuracy information. All MS/MSD recoveries and relative percent differences (RPDs) were acceptable with the following comments:

- SDG PI20: The MSD percent recoveries were out of control low for 2-Chloroethylvinylether. No further action was taken as the LCS/LCSD and MS recoveries were in control, and the MSD percent recovery was within recently updated CLs on the ARI website.

Refer to Laboratory Control Sample data and field duplicate data for additional precision and accuracy information.

4.8 Laboratory Control Sample Recovery – *acceptable*

Laboratory control samples (LCS) were evaluated using control limits listed in Table 4 of the QAPP (EPI, 2008) and recently updated CLs on the ARI website. All LCS/LSCD recoveries and relative percent differences (RPDs) were acceptable.

4.9 Field Duplicate Sample Analysis

Field duplicate samples were collected and analyzed as follows:

TABLE 2
Field Duplicates

Laboratory SDG	Sample	Field Duplicate Sample
PI20	GW-090727-PL2-310A-0	GW-090727-PL2-310A-1

Field duplicate analysis criteria were met.

5.0 TOTAL PETROLEUM HYDROCARBON – GASOLINE, DIESEL, & MOTOR OIL

The laboratory provided a full data package for northwest total petroleum hydrocarbon (NWTPH) analysis for gasoline, diesel and motor oil; the items reviewed during validation are summarized below.

5.1 Analytical Methods – *acceptable*

Samples for TPH parameters were analyzed using the following methodology:

- NWTPH–Gasoline in the Toluene–Naphthalene range;
- NWTPH–Diesel in the C12–C24 range; and
- TPH–Motor Oil in the C24–C38 range.

5.2 Sample Holding Times – *acceptable*

All samples were prepared and/or analyzed within the recommended holding times:

- NWTPH-G – All samples were analyzed within 14 days of sample collection (preserved water samples) or within 7 days of sample collection (unpreserved water samples).
- NWTPH-Dx – All samples were extracted within 7 days for waters of sample collection and analyzed within 40 days from collection to analysis.

5.3 Laboratory Reporting

The laboratory compared sample chromatograms with gas, diesel and motor oil standard chromatograms and based on this comparison ARI qualified these results (as GRO, DRO, or MMO) to indicate qualitative or quantitative uncertainty with the results (the chromatogram was a poor match or other organics were detected in the sample). NWTPH-G and/or NWTPH-Dx (diesel and motor oil) sample results are considered estimated and qualified 'J' in the following instances.

- SDG PI20: For sample GW-090727-PL2-310A-1 the diesel hydrocarbon results are qualified as estimated (J).

5.4 Laboratory Reporting Limits – acceptable

The laboratory achieved the reporting limits (RLs) required by the approved quality assurance project plan (EPI, 2008). The reporting limits were not met in cases in which the samples were analyzed at dilutions due to high concentrations of target compounds. No action was taken.

5.5 Blank Contamination – acceptable

The method and equipment blanks were free of target compounds.

5.6 Surrogate Recovery – acceptable

All surrogate recoveries were within control limits.

5.7 Matrix Spike Compound Recovery – acceptable

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) analysis was performed on GW-090727-PL2-332A-0 in SDG PI20. In SDGs where MS/MSD data are not available refer to LCS/LCSD and field duplicate data for precision and accuracy information. All MS/MSD recoveries and relative percent differences (RPDs) were acceptable.

5.8 Laboratory Control Sample Recovery – acceptable

Laboratory control samples (LCS) were evaluated and were within the control limits listed in the QAPP (EPI, 2008).

5.9 Field Duplicate Sample Analysis – acceptable

Field duplicate samples were collected and analyzed as follows:

TABLE 3
Field Duplicates

Laboratory SDG	Sample	Field Duplicate Sample
PI20	GW-090727-PL2-310A-0	GW-090727-PL2-310A-1

Field duplicate analysis criteria were met.

6.0 DATA QUALIFIERS

Data qualifiers applied by the laboratory have been removed from the data summary report sheets and superseded by data validation qualifiers as follows:

The following qualifiers were used to modify the data quality and usefulness of individual analytical results.

- U – The constituent was analyzed for, but was not detected above the reported sample quantitation limit.
- J – The constituent was positively identified and detected; however, the concentration reported is an estimated value because the result is less than the quantitation limit or quality control criteria were not met.
- J+ – The constituent was positively identified and detected; however, the concentration reported is an estimated value because the result may be biased high.

- J- – The constituent was positively identified and detected; however, the concentration reported is an estimated value because the result may be biased low.
- UJ – The constituent was not detected; the associated quantitation limit is an estimated value because quality control criteria were not met.
- R – Data are rejected due to significant exceedance of quality control criteria. The analyte may or may not be present. Additional sampling and analysis may be required to determine the presence or absence of the constituent. For statistical reasons, rejected values are not included in the database.
- UR – The constituent is rejected at the reported quantitation limit.
- Y – The reporting limit is elevated due to interference. The result is not detected.

7.0 DATA ASSESSMENT

Data review and validation was performed by an experienced quality assurance chemist independent of the analytical laboratory and not directly involved in the project. This is to certify that I have examined the analytical data and based on the information provided to me by the laboratory, in my professional judgment, the data are acceptable for use except where indicated by data qualifiers, which may modify the usefulness of those individual values.



Jill Lamberts
Staff Environmental Scientist, Golder

October 26, 2009

Date



Kent Angelos
Principal & Project Director, Golder

October 27, 2009

Date

8.0 REFERENCES

EPA 1999, USEPA Contract Laboratory Program, National Functional Guidelines for Organic Data Review, EPA-540/R-99/008, October, 1999.

EPI 2008, Interim Measures Work Plan For Other Area 9, Boeing Plant 2, Seattle/Tukwila, Washington, Prepared by Environmental Partners, Inc. (EPI), July 2008 (Includes QAPP).

Golder Associates Inc. (Golder), 2009, Compendium of Sampling and Analysis Plans and Quality Assurance Plans for Boeing Plant 2, Prepared for The Boeing Company by Golder Associates Inc. (Golder) and Environmental Partners, Inc. (EPI), June of 2009.

- Results for volatile organic compound 1, 1, 2-trichloro-1, 2, 2-trifluoroethane are reported in a truncated format (1, 1, 2-trichloro-1, 2, 2-trifluoroe) due to ARI report format. No action was taken.

4.0 VOLATILE ORGANIC COMPOUNDS

Level 1 summary data packages were provided for the VOC analysis. The items reviewed during validation are summarized below.

4.1 Analytical Methods – *acceptable*

Samples for VOC analysis were analyzed by gas chromatography/mass spectrometry (GC/MS) using EPA SW846 Method 8260C. The QAPP lists the method for VOCs as 8260B. ARI recently updated their methods due to a NELAP audit and a memo dated 6/1/2009 was sent to Boeing, EPI, and Golder Project Managers informing them of the change.

4.2 Sample Holding Times and Preservations – *acceptable*

All samples were prepared and analyzed within 14 days of sample collection (preserved water samples) or within 7 days of sample collection (unpreserved water samples).

4.3 Laboratory Reporting Limits

The laboratory achieved the reporting limits (RLs) required by the approved quality assurance project plan (EPI, 2008) with the following exceptions:

- Quality assurance project plan (QAPP) reporting limits were not met for nine compounds. A review of current ARI detection limits shows that both method and reporting limits were recently updated (as of 6/1/2009). Compounds that do not meet QAPP stipulated reporting levels (RLs) are identified in the following table:

TABLE 1
OA12 Reporting Limits

Compound	QAPP Table 5 RLs (µg/L)	Lab Reported RLs (µg/L)
Chloromethane	0.2	0.5
Bromomethane	0.2	0.5
Methylene Chloride	0.3	0.5
Acetone	3	5.0
2-Butanone	2	5.0
Vinyl Acetate	0.5	1.0
2-Chloroethylvinylether	0.5	1.0
4-Methyl-2-Pentanone	2	5.0
2-Hexanone	2	5.0

- No action was taken; this change in the RLs was sent by ARI to Boeing, EPI, and Golder Project Managers on June 1, 2009 and subsequently approved and implemented as part of the June 2009 QAPP compendium (Golder, 2009).
- Trichloroethene is listed twice in QAPP Table 5. No action was taken.
- The reporting limits were not met in cases in which the samples were analyzed at dilutions due to high concentrations of target compounds.

4.4 Instrument Calibration – *acceptable*

Calibration review is not required under the QAPP; however, the lab provided information on the calibration performance in the case narratives. All of the calibration criteria were met.

4.5 Blank Contamination – *acceptable*

The method blanks and trip blanks were free of contamination

4.6 Surrogate Recovery - *acceptable*

All surrogate recoveries were within control limits.

4.7 Matrix Spike Compound Recovery – *acceptable*

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) analysis was performed on GW-090727-PL2-332A-0 in SDG PI20. In SDGs where MS/MSD data are not available refer to LCS/LCSD and field duplicate data for precision and accuracy information. All MS/MSD recoveries and relative percent differences (RPDs) were acceptable.

Refer to Laboratory Control Sample data and field duplicate data for additional precision and accuracy information.

4.8 Laboratory Control Sample Recovery – *acceptable*

Laboratory control samples (LCS) were evaluated using control limits listed in Table 4 of the QAPP (EPI, 2008) and recently updated CLs on the ARI website. All LCS/LSCD recoveries and relative percent differences (RPDs) were acceptable.

4.9 Field Duplicate Sample Analysis - *acceptable*

Field duplicate samples were collected and analyzed as follows:

TABLE 2
Field Duplicates

Laboratory SDG	Sample	Field Duplicate Sample
PI20	GW-091027-PL2-606A-0	GW-091027-PL2-606A-1

Field duplicate analysis criteria were met.

5.0 TOTAL PETROLEUM HYDROCARBON – GASOLINE, DIESEL, & MOTOR OIL

The laboratory provided a full data package for northwest total petroleum hydrocarbon (NWTPH) analysis for gasoline, diesel and motor oil; the items reviewed during validation are summarized below.

5.1 Analytical Methods – *acceptable*

Samples for TPH parameters were analyzed using the following methodology:

- NWTPH–Gasoline in the Toluene–Naphthalene range;
- NWTPH–Diesel in the C12–C24 range; and
- TPH–Motor Oil in the C24–C38 range.

5.2 Sample Holding Times – *acceptable*

All samples were prepared and/or analyzed within the recommended holding times:

- NWTPH-G – All samples were analyzed within 14 days of sample collection (preserved water samples) or within 7 days of sample collection (unpreserved water samples).
- NWTPH-Dx – All samples were extracted within 7 days for waters of sample collection and analyzed within 40 days from collection to analysis.

5.3 Laboratory Reporting Limits – *acceptable*

The laboratory achieved the reporting limits (RLs) required by the approved quality assurance project plan (EPI, 2008). The reporting limits were not met in cases in which the samples were analyzed at dilutions due to high concentrations of target compounds. No action was taken.

5.4 Blank Contamination – *acceptable*

The method and equipment blanks were free of target compounds.

5.5 Surrogate Recovery – *acceptable*

All surrogate recoveries were within control limits.

5.6 Matrix Spike Compound Recovery – *acceptable*

Matrix Spike (MS) and Matrix Spike Duplicate (MSD) analysis was performed on GW-090727-PL2-332A-0 in SDG PI20. In SDGs where MS/MSD data are not available refer to LCS/LCSD and field duplicate data for precision and accuracy information. All MS/MSD recoveries and relative percent differences (RPDs) were acceptable.

5.7 Laboratory Control Sample Recovery – *acceptable*

Laboratory control samples (LCS) were evaluated and were within the control limits listed in the QAPP (EPI, 2008).

5.8 Field Duplicate Sample Analysis – *acceptable*

Field duplicate samples were collected and analyzed as follows:

TABLE 3
Field Duplicates

Laboratory SDG	Sample	Field Duplicate Sample
PI20	GW-091027-PL2-606A-0	GW-091027-PL2-606A-1

Field duplicate analysis criteria were met.

6.0 DATA QUALIFIERS

Data qualifiers applied by the laboratory have been removed from the data summary report sheets and superseded by data validation qualifiers as follows:

The following qualifiers were used to modify the data quality and usefulness of individual analytical results.

- U – The constituent was analyzed for, but was not detected above the reported sample quantitation limit.
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- UJ – The constituent was not detected; the associated quantitation limit is an estimated value because quality control criteria were not met.
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- Y – The reporting limit is elevated due to interference. The result is not detected.

7.0 DATA ASSESSMENT

Data review and validation was performed by an experienced quality assurance chemist independent of the analytical laboratory and not directly involved in the project. This is to certify that I have examined the analytical data and based on the information provided to me by the laboratory, in my professional judgment, the data are acceptable for use except where indicated by data qualifiers, which may modify the usefulness of those individual values.



Kent Angelos
Principal Environmental Scientist
Golder Associates Inc.

January 18, 2010

Date

8.0 REFERENCES

EPA 1999, USEPA Contract Laboratory Program, National Functional Guidelines for Organic Data Review, EPA-540/R-99/008, October, 1999.

EPI 2008, Interim Measures Work Plan For Other Area 9, Boeing Plant 2, Seattle/Tukwila, Washington, Prepared by Environmental Partners, Inc. (EPI), July 2008 (Includes QAPP).

Golder Associates Inc. (Golder), 2009, Compendium of Sampling and Analysis Plans and Quality Assurance Plans for Boeing Plant 2, Prepared for The Boeing Company by Golder Associates Inc. (Golder) and Environmental Partners, Inc. (EPI), June of 2009.