FOURTH QUARTER 2018 PROGRESS REPORT / THIRD QUARTER 2018 GROUNDWATER PERFORMANCE MONITORING REPORT SITE: FORMER BP HARBOR ISLAND TERMINAL

CLEANUP SITE ID: 4426 1652 SW LANDER STREET SEATTLE, WASHINGTON

CONSENT DECREE NO. 00-2-05714-8SEA

JANUARY 2019

Prepared for
TLP Management Services LLC
1670 Broadway
Suite 3100
Denver, CO 80202

Prepared by TechSolve Environmental, Inc. 7518 NE 169th Street Kenmore, WA 98028

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Scott K. Larsen, CHMM
Project Scientist/Project Manager
TechSolve Environmental, Inc.

Larry E. Roberts, LG, LHG
Principal Hydrogeologist/Site Manager
TechSolve Environmental, Inc.

Larry E. Roberts

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1. INTRODUCTION

TLP Management Services LLC is submitting this report prepared by TechSolve Environmental, Inc. (TechSolve) to summarize the Third Quarter 2018 Groundwater Monitoring event and operation and maintenance of the waterfront remediation system during the fourth quarter (October through December) of 2018 for the Former BP Harbor Island Terminal Site. Groundwater monitoring and remediation system reporting periods are staggered due to the time required to receive and validate laboratory reports from groundwater monitoring events. The combination of these two summary reports was based upon the recommendation of the Washington State Department of Ecology (Ecology) project manager (Ecology, 2004a). This progress report satisfies reporting schedule submittal requirements pursuant to Ecology Consent Decree No. 00-2-05714-8SEA, entered into court March 24, 2000 (Ecology, 2000b).

2. REMEDIATION SYSTEM OPERATIONS

Remediation systems were installed and completed at the Site in accordance with specifications outlined in the Engineering Design Report (EDR) (TechSolv and AG&M, 2000) and Cleanup Action Plan (CAP) (Ecology, 1999). Throughout 2018, a waterfront groundwater/Light Non-Aqueous Phase Liquid (LNAPL) remediation system has operated to remove free-phase LNAPL and dissolved petroleum hydrocarbons from groundwater at Plant 1 (Figure 1).

2.1. WATERFRONT SYSTEM OPERATIONS

Installation and startup of the final waterfront remediation system was completed in 2002 and operational testing was conducted through 2003. Standard operation began once testing showed the system operated as designed and in accordance with Consent Decree and EDR requirements. Reports were submitted to Ecology summarizing both construction and operation & maintenance (O&M) of the remediation system. The Construction Completion Report (CCR) (TechSolve, 2003b) summarized construction, installation, and startup testing of the final remediation system, and documented that systems met design criteria, attained desired capture, and hydraulic control along the waterfront. The Final O&M Manual (TechSolve, 2003c) contains procedures to operate and maintain systems, vendor-supplied manuals for components, and health and safety practices. Ecology stated that the CCR and O&M Manual complied with the requirements of the Consent Decree, the Groundwater Compliance Monitoring Program, and the Model Toxics Control Act (WAC 173-340-400) and, as such, were approved (Ecology, 2004b). The O&M Manual is updated as practices or procedures change, or as systems are altered.

O&M activities are conducted on systems weekly to ensure they operate as designed and in accordance with applicable permits. These activities include, but are not limited to:

- Weekly checks of groundwater recovery system pumping rates.
- Weekly inspections of system components and waste storage containers for integrity per the requirements of WAC 173-303-320.
- Monthly sampling of recovered groundwater influent and effluent streams to ensure compliance with King County Department of Natural Resources and Parks (KCDNR) Discharge Permit 7592-05 for discharge A43262.

- Monthly monitoring and calculation of system LNAPL recovery.
- Monthly sampling of system flow rates and hydrocarbon concentrations.

Additional maintenance activities are conducted as needed to maintain system operational integrity and to ensure discharges are within permitted ranges.

Operation of waterfront air sparging and SVE systems were discontinued in May 2008, as the bulk of available hydrocarbons had been recovered. System data collected during 5 years of operation prior to shutdown were presented in previous reports, and support system shutdown. These findings were presented to Ecology in a 5-year Review meeting, conducted October 8, 2008, and summarized in the 2008 Annual Site Report (TechSolve, 2009).

Combined LNAPL recovery (free-phase, residual, and dissolved) from final SVE and groundwater/LNAPL recovery systems is approximately 14,555 gallons (October 2002 to December 2018) (Table 1). Interim systems, operating from 1992 through 2002, recovered an additional 15,223 gallons of LNAPL, for a combined LNAPL recovery from interim and final remediation systems of 29,778 gallons. The majority of LNAPL recovered by interim remediation systems was free-phase LNAPL. The majority of LNAPL recovered by final remediation systems was from enhanced biodegradation, calculated from SVE vapor sampling for CO_2 . SVE system shutdown in 2008 was based, in part, on concentrations of CO_2 reaching atmospheric (background) levels.

Groundwater/LNAPL recovery system data presented in Table 1 show influent concentrations of dissolved benzene, diesel, and gasoline in recovered groundwater fluctuate slightly throughout the year but have decreased over time. Table 1 also shows that measurable volumes of free LNAPL have not been generated since 2008, which was the last time sufficient quantities of LNAPL were recovered to warrant off-site shipment. These data correspond with the lack of free LNAPL observed in recovery wells utilized by the groundwater/LNAPL recovery system. Lack of free LNAPL in wells and limited free LNAPL recovery by the groundwater/LNAPL recovery system indicates that the recovery system has captured most available free LNAPL.

Effluent discharges from the groundwater/LNAPL recovery system to sanitary have been within KCDNR's permitted ranges (Table 1) in 2018. Average monthly effluent flow rates ranged from 1.7 to 1.0 gallons per minute (gpm) in 2018, below KCDNR's maximum permitted flow of 17.5 gpm, consistent with past rates.

Maintenance and repair activities of remediation systems and wells are conducted to maintain integrity, effective operation, capture, and hydraulic control along the waterfront. Notable activities conducted in the third quarter of 2018 include:

- Piping and system inspections for corrosion and integrity to ensure system are operable.
- Piping and system back flushing and preventative maintenance to maintain conveyance piping and pumping wells.

Data show that the system continues to operate as designed and in accordance with permit requirements.

2.2. INLAND SYSTEM OPERATIONS

An Inland SVE system operated from 2008 through 2014 to improve soil and groundwater conditions along the southern boundary of Plant 1. The SVE system was shut down in December 2014 as data indicated the system no longer recovered measurable concentrations of petroleum hydrocarbons and induced airflow was no longer affecting biodegradation. Additional information regarding shutdown of the Inland SVE system was provided in the 2015 Annual Site Report (TechSolve, 2016). In 2018, a plan (TechSolve, 2018) was submitted to and approved by Ecology (Ecology 2018) to decommission the mechanical and electrical components of the Inland SVE System that required ongoing maintenance. These components were subsequently decommissioned. The in-ground SVE piping and control manifold for this system remain onsite as a contingency in case operation of the system is warranted in the future.

Groundwater monitoring data collected along Plant 1's southern boundary indicate the system improved groundwater conditions at the southern property boundary, as discussed in the following section.

3. SUMMARY OF GROUNDWATER PERFORMANCE MONITORING PROGRAM

The Third Quarter 2018 Groundwater Monitoring Event was conducted in accordance with requirements of the Consent Decree, CAP, and Groundwater Compliance Monitoring and Contingency Program (TechSolve, 1999). The Groundwater Compliance Monitoring and Contingency Program describes the monitoring well network, sampling frequency, and analytes. Some revisions to the monitoring plan were included in the EDR, per Ecology's approval. Additional revisions have been made with Ecology's approval, as highlighted below. The current groundwater monitoring schedule is summarized in Table 2. Monitoring well locations are shown on Figure 2 for Plant 1.

In 2005, four wells (MW-1-T9, MW-2-T9, MW-3-T9, and MW-4-T9) were installed along the southern property boundary of Plant 1 (Figure 2) to evaluate groundwater trends due to cleanup level exceedances in Monitoring Well AR-03. These wells were monitored quarterly from December 2005 through March 2018, which aided in evaluating the effectiveness of the Inland SVE system in meeting cleanup objectives. In 2018, a monitoring revision plan (TechSolve, 2018a) was submitted to and approved by Ecology (Ecology 2018) to eliminate monitoring of Well MW-4-T9 and reduce the monitoring frequency in Wells AR-03, GM-15S, MW-1-T9, MW-2-T9, and MW-3-T9 from quarterly to semi-annual. Contingency actions were detailed in the plan to resume quarterly monitoring of Wells AR-03, GM-15S, MW-1-T9, MW-2-T9, and MW-3-T9 for specified periods if cleanup levels are exceeded in these wells.

Well GM-14S was historically used to monitor for sheens on groundwater, as discussed below. As sheens are no longer detected in GM-14S, quarterly groundwater monitoring for indicator hazardous substances (IHSs) was initiated in this well in 2007.

Wells GM-16S and GM-17S are hydraulically upgradient from Plant 1. These wells were removed from most of the monitoring program with approval from Ecology in March 2000 (Ecology, 2000a) as sufficient upgradient data had been collected. Monitoring for hydrocarbons was voluntarily reinitiated in these wells in September 2007, as recommended by Ecology, to monitor for petroleum hydrocarbon migration onto the property from upgradient, off-site sources.

Revisions to the groundwater monitoring program were approved by Ecology in 2009 (Ecology, 2009), which reduced monitoring frequencies and required analyses. These revisions reduced the monitoring frequency from Wells GM-16S, and 17S from quarterly to semi-annual. The monitoring frequency from 16S, and 17S was reduced due to consistent monitoring data for total petroleum hydrocarbons (TPH) and benzene below cleanup levels. Additionally, the voluntary monitoring frequency of sampling for carcinogenic polynuclear aromatic hydrocarbons (cPAHs) was set to an annual basis in waterfront wells (AMW-01 through AMW-05) as extensive historical sampling does not indicate any significant detection trends. Ecology agreed that analysis for cPAHs from these wells is voluntary until cleanup objectives are met (Ecology, 2003). Sampling for cPAHs was last conducted in the fourth quarter of 2017 (TechSolve, 2018b)

Wells monitored on a semi-annual basis are sampled in the first and third quarter, which typically correspond with seasonal groundwater highs and lows, respectively. As such, Wells AR-03, GM-15S, GM-16S, GM-17S, MW-1-T9, MW-2-T9, and MW-3-T9 were sampled in the third quarter of 2018. These wells will next be sampled in the first quarter of 2019.

The Third Quarter 2018 Groundwater Monitoring event was conducted September 11th and 12th, 2018. Overall, the third quarter 2018 groundwater elevations (Table 3) were lower than the elevations measured in the first and second quarters of 2018. These data indicate that the seasonal groundwater high occurred in early 2018, which corresponds with historic trends showing groundwater elevations rise to seasonal highs in the winter and spring and decrease to seasonal lows in the summer and autumn.

Third Quarter 2018 Groundwater Monitoring Event samples were submitted to Test America Laboratories of Tacoma, Washington for laboratory analysis of IHSs identified in the CAP. The IHSs include TPH as gasoline (TPH-G), TPH as diesel (TPH-D), TPH as oil (TPH-O), and benzene.

Petroleum hydrocarbon monitoring results for the Third Quarter 2018 Groundwater Monitoring Event are included in Table 4 and Figures 2 and 3. The only detection of IHSs (benzene, TPH-G, TPH-D, or TPH-O) above cleanup levels from any of the samples analyzed in the second quarter of 2018 was for TPH-G, detected from Well GM-14S. All other IHS monitoring results were below associated cleanup levels in all other wells. The TPH-G concentration detected in well GM-14S was within historic ranges and consistent with historical trends. Data trend evaluations will be presented in the 2018 Annual Site Report, in accordance with Consent Decree requirements.

Three wells (GM-11S, GM-12S, and GM-13S) are examined monthly for the presence of free LNAPL and sheens. Laboratory analysis for IHSs will not be conducted on groundwater from these Wells until they are removed from the monthly LNAPL gauging program, as required by the Groundwater Compliance Monitoring and Contingency Program. Historically, gauging for free LNAPL at Plant 1 was conducted at four wells; however, gauging of Wells GM-14S was discontinued in 2004, with concurrence from Ecology (Ecology, 2004c), and converted to a monitoring well in 2007, as it has been free of LNAPL since 1999.

No sheens were detected in Well GM-12S in 2018. A slight sheen was detected in well GM-11S from April through August of 2018. A slight sheen was also detected in GM-13S in January, May and October 2018. The results of LNAPL monitoring for 2018 are within historic ranges and consistent with past trends. LNAPL and sheen monitoring results are presented in Table 5.

4. SUMMARY OF DATA VALIDATION

Laboratory analytical results were reported with associated laboratory quality assurance/quality control data (QA/QC). Analytical reports were reviewed and data were validated. During this quarter, limited data were qualified with a J or a UJ qualifier (the associated value is approximate or the analyte was not detected at an approximated quantitation limit, respectively). A summary of the data qualified during validation, qualifiers assigned, and reasons for data qualification are provided in Table 6. All laboratory reports are retained at the TechSolve office.

5. ADDITIONAL ACTIVITIES

Preliminary discussions were conducted with Ecology during the fourth quarter of 2018 related to proposed remedial work to be conducted at the Site and a memorandum was submitted to Ecology (TechSolve, 2018c) discussing these proposed remedial activities. The proposed activities include a voluntary probing investigation to evaluate if ongoing remedial actions along the Plant 1 waterfront are achieving cleanup objectives, and a regulatory driven (Ecology, 2015) evaluation of how a new seawall installed along the Plant 1 waterfront in 2018 has affected site hydrology. Discussions with Ecology related to the activities are currently ongoing.

6. SUMMARY

This progress report and groundwater monitoring report summarizes operation of remediation systems during the fourth quarter of 2018 (October through December 2018) and the Third Quarter 2018 Groundwater Monitoring Event. In accordance with the Consent Decree, the 2018 Annual Site Report will be the next report submitted to Ecology. This report will be submitted to Ecology by April 15, 2019.

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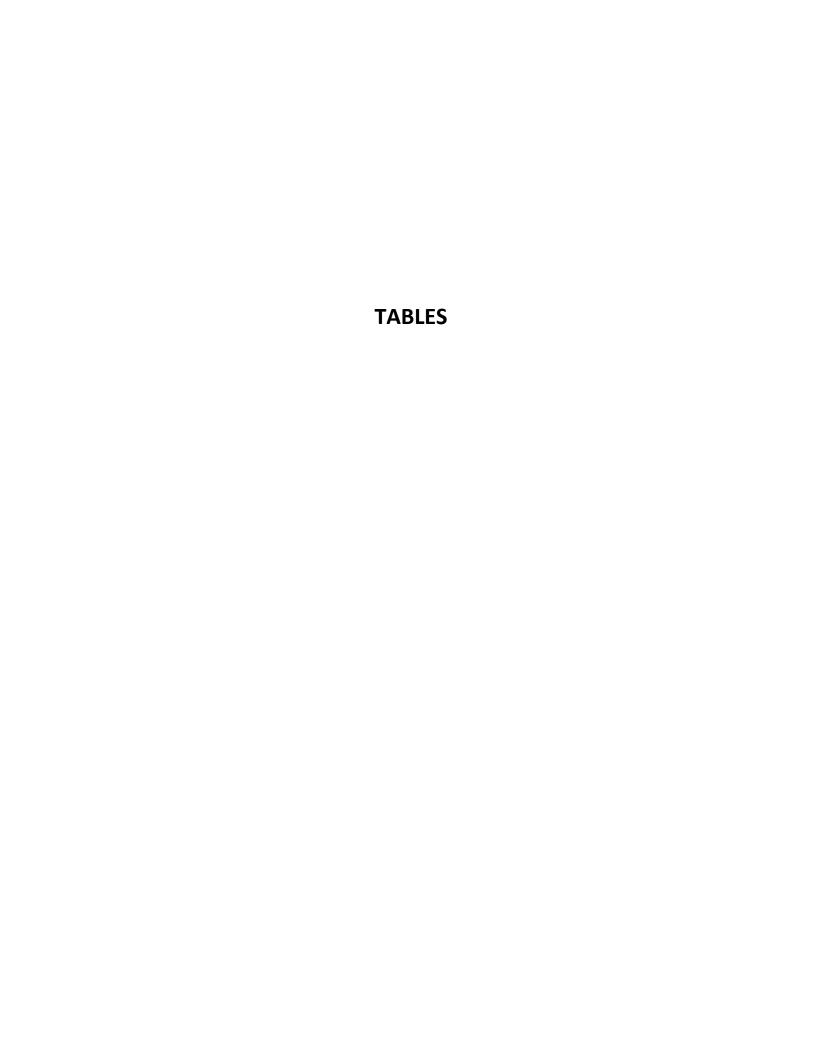


Table 1. Waterfront Groundwater System Petroleum Hydrocarbon Recovery Rates Site: Former BP Harbor Island Terminal

GROUNDWATER SYSTEM EFFICIENCIES

		Influent	Effluent	%	Influent	Effluent	%	Influent	Effluent	%	Influent	Effluent	%	Influent	Effluent	%	Influent	Effluent	%	Influent	Effluent	%
SAMPLE DATE	UNITS	Benzene	Benzene	Reduction	Diesel	Diesel	Reduction	Ethylbenzene	Ethylbenzene	Reduction	Gasoline	Gasoline	Reduction	Oil	Oil	Reduction	Toluene	Toluene	Reduction	Xylenes	Xylenes	Reduction
2002 Averages	μg/L	225.3	14.3	91%	7,315	7,020	4%	55.2	6.2	75%	1,770	336	82%	831	804	5%	17.0	2.5	88%	88.8	9.9	87%
2003 Averages	μg/L	137.7	19.5	76%	4,945	4,648	-1%	44.5	12.9	69%	1,854	678	62%	760	763	0%	42.7	5.4	61%	154.1	50.3	68%
2004 Averages	μg/L	93.5	3.2	82%	10,285	9,342	-6%	76.8	4.7	79%	4,383	840	59%	762	1,026	-8%	116.6	2.2	82%	356.6	23.0	75%
2005 Averages	μg/L	76.7	14.5	84%	4,162	5,987	-9%	170.8	45.4	81%	10,090	3,229	70%	864	750	15%	566.9	121.0	84%	1,327.7	367.9	78%
2006 Averages	μg/L	38.9	1.2	89%	11,263	2,174	42%	42.1	0.9	90%	4,944	202	94%	665	666	0%	55.6	8.0	77%	485.1	5.2	96%
2007 Averages	μg/L	8.8	1.5	60%	1,223	906	18%	6.6	0.8	56%	407	115	63%	598	598	0%	1.0	0.5	21%	19.8	1.9	50%
2008 Averages	μg/L	10.0	1.1	70%	540	468	6%	5.5	0.7	39%	279	76	61%	505	504	0%	0.7	0.5	40%	10.6	1.6	65%
2009 Averages	μg/L	5.2	1.0	48%	369	561	8%	4.1	1.6	31%	407	182	46%	497	489	2%	0.8	0.7	44%	15.2	7.4	33%
2010 Averages	μg/L	3.9	0.7	76%		2,193	NA	6.8	1.7	78%	915	336	65%		410	NA	0.9	0.9	NA	26.3	6.7	69%
2011 Averages	μg/L	3.2	0.5	80%		1,714	NA	2.4	1.0	53%	439	89	69%	1	492	NA	1.0	1.0	NA	7.1	3.0	29%
2012 Averages	μg/L	3.6	1.3	48%		2,787	NA	1.9	1.2	37%	362	144	61%		636	NA	1.0	1.0	NA	5.7	3.4	48%
2013 Averages	μg/L	1.0	0.5	45%		1,333	NA	1.1	0.5	49%	356	124	57%	1	433	NA	0.5	0.5	NA	2.4	1.0	78%
2014 Averages	μg/L	1.7	0.3	61%		1,699	NA	0.6	0.3	46%	539	122	79%		236	NA	0.5	0.3	NA	1.5	0.5	61%
2015 Averages	μg/L	2.3	0.4	66%		5,175	NA	1.6	0.4	60%	1,146	406	64%		396	NA	0.5	0.4	NA	2.8	0.5	74%
2016 Averages	μg/L	2.2	0.6	76%		2,292	NA	2.3	0.5	81%	1,282	582	50%	1	248	NA	0.4	0.4	NA	2.9	1.0	62%
2017 Averages	μg/L	1.9	0.4	74%		4,325	NA	1.0	0.4	63%	1,421	641	56%		349	NA	0.5	0.4	NA	1.0	0.7	55%
1/17/2018	μg/L	3	0.20	93%		4,200	NA	0.68	0.20	71%	1,400	390	72%		320	NA	0.20	0.20	NA	0.66	0.50	24%
2/14/2018	μg/L	1.9	0.20	89%		1,100	NA	0.20	0.20	NA	310	51	84%	1	260	NA	0.20	0.20	NA	0.50	0.50	NA
3/14/2018	μg/L	0.29	0.20	31%		820	NA	0.20	0.20	NA	830	130	84%		260	NA	0.20	0.20	NA	0.50	0.50	NA
4/18/2018	μg/L	3.0	3.0	NA		1,100	NA	3.0	3.0	NA	250	110	56%	1	370	NA	2.0	2.0	NA	3.0	3.0	NA
5/16/2018	μg/L	0.2	0.2	NA		760	NA	0.34	0.20	41%	210	68	68%		360	NA	0.20	0.20	NA	3.0	0.50	83%
6/13/2018	μg/L	0.20	0.20	NA		1,200	NA	0.20	0.20	NA	330	200	39%		380	NA	0.20	0.20	NA	0.77	0.50	35%
7/18/2018	μg/L	0.20	0.20	NA		840	NA	0.20	0.20	NA	180	58	68%		270	NA	0.20	0.20	NA	0.50	0.50	NA
8/15/2018	μg/L	0.20	0.20	NA		820	NA	0.20	0.20	NA	220	60	73%		260	NA	0.20	0.20	NA	0.50	0.50	NA
9/19/2018	μg/L	0.20	0.20	NA		3,700	NA	0.20	0.20	NA	50	50	NA	1	400	NA	0.20	0.20	NA	0.50	0.50	NA
10/17/2018	μg/L	3.0	3.0	NA		630	NA	3.0	3.0	NA	110	50	55%		390	NA	2.0	2.0	NA	3.0	3.0	NA
11/14/2018	μg/L	0.20	0.20	NA		1,200	NA	0.20	0.20	NA	120	100	17%	1	380	NA	0.20	0.20	NA	2.3	0.50	78%
12/19/2018	μg/L	0.42	0.20	52%		3,700	NA	0.20	0.20	NA	300	360	-20%		500	NA	0.20	0.20	NA	0.50	0.50	NA
SURFACE WATER CLEA	NUP LEVELS	71 µg/L			10,000 μg/L			NA			1,000 μg/L			10,000 μg/L			NA			NA		
KCDNR DISCH.	ARGE LIMITS		70 µg/L			100,000 μg/L			1,700 µg/L			NA			100,000 µg/L			1,400 µg/L			NA	
2017	Averages:	1.1 µa/L	.67 ua/L	67%	NA	1,673 µg/L	NA	.82 ua/L	.67 µg/L	56%	359 µa/L	136 µa/L	54%	NA	346 µg/L	NA	.5 μg/L	.5 ua/L	NA	1.3 µg/L	.92 µa/L	55%

METRO	DISCHARGE	DAT

	Days Operational since last	Average flow	Total Flow Between Observation dates	Pounds of Benzene	Pounds of Gasoline	Pounds of Diesel	Pounds of Oil	Pounds of Toluene	Pounds of Ethylbenzene	Pounds of Xylenes	Total Gallons Gas, Diesel,
Observation Date	monitoring reading	(GPM)	(gallons)	Removed	Removed	Removed	Removed	Removed	Removed	Recovered	and Oil
2002 Totals and Averages	65	4.18	322,785	0.62	4.99	19.42	2.30	0.05	0.13	0.22	3.90
2003 Totals and Averages	361	8.03	4,114,867	4.43	62.20	169.14	26.05	1.18	1.47	5.05	37.76
2004 Totals and Averages	338	9.58	4,570,461	3.54	175.70	419.25	28.95	5.35	3.16	14.66	92.43
2005 Totals and Averages	359	11.17	5,827,144	3.43	447.43	155.78	41.55	25.29	7.69	59.98	100.52
2006 Totals and Averages	365	6.40	3,220,733	0.80	192.72	663.65	19.09	2.85	1.89	20.04	128.92
2007 Totals and Averages	360	3.17	1,599,607	0.15	9.08	18.30	8.40	0.02	0.11	0.48	5.20
2008 Totals and Averages	363	3.19	1,645,810	0.14	3.95	7.21	6.95	0.01	0.08	0.15	2.59
2009 Totals and Averages	369	2.98	1,569,390	0.07	5.75	7.81	6.40	0.01	0.06	0.22	2.89
2010 Totals and Averages	372	2.17	1,185,127	0.04	8.62	18.84	4.26	0.01	0.05	0.19	4.66
2011 Totals and Averages	356	1.90	949,880	0.03	5.13	17.55	3.54	0.01	0.03	0.13	3.81
2012 Totals and Averages	371	1.89	948,600	0.03	3.97	25.92	3.47	0.01	0.02	0.04	4.81
2013 Totals and Averages	365	1.33	700,450	0.01	2.26	8.80	3.43	0.00	0.01	0.02	2.08
2014 Totals and Averages	332	1.62	761,480	0.01	3.43	10.95	1.55	0.00	0.00	0.01	2.33
2015 Totals and Averages	358	1.71	874,680	0.02	6.56	36.53	2.92	0.00	0.01	0.02	6.68
2016 Totals and Averages	370	1.90	999,770	0.02	13.12	20.02	1.94	0.00	0.03	0.03	5.26
2017 Totals and Averages	363	1.65	866,030	0.01	11.96	33.39	2.62	0.00	0.01	0.01	7.52
January-18	35	1.53	77,220	0.0018	1.92	6.03	0.3422	0.0002	0.0007	0.0006	1.67
February-18	28	1.74	70,090	0.0014	0.50	1.55	0.17	0.0001	0.0003	0.0003	0.33
March-18	28	1.14	45,940	0.0004	0.22	0.37	0.10	0.0001	0.0001	0.0002	0.10
April-18	35	1.04	52,530	0.0007	0.24	0.42	0.14	0.0005	0.0007	0.0008	0.12
May-18	28	1.19	48,160	0.0006	0.09	0.37	0.15	0.0004	0.0007	0.0012	0.09
June-18	28	1.10	44,520	0.0001	0.10	0.36	0.14	0.0001	0.0001	0.0007	0.09
July-18	35	1.08	54,460	0.0001	0.12	0.46	0.15	0.0001	0.0001	0.0003	0.10
August-18	28	1.12	45,090	0.0001	0.08	0.31	0.10	0.0001	0.0001	0.0002	0.07
September-18	35	1.00	50,640	0.0001	0.06	0.95	0.14	0.0001	0.0001	0.0002	0.16
October-18	28	1.07	43,210	0.0006	0.03	0.78	0.14	0.0004	0.0006	0.0006	0.14
November-18	28	1.04	42,110	0.0006	0.04	0.32	0.14	0.0004	0.0006	0.0009	0.07
December-18	35	1.34	67,770	0.0002	0.12	1.39	0.25	0.0001	0.0001	0.0008	0.25
2018 Totals and Averages	371	1.20	641,740	0.007	3.51	13.33	1.95	0.003	0.004	0.007	3.18
		TOTALS:	30,798,554 gal	13.35	960.4	1645.9	165.4	34.80	14.75	101.26	
	Maximum permitted GPM:	17.5	Gallons Gas, Dies	sel, & Oil Recovered:	156.2	235.8	21.7	TO	TAL GALLONS R	ECOVERED:	414.52

Oil Water Separator Data	
Observation Date	Monthly LNAPL Recovery (gal)
February-03	19.6
April-03	6.9
May-03	2.5
July-03	2
December-03	20
January-04	25
June-04	35
August-04	50
September-04	8
November-04	10
December-04	3.5
January-05	0
February-05	35
July-05	110
February-06	5
March-06	2
December-06	30
March-08	30
Total Gallons LNAPL	Recovered 395

TOTAL PETROLEUM RECOVERY

Total lbs. Dissolved Gas, Diesel, and Oil Recovered in Groundwater (2002-Present) 2.772 lbs Total Gallons Dissolved Gas, Diesel, and Oil Recovered in Groundwater (2002-Present)* 415 gal Total Gallons LNAPL Recovered by Final Recovery System (2002-Present) 395 gal Total Gallons LNAPL Recovered by Interim Recovery System (1992-2002)
Total Gallons of TPH Vapor Recovered by Final SVE System (2003-2008)**
Total Gallons of TPH Vapor Recovered by Interim SVE System (1996-2002)** 9,312 gal 2,334 gal 1,248 gal Total Gallons TPH Recovered from Final SVE System due to Biodegradation (2003-2008)*** 11,411 gal 4,664 gal 14,555 gal Total Gallons TPH Recovered from Interim SVE System due to Biodegradation (1996-2002)*** Total Gallons Recovered by Final Recovery Systems (2002-Present)
Total Gallons Recovered by Interim Recovery Systems (1992-2002)
Total Gallons of Petroleum Removed (1992-Present) 15,223 gal

Definitions:

gal - gallons GPM - Gallons per minute

NA - Not available

LNAPL - Light non-aqueous phase liquid (oil) SVE - Soil vapor extraction

TPH - Total petroleum hydrocarbons

μg/L - micrograms per liter

29,778 gal

Notes:

LNAPL Recovery is recorded periodically when sufficient product has been accumulated to be transported off-site for disposal.

Influent diesel and oil samples are no longer analyzed, as influent and effluent samples are collected before and after, respectively, a diffused air stripper, which is not intended or effective at removing diesel or oil.

Effluent sample data are representative of the outflow water to King County Metro sanitary sewer.

The average µg/L of the preceding month and the month of reference are used to calculate pounds of compound removed.

Data presented in italicized text represent non-detections. The italicized result is reported at the laboratory reporting limit

If influent concentrations are below the laboratories reporting limit, the percent reduction is calculated using the reporting limit. The actual percent reduction is ≥ the reported value.

* Calculation of lbs. of Recovered Product:

To convert μ g/L to lbs./gallon - (μ g/L)x(3.785l/gal)= μ g/gal, (μ g/gal)x(μ g/(2.2046x10-9lbs))=lbs./gal lbs./gal of chemical constituent x total gallons recovered =lbs. of chemical recovered

Density of Gasoline utilized for conversions from pounds to gallons is 6.15 lbs./gal

Density of Diesel utilized for conversions from pounds to gallons 6.98 lbs./gal

Density of Oil utilized for conversions from pounds to gallons 7.63 lbs./gal

Benzene, toluene, ethylbenzene, and xylenes volumes are not included in the Total Gallons calculations, as they are assumed to be included in TPH as gasoline.

** /*** SVE Recovery Calculations for TPH and Biodegradation, which are maintained in separate tables.

- C = Average Influent TPH concentration (ppmv)
- Q = Influent Flow Rate (SCFM)

 Mc = Molecular wt. of Carbon Dioxide = 44

Density of Gasoline for conversions is 6.15 lbs./gal

** TPH recovered by SVE system was calculated in lbs./hr. = C x Q x Mg x 1.583 x 10⁻⁷

- 1.583 x 10⁻⁷ is a constant and is derived as follows: 10⁻⁶ ppmv x 60min/1hr x 1 lb. Mole/379 cu.ft.

SVE TPH recovery calculations are based on TPH concentrations in the SVE stream, SVE hrs. of operation, and SVE measured flow rates.

Table 2. Groundwater Performance Monitoring Schedule Site: Former BP Harbor Island Terminal

Analyses Conducted by Quarter

Well	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Plant 1	1 1101 Qualito.	2000114 Qualitat		, suiti Qualto
	Benzene, TPH-G,		Benzene, TPH-G,	
MW-1-T9	TPH-D, TPH-O	(1)	TPH-D, TPH-O	(1)
	Benzene, TPH-G,		Benzene, TPH-G,	. ,
MW-2-T9	TPH-D, TPH-O	(1)	TPH-D, TPH-O	(1)
	Benzene, TPH-G,		Benzene, TPH-G,	
MW-3-T9	TPH-D, TPH-O	(1)	TPH-D, TPH-O	(1)
	Benzene, TPH-G,	Benzene, TPH-G,	Benzene, TPH-G,	Benzene, TPH-G,
GM-14S	TPH-D, TPH-O	TPH-D, TPH-O	TPH-D, TPH-O	TPH-D, TPH-O
	Benzene, TPH-G,		Benzene, TPH-G,	
GM-15S	TPH-D, TPH-O	(1)	TPH-D, TPH-O	(1)
	Benzene, TPH-G,		Benzene, TPH-G,	
GM-16S	TPH-D, TPH-O		TPH-D, TPH-O	
	Benzene, TPH-G,		Benzene, TPH-G,	
GM-17S	TPH-D, TPH-O		TPH-D, TPH-O	
	Benzene, TPH-G,	Benzene, TPH-G,	Benzene, TPH-G,	Benzene, TPH-G,
GM-24S	TPH-D, TPH-O	TPH-D, TPH-O	TPH-D, TPH-O	TPH-D, TPH-O
	Benzene, TPH-G,		Benzene, TPH-G,	
AR-03	TPH-D, TPH-O	(1)	TPH-D, TPH-O	(1)
				Benzene, TPH-G,
	Benzene, TPH-G,	Benzene, TPH-G,	Benzene, TPH-G,	TPH-D, TPH-O,
AMW-01	TPH-D, TPH-O	TPH-D, TPH-O	TPH-D, TPH-O	cPAHs
				Benzene, TPH-G,
	Benzene, TPH-G,	Benzene, TPH-G,	Benzene, TPH-G,	TPH-D, TPH-O,
AMW-02	TPH-D, TPH-O	TPH-D, TPH-O	TPH-D, TPH-O	cPAHs
				Benzene, TPH-G,
	Benzene, TPH-G,	Benzene, TPH-G,	Benzene, TPH-G,	TPH-D, TPH-O,
AMW-03	TPH-D, TPH-O	TPH-D, TPH-O	TPH-D, TPH-O	cPAHs
	D TD: 0	D TOU	D TOU	Benzene, TPH-G,
4 4 4 4 4 6 4	Benzene, TPH-G,	Benzene, TPH-G,	Benzene, TPH-G,	TPH-D, TPH-O,
AMW-04	TPH-D, TPH-O	TPH-D, TPH-O	TPH-D, TPH-O	cPAHs
	D TDU C	D TDU O	Danier TDU O	Benzene, TPH-G,
A B 4) A / O =	Benzene, TPH-G,	Benzene, TPH-G,	Benzene, TPH-G,	TPH-D, TPH-O,
AMW-05	TPH-D, TPH-O	TPH-D, TPH-O	TPH-D, TPH-O	cPAHs
Plant 2				

All Plant 2 monitoring has been discontinued.

Notes: Field Duplicate and QA/QC samples collected from wells highlighted in bold.

TPH-G - Gasoline Range organics utilizing NWTPH-Gx method

TPH-D - Diesel Range Organics utilizing NWTPH-Dx

TPH-O - Extended Range Organics (Motor Oil) utilizing NWTPH-Dx

Benzene is analyzed for utilizing EPA 8021 or 8260B.

cPAHs - Carcinogenic Polycyclic Aromatic Hydrocarbons utilizing EPA 8270SIM Field Parameters (pH, Temperature, Conductivity, Turbidity, Water Level, & Product Level) are recorded from all wells sampled

(1) - If a groundwater cleanup level exceedance occurs in first or third quarter in any of these highlighted wells, all (1) wells will be sampled the following quarter. Wells exceeding cleanup levels will continue quarterly monitoring until four consecutive quarters below cleanup level are achieved.

Table 3. Groundwater Performance Monitoring Groundwater Elevations
Third Quarter 2018

Site: Former BP Harbor Island Terminal

Well	Date	TOC Elevation (ft msl)	Depth to Water (ft below TOC)	Groundwater Elevation (ft msl)
Plant 1				
GM-14S	9/12/2018	8.57	5.34	3.23
GM-15S	9/11/2018	8.92	6.04	2.88
GM-16S	9/12/2018	8.53	5.83	2.70
GM-17S	9/12/2018	9.19	6.03	3.16
GM-24S	9/12/2018	7.62	4.64	2.98
AR-03	9/11/2018	9.35	6.80	2.55
AMW-01	9/11/2018	8.88	6.42	2.46
AMW-02	9/11/2018	12.14	8.45	3.69
AMW-03	9/11/2018	12.07	8.03	4.04
AMW-04	9/11/2018	8.00	8.72	-0.72
AMW-05	9/11/2018	8.14	7.56	0.58
MW-1-T9	9/12/2018	9.07	6.59	2.48
MW-2-T9	9/12/2018	9.23	6.49	2.74
MW-3-T9	9/12/2018	8.73	5.92	2.81

ft Feet

msl Mean sea level

NA Not available. Well elevations have not been surveyed.

NM Not measured. Well was not gauged or sampled due to inaccessibility caused

by the Island redevelopment activities.

TOC Top of casing

Elevations measurements are calculated using NGVD29 Datum.

Table 4. Summary of Analytical Results for Groundwater - TPH-G, TPH-D, TPH-O, and Benzene

Third Quarter 2018

Site: Former BP Harbor Island Terminal

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (µg/L)	Benzene (μg/L)
Plant 1 GM-14S	9/12/2018	2,200 J	1,200	ND	ND
GM-15S	9/11/2018	310	460	ND	ND
GM-16S	9/12/2018	260	700	ND	ND
GM-17S	9/12/2018	63	ND	ND	ND
GM-24S	9/12/2018	530 J	990 J	ND UJ	ND
AR-03	9/11/2018	690 J	690	ND	ND
AMW-01	9/11/2018	ND	ND	ND UJ	ND
AMW-02	9/11/2018	ND	300	ND	1.2
AMW-03	9/11/2018	ND	ND	ND	ND
AMW-04	9/11/2018	ND	ND	ND	ND
AMW-05	9/11/2018	ND	ND	ND	ND
MW-1-T9	9/12/2018	320	1,000	ND	ND
MW-2-T9	9/12/2018	660	1,000	ND	ND
MW-3-T9	9/12/2018	960	690	ND	ND
Cleanup Level		1,000	10,000	10,000	71
Method Reporti	ng Limit	50	250	750	0.5

Note: Values in **bold** exceed the cleanup level.

μg/L Micrograms per liter.

ND Constituent not detected above reporting limit.

NR Not required. Well was not tested for these analyses, as per Ecology approval.

redevelopment activities.

TPH Total petroleum hydrocarbons.

TPH-D Total petroleum hydrocarbons as diesel.

TPH-G Total petroleum hydrocarbons as gasoline.

TPH-O Total petroleum hydrocarbons as oil.

WTPH-DX Washington State Method for Analysis of Diesel in Soil and Water - Extended.

WTPH-G Washington State Method for Analysis of Gasoline in Soil and Water.

J Estimated value.

UJ Not detected at an estimated value.

R Rejected value.

Table 5. Summary of Free Product Measurement Results for Groundwater 2018 Monitoring Data

Site: Former BP Harbor Island Terminal

Well	Date	Free Product (feet)
Plant 1		
GM-11S	1/17/2018	None
GM-11S	2/14/2018	None
GM-11S	3/14/2018	None
GM-11S	4/18/2018	Sheen
GM-11S	5/16/2018	Sheen
GM-11S	6/13/2018	Sheen
GM-11S	7/18/2018	Sheen
GM-11S	8/15/2018	Sheen
GM-11S	9/19/2018	None
GM-11S	10/17/2018	None
GM-11S	11/14/2018	None
GM-11S	12/19/2018	None
GM-12S	1/17/2018	None
GM-12S	2/14/2018	None
GM-12S	3/14/2018	None
GM-12S	4/18/2018	None
GM-12S	5/16/2018	None
GM-12S	6/13/2018	None
GM-12S	7/18/2018	None
GM-12S	8/15/2018	None
GM-12S	9/19/2018	None
GM-12S	10/17/2018	None
GM-12S	11/14/2018	None
GM-12S	12/19/2018	None
GM-13S	1/17/2018	Sheen
GM-13S	2/14/2018	None
GM-13S	3/14/2018	None
GM-13S	4/18/2018	None
GM-13S	5/16/2018	Sheen
GM-13S	6/13/2018	None
GM-13S	7/18/2018	None
GM-13S	8/15/2018	None
GM-13S	9/19/2018	None
GM-13S	10/17/2018	Sheen
GM-13S	11/14/2018	None
GM-13S	12/19/2018	None
Cleanup Level		No Sheen

Notes: Values in **bold** exceed the cleanup level.

Table 6. Summary of Data Validation Results
Groundwater Performance Monitoring

Third Quarter 2018

Site: Former BP Harbor Island Terminal

Sample ID	Constituent	Qualifier	Reason
P1-GWGM-14S-318 & P1-GWAR-03-318	Gasoline	J	Gasoline was detected in an associated rinsate sample. Associated samples with positive results are qualified as estimated values (J).
P1-GWGM-24S-318 & P1-GWGM-224S-318	Gasoline	J	Relative percent difference (RPD) for this field duplicate pair exceeded the control limit of 20%. These results are, therefore, qualified as estimated values (J).
P1-GWGM-14S-318	Gasoline	J	The recovery of one surrogate in this sample exceeded the control limit. This result is, therefore, qualified as an estimated value.
P1-GWGM-24S-318	Gasoline	J	Recovery in a matrix spike duplicate prepared from the sample was below the control limit and the relative percent difference of the matrix spike/matrix spike duplicateprepared from the sample was above the control limit. This sample result is, therefore, qualified as an estimated value (J)
P1-GWGM-24S-318 & P1-GWGM-224S-318, P1-GWAMW-01-318 & P1-GWAMW-201-318	Diesel & Oil	J & UJ	Relative percent difference (RPD) for these two field duplicate pairs exceeded the control limit of 20%. These results are, therefore, qualified as estimated values (J) and non-detect results are qualified as undetected at an approximate quantitation limit (UJ).

Definitions:

J The associated value is approximate.

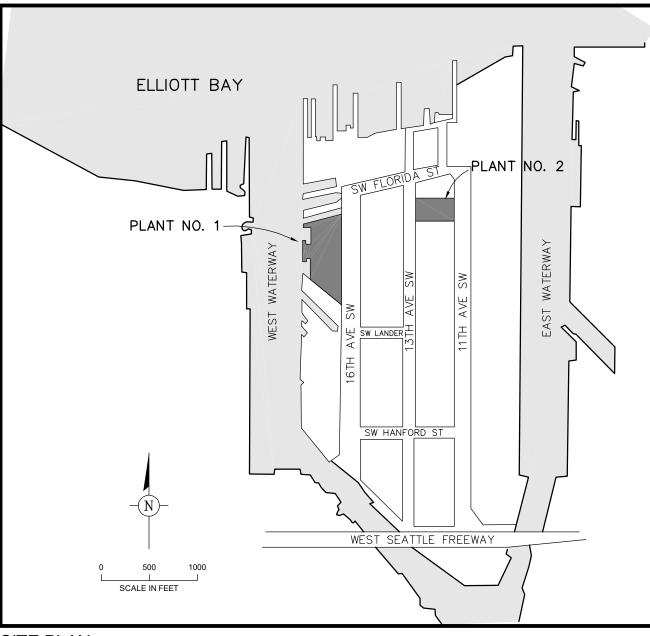
UJ The non-detected results are undetected at an approximate quantitation limit.

RPD Relative Percent Difference

FIGURES



AREA PLAN



SITE PLAN



Site Location Map

Site: Former BP Harbor Island Terminal 1652 Southwest Lander Street Seattle, WA 98134

