THIRD QUARTER 2019 PROGRESS REPORT / SECOND QUARTER 2019 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

OCTOBER 2019

Prepared for
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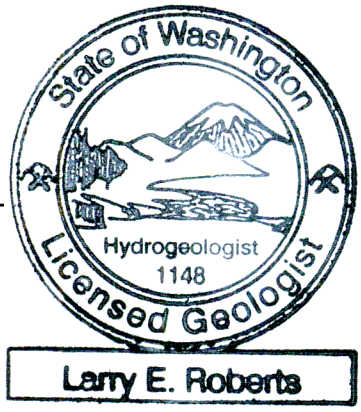

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1. INTRODUCTION

TLP Management Services LLC is submitting this report prepared by TechSolve Environmental, Inc. (TechSolve) to summarize the Second Quarter 2019 Groundwater Monitoring event and operation and maintenance of the waterfront remediation system during the third quarter (July through September) of 2019 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 2019, 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 per 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 September 2019) (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 29,779 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 and 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 used by the groundwater/LNAPL recovery system. Lack of free LNAPL in wells and limited free LNAPL recovery by the groundwater/LNAPL recovery system indicate that the recovery system has captured most available free LNAPL. Evaluations are being conducted to determine if free LNAPL is still present and recoverable along the waterfront, or if LNAPL has been recovered to the extent practicable, as further discussed in Section 5, below.

Effluent discharges from the groundwater/LNAPL recovery system to sanitary have been within KCDNR's permitted ranges (Table 1) in 2019. Average monthly effluent flow rates ranged from 1.66 to 1.01 gallons per minute (gpm) in 2019, below KCDNR's maximum permitted flow of 17.5 gpm, consistent with past rates that have decreased over time.

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 2019 include:

- Annual calibration of the discharge flowmeter, as required by the KCDNR discharge permit.

- 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 in this area of the Site, as discussed in the following section.

3. SUMMARY OF GROUNDWATER PERFORMANCE MONITORING PROGRAM

The Second Quarter 2019 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 approved by Ecology in 2009 (Ecology, 2009), 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 2018.

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 not sampled in the second quarter of 2019. These wells will next be sampled in the third quarter of 2019.

The Second Quarter 2019 Groundwater Monitoring event was conducted June 18th and 19th, 2019. Overall, second quarter 2019 groundwater elevations (Table 3) were lower compared to elevations measured in the first quarter of 2019 and the fourth quarter of 2018. These data indicate that the seasonal groundwater high occurred in late 2018 to early 2019, 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.

Second Quarter 2019 Groundwater Monitoring Event samples were submitted to ALS Laboratories of Everett, Washington (Ecology Accreditation # C601) 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 Second Quarter 2019 Groundwater Monitoring Event are included in Table 4 and Figure 2. The only detection of an IHS (benzene, TPH-G, TPH-D, or TPH-O) above a cleanup level was gasoline (TPH-G) in well GM-14S. Concentrations of IHSs from all other samples analyzed in the second quarter of 2019 were below associated cleanup levels. Data trend evaluations will be presented in the 2019 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 Wells GM-11S, GM-12S, and GM-13S in the first nine months of 2019. The results of LNAPL monitoring for 2019 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 qualifier (the associated value is approximate). 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

Work plans were submitted to Ecology in 2019 for a probing investigation and a hydraulic evaluation to be conducted at the Site (TechSolve, 2019a and TechSolve, 2019b). The voluntary probing investigation will be used to evaluate if ongoing remedial actions along the Plant 1 waterfront are achieving cleanup objectives. The hydraulic evaluation work plan proposed conducting a background water level assessment as the first step in satisfying a regulatory driven (Ecology, 2015) evaluation of how a new seawall, installed along the Plant 1 waterfront in 2018, has affected site hydrology. Negotiations are ongoing with Ecology relating to the scope of the hydraulic evaluation.

Ecology approved the voluntary probing investigation work plan with a few minor modifications in May 2019 (Ecology, 2019). Soil probing was conducted July 22nd through July 31st, 2019. A total of 41 direct push soil borings were completed by licensed driller during the investigation and 11 of the borings were completed as temporary piezometer wells. Soils from all borings were logged, field screened for petroleum contamination, and sampled for IHSs as proposed in the associated work plan. The temporary piezometer wells were then developed, and groundwater was sampled from the wells on September 26th and 27th for concentrations of IHSs and to evaluate the wells for the presence of LNAPL. The locations of soil borings and piezometer wells are shown on Figure 3. The results of the probing investigation are pending and will be documented to Ecology in a standalone report that is in preparation.

6. SUMMARY

This report summarizes operation of remediation systems during the third quarter of 2019 (July through October 2019) and the Second Quarter 2019 Groundwater Monitoring Event. In accordance with the Consent Decree, the Fourth Quarter 2019 Progress Report/Third Quarter 2019 Groundwater Monitoring Report will be the next report submitted to Ecology. This report will be submitted to Ecology by January 15, 2019.

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TABLES

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

GROUNDWATER SYSTEM EFFICIENCIES

SAMPLE DATE	UNITS	Influent Benzene	Effluent Benzene	% Reduction	Influent Diesel	Effluent Diesel	% Reduction	Influent Ethylbenzene	Effluent Ethylbenzene	% Reduction	Influent Gasoline	Effluent Gasoline	% Reduction	Influent Oil	Effluent Oil	% Reduction	Influent Toluene	Effluent Toluene	% Reduction	Influent Xylenes	Effluent 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	0.8	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%*		*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%*		*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%*		*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%
2018 Averages	µg/L	1.1	0.7	60%		1,673	*NA*	0.7	0.7	7%	359	136	*62%*		*346*	*NA*	*0.5*	*0.5*	*NA*	1.3	0.9	30%
1/16/2019	µg/L	0.25	*0.20*	25%		950	NA	0.20	*0.20*	NA	340	78	77%		370	*NA*	*0.20*	*0.20*	*NA*	0.50	*0.50*	NA
2/13/2019	µg/L	0.78	*0.20*	74%		2,400	NA	0.20	*0.20*	*NA*	750	190	75%		*390*	*NA*	*0.20*	*0.20*	*NA*	0.50	*0.50*	*NA*
3/20/2019	µg/L	0.5	*0.50*	NA		900	NA	0.50	*0.50*	*NA*	330	77	77%		*360*	*NA*	*0.50*	*0.50*	*NA*	*0.50*	*0.50*	*NA*
4/24/2019	µg/L	*0.2*	*0.2*	*NA*		420	NA	*0.50*	*0.5*	*NA*	410	76	81%		*370*	*NA*	*0.2*	*0.2*	*NA*	*0.5*	*0.5*	*NA*
5/15/2019	µg/L	*0.2*	*0.2*	*NA*		500	NA	0.20	*0.20*	NA	230	50	78%		*270*	*NA*	*0.20*	*0.20*	*NA*	0.5	*0.50*	NA
6/11/2019	µg/L	*0.50*	*0.50*	*NA*		1,400	NA	*1.00*	*1.00*	*NA*	170	*50*	71%		*750*	*NA*	*1.00*	*1.00*	*NA*	3.00	*3.00*	NA
7/10/2019	µg/L	*0.50*	*0.50*	*NA*		5,100	NA	*1.00*	*1.00*	*NA*	140	*50*	64%		*750*	*NA*	*1.00*	*1.00*	*NA*	*3.00*	*3.00*	*NA*
8/14/2019	µg/L	*0.50*	*0.50*	*NA*		810	NA	*1.00*	*1.00*	*NA*	100	*50*	*50%*		*750*	*NA*	*1.00*	*1.00*	*NA*	*3.00*	*3.00*	*NA*
9/11/2019	µg/L	*0.50*	*0.50*	*NA*		1,200	*NA*	*1.00*	*1.00*	*NA*	140	*50*	*64%*		*750*		*1.00*	*1.00*	*NA*	*3.00*	*3.00*	*NA*
SURFACE WATER CLEANUP LEVELS		71 µg/L			10,000 µg/L			NA			1,000 µg/L			10,000 µg/L			NA			NA		
KCDNR DISCHARGE LIMITS			70 µg/L			100,000 µg/L			1,700 µg/L			NA			100,000 µg/L			1,400 µg/L			NA	
2019 Averages:		.4 µg/L	.37 µg/L	#DIV/0!	NA	1,520 µg/L	NA	.62 µg/L	.62 µg/L	#DIV/0!	290 µg/L	75 µg/L	#DIV/0!	NA	529 µg/L	NA	.59 µg/L	.59 µg/L	NA	1.6 µg/L	1.61 µg/L	#DIV/0!

METRO DISCHARGE DATA

Observation Date	Days Operational since last monitoring reading	Average flow (GPM)	Total Flow Between Observation dates (gallons)	Pounds of Benzene Removed	Pounds of Gasoline Removed	Pounds of Diesel Removed	Pounds of Oil Removed	Pounds of Toluene Removed	Pounds of Ethylbenzene Removed	Pounds of Xylenes Recovered	Total Gallons Gas, Diesel, 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	0.037	8.62	18.84	4.26	0.01	0.05	0.19	**4.66**
2011 Totals and Averages	356	1.90	949,880	0.026	5.13	17.55	3.54	0.01	0.03	0.13	**3.81**
2012 Totals and Averages	371	1.89	948,600	0.034	3.97	25.92	3.47	0.01	0.02	0.04	**4.81**
2013 Totals and Averages	365	1.33	700,450	0.014	2.26	8.80	3.43	0.003	0.01	0.02	**2.08**
2014 Totals and Averages	332	1.62	761,480	0.010	3.43	10.95	1.55	0.003	0.00	0.01	**2.33**
2015 Totals and Averages	358	1.71	874,680	0.015	6.56	36.53	2.92	0.004	0.01	0.02	**6.68**
2016 Totals and Averages	370	1.90	999,770	0.021	13.12	20.02	1.94	0.004	0.03	0.03	**5.26**
2017 Totals and Averages	364	1.65	866,030	0.014	11.96	33.39	2.62	0.004	0.01	0.01	**7.52**
2018 Totals and Averages	371	1.20	641,740	0.006	2.16	9.61	1.79	0.002	0.004	0.007	**1.96**
January-19	28	1.55	62,470	0.0002	0.17	1.21	0.2268	0.0001	0.0001	0.0003	**0.23**
February-19	28	1.66	66,790	0.0003	0.30	0.93	0.21	0.0001	0.0001	0.0003	**0.21**
March-19	35	1.01	50,760	0.0003	0.23	0.70	0.16	0.0001	0.0001	0.0002	**0.16**
April-19	35	1.26	63,300	0.0002	0.20	0.35	0.19	0.0002	0.0003	0.0003	**0.11**
May-19	21	1.02	30,950	0.0001	0.08	0.12	0.08	0.0001	0.0001	0.0001	**0.04**
June-19	27	1.15	44,770	0.0001	0.07	0.35	0.19	0.0002	0.0002	0.0007	**0.09**
July-19	29	1.09	45,620	0.0002	0.06	1.24	0.29	0.0004	0.0004	0.0011	**0.22**
August-19	35	1.03	51,770	0.0002	0.05	1.28	0.32	0.0004	0.0004	0.0013	**0.23**
September-19	28	1.13	45,540	0.0002	0.05	0.38	0.29	0.0004	0.0004	0.0011	**0.10**
2019 Totals and Averages	266	1.26	461,970	0.00	1.21	6.56	1.96	0.00	0.00	0.01	**1.39**
		TOTALS:	**31,260,524 gal**	**13.4**	**960.2**	**1648.7**	**167.2**	**34.8**	**14.8**	**101.3**	
Maximum permitted GPM:		**17.5**	**Gallons Gas, Diesel, & Oil Recovered:**	**156.1**	**236.2**		**21.9**		**TOTAL GALLONS RECOVERED:**		**414.69**

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)	2,776 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)	**9,312 gal**
Total Gallons of TPH Vapor Recovered by Final SVE System (2003-2008)**	**2,334 gal**
Total Gallons of TPH Vapor Recovered by Interim SVE System (1996-2002)**	**1,248 gal**
Total Gallons TPH Recovered from Final SVE System due to Biodegradation (2003-2008)***	**11,411 gal**
Total Gallons TPH Recovered from Interim SVE System due to Biodegradation (1996-2002)***	**4,664 gal**
Total Gallons Recovered by Final Recovery Systems (2002-Present)	**14,555 gal**
Total Gallons Recovered by Interim Recovery Systems (1992-2002)	**15,223 gal**
Total Gallons of Petroleum Removed (1992-Present)	**29,779 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

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 µg/L to lbs./gallon - (µg/L)x(3.785l/gal)=ug/gal, (ug/gal)x(ug/(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
Mg = Molecular wt. of Gasoline = 87
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				
MW-1-T9	Benzene, TPH-G, TPH-D, TPH-O	(1)	Benzene, TPH-G, TPH-D, TPH-O	(1)
MW-2-T9	Benzene, TPH-G, TPH-D, TPH-O	(1)	Benzene, TPH-G, TPH-D, TPH-O	(1)
MW-3-T9	Benzene, TPH-G, TPH-D, TPH-O	(1)	Benzene, TPH-G, TPH-D, TPH-O	(1)
GM-14S	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O
GM-15S	Benzene, TPH-G, TPH-D, TPH-O	(1)	Benzene, TPH-G, TPH-D, TPH-O	(1)
GM-16S	Benzene, TPH-G, TPH-D, TPH-O		Benzene, TPH-G, TPH-D, TPH-O	
GM-17S	Benzene, TPH-G, TPH-D, TPH-O		Benzene, TPH-G, TPH-D, TPH-O	
GM-24S	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O
AR-03	Benzene, TPH-G, TPH-D, TPH-O	(1)	Benzene, TPH-G, TPH-D, TPH-O	(1)
AMW-01	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O, cPAHs
AMW-02	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O, cPAHs
AMW-03	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O, cPAHs
AMW-04	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O, cPAHs
AMW-05	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, TPH-D, TPH-O	Benzene, TPH-G, 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
Second Quarter 2019
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	6/19/2019	8.57	4.91	3.66
GM-16S	6/19/2019	8.53	5.33	3.20
GM-17S	6/19/2019	9.19	5.40	3.79
GM-24S	6/19/2019	7.62	4.10	3.52
AMW-01	6/18/2019	8.88	8.00	0.88
AMW-02	6/18/2019	12.14	9.76	2.38
AMW-03	6/18/2019	12.07	9.01	3.06
AMW-04	6/18/2019	8.00	9.86	-1.86
AMW-05	6/18/2019	8.14	7.29	0.85
MW-06	6/18/2019	8.03	5.11	2.92

Definitions and Notes:

ft	Feet
msl	Mean sea level
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
Second Quarter 2019
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	6/19/2019	**2,500**	1,400	ND	ND
GM-24S	6/19/2019	580	470	ND	ND
AMW-01	6/18/2019	ND	270	ND	ND
AMW-02	6/18/2019	ND	630	ND	2.4
AMW-03	6/18/2019	ND	ND	ND	ND
AMW-04	6/18/2019	ND	ND	ND	ND
AMW-05	6/18/2019	ND	ND	ND	ND
Cleanup Level		1,000	10,000	10,000	71
Method Reporting 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
2019 Monitoring Data
Site: Former BP Harbor Island Terminal

Well	Date	Free Product (feet)
Plant 1		
GM-11S	1/16/2019	None
GM-11S	2/15/2019	None
GM-11S	3/20/2019	None
GM-11S	4/24/2019	None
GM-11S	5/14/2019	None
GM-11S	6/10/2019	None
GM-11S	7/10/2019	None
GM-11S	8/13/2019	None
GM-11S	9/10/2019	None
GM-12S	1/16/2019	None
GM-12S	2/15/2019	None
GM-12S	3/20/2019	None
GM-12S	4/24/2019	None
GM-12S	5/14/2019	None
GM-12S	6/10/2019	None
GM-12S	7/10/2019	None
GM-12S	8/13/2019	None
GM-12S	9/10/2019	None
GM-13S	1/16/2019	None
GM-13S	2/15/2019	None
GM-13S	3/20/2019	None
GM-13S	4/24/2019	None
GM-13S	5/14/2019	None
GM-13S	6/10/2019	None
GM-13S	7/10/2019	None
GM-13S	8/13/2019	None
GM-13S	9/10/2019	None
Cleanup Level		No Sheen

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

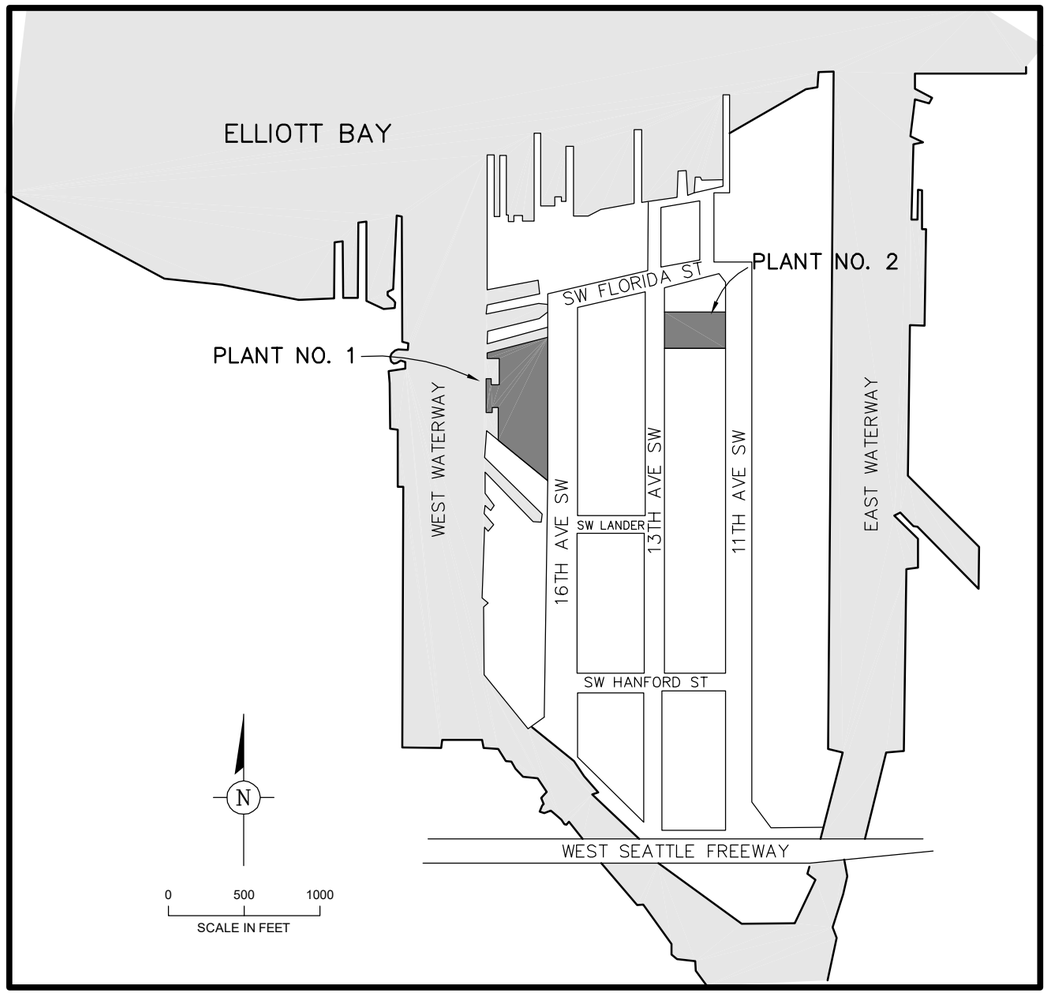
Table 6. Summary of Data Validation Results
Groundwater Performance Monitoring
Second Quarter 2019
Site: Former BP Harbor Island Terminal

Sample ID	Constituent	Qualifier	Reason
P1-GWGM-24S-119 P1-GWGM-224S-119	Gasoline and Diesel	J	The relative percent differences (RPD) for the field duplicate pair P1-GWMW-24S-219 / P1-GWMW-224S-219 are greater than 20% for gasoline and diesel. These sample results are, therefore, qualified as estimated values (J).

Definitions:
J The associated value is approximate.
RPD Relative Percent Difference

FIGURES

AREA PLAN



SITE PLAN

TECHSOLVE ENVIRONMENTAL
7518 NE 169th Street, Kenmore WA 98028
(425) 402-8277 FAX (425) 402-7917

Site Location Map

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

FIGURE
1

P1-GWGM-14S-219	
Date	6/19/2019
GW Elev.	3.66
Benzene	<0.5
TPH-G	2,500
TPH-D	1,400
TPH-O	<750

Date	6/19/2019
GW Elev.	3.79

P1-GWGM-24S-219	
Date	6/19/2019
GW Elev.	3.52
Benzene	<0.5
TPH-G	580
TPH-D	470
TPH-O	<750

Date	6/19/2019
GW Elev.	3.20

Date	6/18/2019
GW Elev.	2.92'

P1-GWAMW-05-219	
Date	6/18/2019
GW Elev.	3.10
Benzene	<0.5
TPH-G	<50
TPH-D	<250
TPH-O	<750

P1-GWAMW-04-219	
Date	6/18/2019
GW Elev.	1.02
Benzene	<0.5
TPH-G	<50
TPH-D	300
TPH-O	<750

P1-GWAMW-03-219	
Date	6/18/2019
GW Elev.	2.16
Benzene	<0.5
TPH-G	<50
TPH-D	<250
TPH-O	<750

P1-GWAMW-02-219	
Date	6/18/2019
GW Elev.	2.64
Benzene	2.4
TPH-G	<50
TPH-D	630
TPH-O	<750

P1-GWAMW-01-219	
Date	6/18/2019
GW Elev.	3.03
Benzene	<0.5
TPH-G	<50
TPH-D	270
TPH-O	<750

GM-18S
GM-17D
GM-17S
GM-16S
GM-24S
IMW-1-T9
IMW-2-T9
AR-03
IMW-3-T9
IMW-4-T9
GM-15S
MW-06
GM-14S
GM-11S
GM-12S
GM-10S
GM-10D
AMW-05
AMW-04
AMW-03
AMW-02
GM-13D
GM-13S
AMW-01
TANK 1
TANK 2
TANK 3
TANK 4
TANK 5
TANK 6
TANK 7
TANK 8
TANK 9
TANK 10
TANK 11
TANK 12
TANK 13
TANK 15
TANK 16
TANK 20
3.7
3.6
3.5
3.4
3.3

Image © 2018 DigitalGlobe

LEGEND

- GM-16S — Monitoring Well
- AMW-01 — Performance/Confirmation Well
- GM-13D — Performance Well
- GM-13S — Product Performance Well
- 3.1 — Groundwater Contour (Feet MSL)

Sample ID	
Date	Date Sample Collected
GW Elev.	Groundwater Elevation in Feet Mean Sea Level (MSL)
Benzene	Benzene (EPA 8260) in µg/L
TPH-G	Total Petroleum Hydrocarbons as Gasoline (NWTPH-GX) in µg/L
TPH-D	Total Petroleum Hydrocarbons as Diesel (NWTPH-DX) in µg/L
TPH-O	Total Petroleum Hydrocarbons as Oil (NWTPH-DX) in µg/L

Notes: **Bold** - Detected concentration exceeds site specific cleanup level
< = Not detected at listed laboratory reporting limit

N

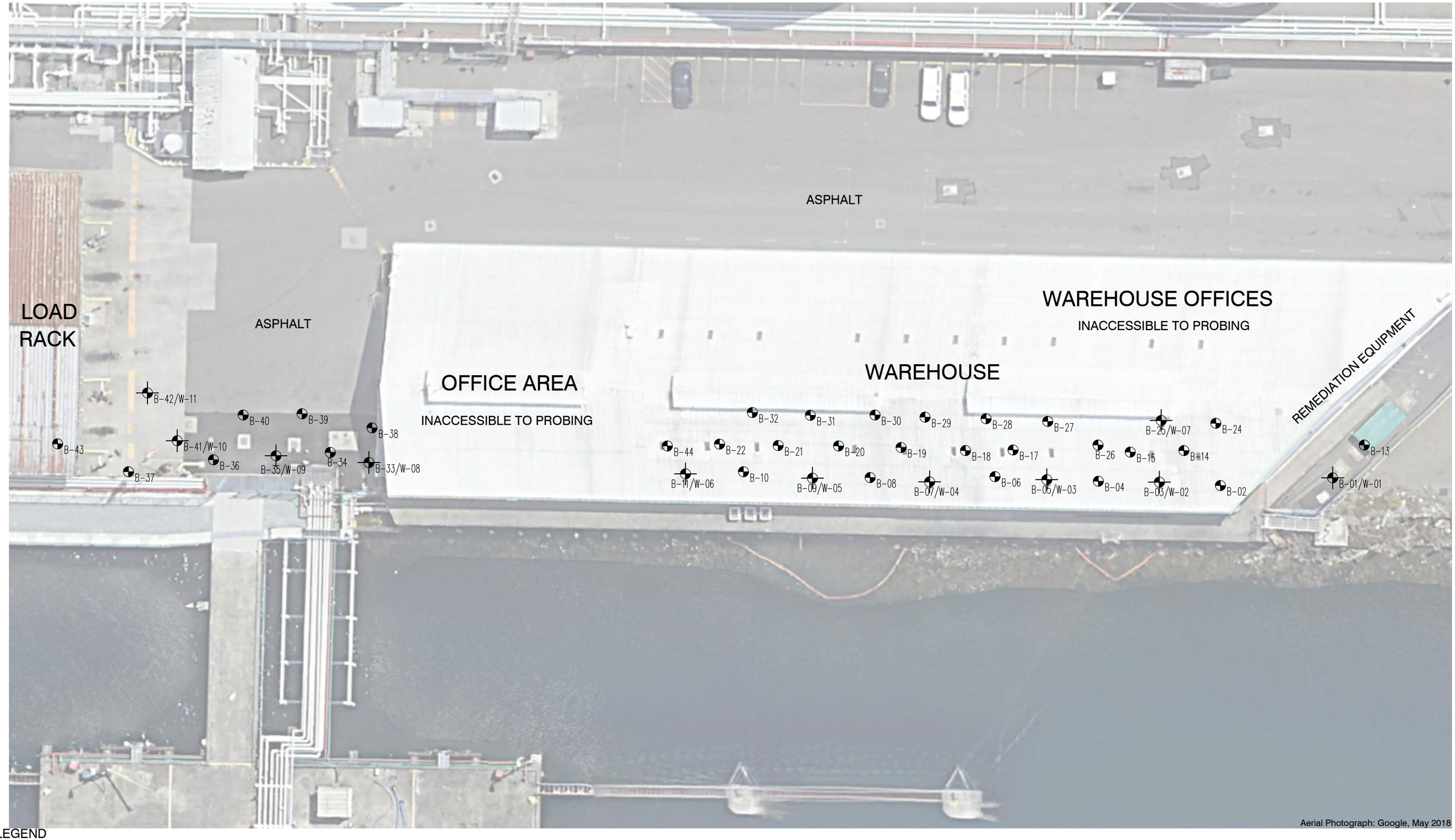
0 50 100
SCALE IN FEET

TECHSOLVE ENVIRONMENTAL
7518 N.E. 169th Street
Kenmore, WA 98028
P:(425) 402-8277 F:(425) 402-7917

Plant 1 Second Quarter 2019 Groundwater Monitoring Analytical Results

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

FIGURE
2



Aerial Photograph: Google, May 2018

LEGEND

B-01 PROBING BORING LOCATION

B-01/W-01 PROBING BORING LOCATION / TEMPORARY PIEZOMETER WELL

N

0 15 30

SCALE IN FEET

TECHSOLVE ENVIRONMENTAL
7518 N.E. 169th Street
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Plant 1 Probing Investigation Boring Locations

BP West Coast Products Terminal 21T
1652 Southwest Lander Street
Seattle, WA 98134

FIGURE

3