BP HARBOR ISLAND TERMINAL

PERIODIC REVIEW FINAL REPORT

BP West Coast Products Terminal
Former ARCO Harbor Island Terminal
1652 SW Lander Street, Harbor Island
Seattle, WA

Cleanup Site ID# 4426
Facility Site ID# 2024

Northwest Region Office

TOXICS CLEANUP PROGRAM

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Table of Content

Figures

Tables

Appendicies

1. INTRODUCTION

This document is a review by the Washington State Department of Ecology (Ecology) of site cleanup actions and monitoring results to ensure that human health and the environment are being protected at the BP West Coast Products Harbor Island Terminal, and former ARCO Harbor Island Terminal in Seattle (Site). The Site is located at 1652 SW Lander Street, Seattle, Washington as shown in Figure 1. This review focuses on the last five years from 2010 through 2014 and a brief overview of cleanup actions from 2000 to 2010 following an earlier review published in 2010.

Site cleanup activities are conducted under Consent Decree 00-2-05714-8SEA (CD) between Ecology and ARCO signed in 2000. BP assumed the obligations of the CD in 2000 when ARCO merged with BP. A copy of the CD and its associated exhibits are included in Appendix A.

This Site is one of three petroleum terminals at Harbor Island as shown on Figure 2, a man-made island and industrial area located at the south side of Elliott Bay and confluence with the Duwamish River. The terminals make up one operable unit within Harbor Island and within the US Environmental Protection Agency (EPA) Harbor Island Superfund Site as shown in Figure 3.

This review is to satisfy the requirements for the Model Toxics Control Act (MTCA) Periodic Review Washington Administrative Code WAC 173-340-420 and the EPA Five-Year Review for Harbor Island Superfund Site. The fourth EPA Five-Year Review for Harbor Island Superfund Site for 2010 – 2014 will be published in September 2015.

The EPA Federal Consent Decree was entered in August 1995 in US v. The Port of Seattle et al relating to claims under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. $ 9601 et seq. for the Harbor Island Superfund Site. Federal Consent Decree Article I, Paragraph 8 identifies operable units within the Harbor Island Superfund Site and lists that the Petroleum Tank Farm Operable Unit is under management of the Washington State Department of Ecology. The EPA and Ecology have entered into a Memorandum of Understanding (MOU) dated February 5, 1991 and March 3, 1994 setting forth the duties and responsibilities of each agency with regard to site management and enforcement activities at the Harbor Island Superfund Site. The MOUs are listed in Appendix B.

Cleanup activities at the Site are implemented under the MTCA regulations and in coordination with the EPA superfund regulations called CERCLA. Soil and groundwater cleanup levels were developed based on the industrial zoning of the Site and the determination by Ecology that there is no current or planned future use of the groundwater for drinking water purposes. The cleanup level defined for the site groundwater is intended to be protective of the adjacent surface waters and ecosystems and to prevent dissolved petroleum hydrocarbon plume in the groundwater from migrating off site which could impact adjacent properties and waterways.

The cleanup actions began in 2000 due to concentrations of petroleum hydrocarbons including gasoline, diesel, and oil, benzene, carcinogenic poly-aromatic hydrocarbons (cPAHs) and copper remained at the Site exceeding MTCA cleanup levels. The cleanup actions are to address and remediate these chemicals of concern also called Indicator Hazardous Substances (IHSs) in soil and groundwater and to protect adjacent properties and surface waters at Elliott Bay and the waterways connecting the Duwamish River to Elliott Bay and Puget Sound.

The MTCA cleanup levels for soil are established under WAC 173-340-740. The MTCA cleanup levels for groundwater are established under WAC 173-340-720. Ecology conducts a periodic review every five years following WAC 173-340-420 under the following conditions:

(a) Whenever the department conducts a cleanup action.

(b) Whenever the department approves a cleanup action under an order, agreed order or consent decree.

(c) Or, as resources permit, whenever the department issues a no further action opinion, and one of the following conditions exists:

1. Institutional controls or financial assurance are required as part of the cleanup;

2. Where the cleanup level is based on a practical quantitation limit; or

3. Where, in the department's judgment, modifications to the default equations or assumptions using Site-specific information would significantly increase the concentration of hazardous substances remaining at the Site after cleanup or the uncertainty in the ecological evaluation or the reliability of the cleanup action is such that additional review is necessary to assure long-term protection of human health and the environment.

When evaluating whether human health and the environment are being protected, the factors the department shall consider include [WAC 173-340-420(4)]:

(a) The effectiveness of ongoing or completed cleanup actions, including the effectiveness of engineered controls and institutional controls in limiting exposure to hazardous substances remaining at the Site;
(b) New scientific information for hazardous substances of mixtures present at the Site;
(c) New applicable state and federal laws for hazardous substances present at the Site;
(d) Current and projected Site use;
(e) Availability and practicability of higher preference technologies; and
(f) The availability of improved analytical techniques to evaluate compliance with cleanup levels.

The Department shall publish a notice of all periodic reviews in the Site Register and provide an opportunity for public comment.

2. SUMMARY OF SITE CONDITIONS

2.1 Site Description and History

The Site is located on Harbor Island, Seattle Washington, and consists of two separate bulk fuel storage plants (Figure 1). Harbor Island is a 455-acre man-made island lying between the East and West Waterways of the Duwamish River. Plant 1 occupies about 12 acres on the western portion of the island, bordering the West Waterway. Plant 2 occupies about 3.5 acres in the north-central part of the island. Both plants were constructed in the 1930s and have operated as bulk fuel storage and transfer facilities since that time.

Harbor Island was created primarily from marine sediments dredged from the Duwamish River. Currently, about 95 percent of the island is covered with industrial buildings, paved roads, or other impervious surfaces. The pervious surfaces of the island consist primarily of land adjacent to aboveground storage tanks and railroad tracks.

Groundwater extraction on Harbor Island is limited as Ecology and the EPA determined that groundwater beneath Harbor Island is non-potable (will not be used for drinking water). In the northern portion of the island, where the Site is located, groundwater flows in a radial pattern outward from the island center entering the marine surface water at the island's edge. This flow pattern has been verified at the Site during routine groundwater monitoring, as further discussed in Section 2.2.1.5. Local groundwater recharge is from precipitation and, possibly, leaking underground utilities such as storm sewers and public water supply piping. Recharge of island-wide groundwater from precipitation has decreased over time from island redevelopment activities that increased impermeable surface areas.

2.2 Site Investigation and Sample Results

ARCO and Ecology cooperatively entered into Agreed Order in 1992 (Ecology, 1992) to conduct Site remedial investigations and to characterize the extent of contamination, plus review alternative cleanup methods to prepare the Cleanup Action Plan. Remedial Investigation and Feasibility Study (RI/FS) were completed in 1997 (Geraghty & Miller 1997). The RI results showed highly weathered total petroleum hydrocarbons (TPH) as diesel (TPH-D) with lesser amounts of weathered gasoline (TPH-G) and heavier oil (TPH-O) present in groundwater and soil, likely resulting from historic spills at the Site. The RI/FS showed the primary area of impact was a petroleum-based light non-aqueous phase liquid (LNAPL) plume located beneath the warehouse adjacent to the West Waterway of the Duwamish River at Plant 1. Secondary areas of concern included petroleum impacted soils located within the Plant 1 and Plant 2 tank farms shown in Figures 4 and 5.

Groundwater monitoring activities have been conducted at the Site since the RI/FS using a network of selected wells. Monitoring activities were implemented voluntarily through 1999. Since 2000, groundwater monitoring has been conducted per the requirements of the Consent

Decree's Groundwater Compliance Monitoring and Contingency Program (TechSolv, 1999b) with periodic revisions, as noted below.

Groundwater samples are analyzed for selected IHSs including TPH-G, TPH-D, TPH-O, benzene, and cPAHs. Monitoring activities also include monthly inspections for LNAPL presence in selected wells. Analytes and selected wells have been deleted from the monitoring program with Ecology's approval, due to analyte concentrations consistently below cleanup levels. Wells have also been installed and added to the program. Groundwater monitoring data are included on Tables 1 through 4.

The groundwater monitoring well network for Plant 1(Figure 6) and Plant 2 (Figure 7) currently includes:

	Monitoring Parameter and Frequency					
Well	Benzene	TPH-G	TPH-D	TPH-O	cPAHs	LNAPL Presence
Plant 1						
AMW-01	Q	Q	Q	Q	A	
AMW-02	Q	Q	Q	Q	A	
AMW-03	Q	Q	Q	Q	A	
AMW-04	Q	Q	Q	Q	A	
AMW-05	Q	Q	Q	Q	A	
AR-03	Q	Q	Q	Q		
GM-11S						M
GM-12S						M
GM-13S						M
GM-14S	Q	Q	Q	Q		
GM-15S	Q	Q	Q	Q		
GM-16S	S	S	S	S		
GM-17S	S	S	S	S		
GM-24S	Q	Q	Q	Q		
MW-1-T9	Q	Q	Q	Q		
MW-2-T9	Q	Q	Q	Q		
MW-3-T9	Q	Q	Q	Q		
MW-4-T9	Q	Q	Q	Q		
Plant 2						
GM-19S	S	S				
Monitoring Frequency Definitions						
A	Annual					
M	Monthly					
Q	Quarterly					
S	Semiannual					

The monitoring history and rationale for the above table is based on the following:

- Monitoring wells AMW-01 through AMW-05 were installed in 2000 as waterfront compliance wells. These wells were screened to allow representative sampling in a zone of groundwater discharge located beneath the existing warehouse foundation and island bulkhead and above deeper brackish groundwater. These wells are screened deeper than inland monitoring wells, which monitor conditions in shallower groundwater.

- Well AR-03 is located just south of the Plant 1 southern property boundary, hydraulically down-gradient from petroleum contaminated soil excavations, and within the Inland Soil Vapor Extraction (SVE) System's capture zone (Section 2.3.3).

- Monitoring wells GM-11S, GM-12S, and GM-13S are used to monitor for LNAPL presence and sheen on groundwater and to monitor the performance and effectiveness of the Waterfront Groundwater/LNAPL Recovery System (Section 2.2.1.3).

- Monitoring well GM-14S was added to the monitoring well network in 2007. Previously, GM-14S was used to monitor for LNAPL presence on groundwater. As sheens are no longer detected in this well, performance monitoring was initiated to monitor water quality in this area of the Site.

- Well GM-15S is located down-gradient from former soil remedy excavations and is within the Inland SVE system's capture zone. Based on limited IHS detections, the monitoring frequency of GM-15S was reduced, with concurrence from Ecology (Ecology, 2009) from quarterly to semi-annually. In 2013, the monitoring frequency was voluntarily increased to quarterly due to detections of TPH-G and benzene above cleanup levels. TPH-G and benzene concentrations fell back below cleanup levels by fourth quarter of 2013. However, GM-15S continues to be monitored quarterly to provide additional data from this well and this location.

- Wells GM-16S and GM-17S are hydraulically up-gradient of Plant 1. Monitoring for IHSs was discontinued in 2000 with Ecology approval (Ecology, 2000b), as sufficient background data had been collected from these wells. Monitoring for IHSs was resumed in 2007, as recommended by Ecology, to monitor for potential IHS migration onto the property from up-gradient, off-site sources. The groundwater sampling frequency was reduced to semi-annually in 2009, with concurrence from Ecology (Ecology, 2009) as IHS concentrations were below cleanup levels since resuming sampling.

- Well GM-24S is located within the Plant 1 soil remedy excavation area, and is upgradient of the Inland SVE System capture zone.

- Wells MW-1-T9 through MW-4-T9 were installed and added to the monitoring well network in 2005 to further evaluate groundwater quality down-gradient from Plant 1 soil remedy excavations (TechSolve, 2007). These wells are located within the Inland SVE system's capture zone.

- Well GM-19S is located hydraulically upgradient of Plant 2 and is utilized to monitor for TPH-G and benzene detected from an unidentified off-site source.

The results of these groundwater monitoring activities are summarized in the following sections.

2.2.1 Plant 1 Monitoring

Performance monitoring at Plant 1 includes groundwater monitoring for TPH-G, TPH-D, TPH-O, benzene, cPAHs, groundwater elevations, and the presence of LNAPL (Tables 1 through 4). Analytical results for TPH and benzene are included on Table 1 and line charts of thess data over time are included in Appendix C. Analytical results for cPAHs are listed on Table 2. LNAPL and sheen monitoring results are provided on Table 3. Groundwater elevation data are presented on Table 4.

2.2.1.1 Plant 1 Waterfront Hydrocarbon Monitoring

Groundwater compliance monitoring wells AMW-01 through AMW-05, located along the waterfront, have been below cleanup levels for TPH-G, TPH-D, and TPH-O for all quarterly groundwater monitoring events since installation listed on Table 1. These wells have also been below cleanup levels for benzene, with the exception of Wells AMW-01 and AMW-02.

Detected benzene concentrations in well AMW-01 appear to have reduced significantly over the past ten years. Well AMW-01 has exceeded the 71 µg/L cleanup level for benzene in 40 of 56 quarters since 2000. However, benzene has been below the cleanup level in 7 of the past 9 quarters. The last two benzene exceedances (concentration above cleanup level) at 77 and 110 µg/L (microgram per liter or parts per billion) are significantly lower than historical exceedances, as high as 1,680 µg/L in June 2002. A line chart of AMW-01 benzene concentration data is plotted over time and shown in Figure 8. These results show a clear downward trend beginning around 2004 with benzene concentrations now mainly below the Site cleanup level.

Well AMW-02 has exceeded the benzene cleanup level in 13 of 31 quarters since benzene was first detected above the cleanup level in 2007. However, benzene has been below the cleanup during each of the last nine monitoring events, and was last detected above the cleanup level in the second quarter of 2012. Benzene concentration data are plotted over time in Figure 9 and show a clear downward trend beginning around 2009. Well AMW-02 data also show that the one exceedance since June 2011 of 82.5µg/L was significantly lower than historical exceedances as high as 442 µg/L in June of 2007. So the 2010 through 2014 periodic review shows a significant decrease in benzene concentration and a significant improvement in achieving cleanup level at these wells.

Efforts made by BP to determine the source(s) of benzene in the area of AMW-01 and AMW-02 were inconclusive. Several remediation activities were implemented prior to the last 5-year review to mitigate known sources of benzene. Additional evaluations and remedial actions have been implemented since the last 5-year review. These actions include operation of an Inland Soil Vapor Extraction (SVE) cleanup system (Section 2.3.3) up-gradient of wells AMW-01 and AMW-02, and operation of another treatment system called the Waterfront Groundwater/ LNAPL Recovery System (Section 2.3.1) to capture shallow groundwater above wells AMW-01 and AMW-02. These remedial actions appear to be effective at reducing benzene concentrations in these wells.

2.2.1.2 Plant 1 Inland Hydrocarbon Monitoring

In the up-gradient area of Plant 1, IHSs have not been detected at or above cleanup levels in monitoring wells GM-16S and GM-17S since monitoring was resumed in 2007. These wells are monitored semi-annually in the first and third quarters to evaluate for the potential migration of IHSs onto the Site from off-site sources.

Near the center of Plant 1, well GM-14S results have been below cleanup levels for TPH-D, TPH-O, and benzene since sampling resumed in this well in 2007. Concentrations of TPH-G have been detected above the cleanup standard in 20 of 29 quarters since 2007. TPH-G concentrations detected in well GM-14S vary from quarter to quarter but appear relatively stable. Well GM-14S is located hydraulically up-gradient from the Waterfront Groundwater/LNAPL Recovery System and is located near the center of Plant 1. The location of the well and stable TPH-G concentrations indicate that TPH-G detected in well GM-14S is not a threat to surface water or property boundaries, the primary receptors of concern at the Site.

Along the southern portion of Plant 1, monitoring results from wells in and down-gradient of former soil hot spot areas in (wells GM-24S, AR-03, GM-15S, MW-1-T9, MW-2-T9, MW-3-T9, and MW-4-T9) indicate that soil removal actions completed in 2000 (Section 2.3.3) stabilized concentrations of dissolved hydrocarbons in this area. Groundwater quality appears to have improved further from the operation of the Inland SVE System, which has been in operation since 2008 (Section 2.3.3).

Concentrations of TPH-D, TPH-O and benzene detected in well GM-24S, located hydraulically upgradient of the Inland SVE System and in the location of former soil “hot spot” excavations (Section 2.3.3), have been below cleanup levels since 2002. Concentrations of TPH-G have exceeded the cleanup level in 10 of the last 20 quarters. From 1997 through 2007 TPH-G concentrations in well GM-24S appear to be stable and averaged 2,389 µg/L. Since 2007, TPH-G concentrations appear to be decreasing and have averaged 1,107 µg/L. These results appear to indicate that biodegradation is occurring in the area of the Site and that TPH-G appears to be naturally attenuating with benzene concentrations decreasing.

Concentrations of IHSs detected in wells hydraulically down-gradient of well GM-24S (AR-03, GM-15S, MW-1-T9, MW-2-T9, MW-3-T9, and MW-4-T9) appear to have decreased overall since Inland SVE System startup and are now mainly below cleanup levels. No TPH-O exceedances have occurred in these six wells.

TPH-D exceedances in the six wells listed above over the last five years (20 quarters) were limited to two wells in 2010 at wells AR-03 and MW-1-T9. These TPH-D exceedances in 2010 were attributed to abnormally high groundwater elevations.

TPH-G exceedances in the six wells listed above over the last five years were limited to well GM-15S in 2013, well MW-1-T9 in 2010, and well MW-2-T9 in 8 of 12 quarters from 2009-2012 (no exceedance in the last 8 quarters), and well MW-3-T9 at the cleanup level in 2014. Benzene exceedances in the six wells listed above over the last five years were limited to well MW-3-T9 in five quarters from 2011 through 2012, and well GM-15S in two quarters in 2013.

Wells AR-03, MW-1-T9, and MW-2-T9 routinely exceeded the TPH-G and benzene cleanup levels prior to Inland SVE System startup in August 2008 (Section 2.3.3.1). However, the benzene concentrations have been below the cleanup level in these wells since SVE startup. TPH-G concentrations have been below the cleanup level in well AR-03 for the past 20 quarters, in well MW-1-T9 for the past 18 quarters, and in well MW-2-T9 for the past 8 quarters.

TPH-G and benzene concentrations in well GM-15S and MW-3-T9 appear stable and have been mostly below the associated cleanup level. Well GM-15S has only exceeded benzene and TPH-G cleanup levels in 1 out of 62 monitoring events since 1997. TPH-G was detected in well MW-3-T9 at the 1,000 µg/L TPH-G cleanup level in March 2014, but has never exceeded the cleanup level. Benzene concentrations plotted for well MW-3-T9 appeared to peak in late 2011 and 2012 but have fallen below the cleanup level for the last seven quarters as shown in Figure 10.

Well MW-3-T9 is approximately 50 feet hydraulically cross to up-gradient of well GM-15S (Section 2.2.1.5), indicating benzene and TPH-G detected in MW-3-T9 in 2012 may have been localized and migrated to well GM-15S in 2013. The short-term exceedances (a year or less) coincide with several years of relatively high groundwater elevations as shown in Figures 11 and 12. A correlation between higher benzene and TPH concentrations during periods of high groundwater elevation has been established for the Site. This correlation appears to indicate that the source in this area is located in the smear zone at the water table (TechSolv, 2005). As discussed in Section 2.3.3.1, the Inland SVE System continues to operate in this area and the system was modified to increase vapor capture from portions of the system located closest to wells GM-15S and MW-3-T9, and appears to be effective in reducing concentrations.

2.2.1.3 Plant 1 LNAPL Monitoring

The compliance monitoring program includes monthly inspection for sheen and LNAPL presence in three monitoring wells in Plant 1 (wells GM-11S, GM-12S, and GM-13S). Well GM-14S (located inside the main Plant 1 tank farm) was removed from the monthly LNAPL monitoring program in 2004, with concurrence from Ecology (Ecology, 2004b), as this well had been free of LNAPL and sheens since June 1999.

Results of monthly sheen and LNAPL monitoring have shown a reduction in LNAPL occurrence in Plant 1 and listed on Table 3. No sheens or LNAPL have ever been detected in well GM-12S located up-gradient from the warehouse. Well GM-13S located inside the southern end of the warehouse has periodically had sheens over time, but no sheens have been observed in this well since November 2012.

The frequency of sheens being detected in well GM-11S has decreased over time. Measurable LNAPL was detected in Well GM-11S located outside the northeast end of the warehouse in 1999 and the well was subsequently converted to an LNAPL recovery well in April 2000. Only a sheen has been detected in this well following convertion to a recovery well. Only four sheens were detected in the last three years of monthly monitoring and no sheens have been detected in well GM-11S within the last year. This represents a significant improvement in achieving cleanup level.

2.2.1.4 Plant 1 cPAH Monitoring

Selected wells at Plant 1 were monitored for cPAHs and this monitoring was discontinued in 2003, per Ecology's approval (Ecology, 2003). During earlier monitoring, cPAH concentrations were rarely detected above cleanup level as listed on Table 2. Monitoring for cPAHs was voluntarily resumed in compliance monitoring wells AMW-01 through AMW-05 in 2004 following a recommendation by Ecology and to assist in determining when cleanup levels have been met. Since resuming monitoring, concentrations of cPAHs have been rarely detected, and occasional detections have often been associated with laboratory quality control deficiencies that affect the validity of reported data results. These laboratory issues have been discussed in more detail in previous Site Annual Reports. The limited detections of cPAHs have only slightly exceeded the laboratory detection limit (0.025 µg/L) for these compounds. Based upon these findings, the cPAH sampling frequency was decreased in 2009 to an annual basis, with concurrence from Ecology (Ecology, 2009).

During the recent December 2013 monitoring event, concentrations of cPAHs were only detected above cleanup levels in well AMW-05, and were mainly low level detections. Based upon data evaluation of the extensive cPAHs sampling history, the limited low-level detections in AMW-05 in 2013 do not appear to indicate any significant ongoing trend.

2.2.1.5 Plant 1 Groundwater Elevation Monitoring

Water table elevations at Plant 1 are recorded during all monitoring events. Most Plant 2 monitoring has been discontinued as discussed in the following section below. Recorded water table elevations for 2014 are listed on Table 4. Hydrographs for selected wells in the southern boundary area are illustrated in Figure 11 and in the waterfront area of Plant 1 in Figure 12 showing trends in water table elevations over time for the Site. Corresponding water table elevation maps are prepared each quarter to show overall groundwater flow patterns. Maps for the highest, December 2012, and lowest, September 2010, overall groundwater elevations recorded over the past five years are provided in Figures 13 and 14.

Site flow directions can vary seasonally but are generally west towards the waterway, and south to southwest along the southern property boundary. Groundwater gradients are similar each year and range from approximately 0.001 feet per foot (ft./ft.) from the main tank farm to the waterfront, to 0.01 ft./ft. at the southern boundary of Plant 1.

The data for Plant 1 show that the water table fluctuates seasonally and all wells are responding to these fluctuations (i.e., none of the wells are screened in groundwater isolated from other wells, such as would occur with "perched" groundwater). Variations and trends in water table elevation generally coincide with precipitation data for the area. Hydrographs show that higher water table elevations occur during wetter winter and spring months than in drier summer and fall months.

Monitoring well MW-06, located in Plant 1 east of the northeast corner of the warehouse, is not part of the groundwater monitoring program but is used to provide water level data in this area. Wells closest to the waterfront that are part of the monitoring program (wells GM-13S, and AMW-01 through AMW-05) are not used for water table elevation maps due to tidal fluctuations that affect these wells. Additionally, startup testing showed groundwater elevations in well GM-13S are depressed by the Groundwater/LNAPL Recovery System capture.

2.2.2 Plant 2 Monitoring

Ongoing performance groundwater monitoring results, conducted following soil excavation, showed that cleanup objectives for diesel impacted inland soils at the Plant 2 diesel tank farm had been met (see Section 2.3.3). However, concentrations of TPH-G and benzene were detected following excavation activities in well GM-19S. Results of a 2002 investigation (TechSolv, 2003a) concluded that TPH-G and benzene detected in well GM-19S was from an unidentified off-site source. Monitoring at Plant 2 was discontinued except for TPH-G and benzene in monitoring well GM-19S listed in Figure 7, as agreed to by Ecology (Ecology, 2004b). Well GM-19S continues to be monitored semi-annually for TPH-G and benzene during the first and third quarters, which typically correspond with the groundwater seasonal high and low, respectively. Benzene concentrations detected in well GM-19S were last above the cleanup level in the third quarter of 2013, the first exceedance since third quarter 2010. The TPH-G concentrations in well GM-19S have been below the cleanup level since third quarter 2007. TPH-G and benzene concentrations appear stable and are decreasing and represent improvement.

2.2.3 Biochemical Parameter Monitoring

Monitoring for biochemical parameters has been conducted at the Site to determine the effectiveness of Monitored Natural Attenuation (an in-situ cleanup treatment system) for locations where the subsurface soils are inaccessible and containing TPH above cleanup levels. Monitoring of biochemical parameters has been suspended until additional Site cleanup goals are achieved (TechSolv, 2005). Results of the last biochemical sampling were included in the 2006 Annual Site Report (TechSolv, 2007).

2.3 Cleanup Actions

ARCO entered into the Consent Decree with Ecology in 2000 (Ecology, 2000b) to implement cleanup actions at this Site. Separate cleanup actions were specified for Plant 1 and Plant 2 in a

CD Cleanup Action Plan (Ecology, 1999) and the Engineering Design Report (EDR) (TechSolv and AG&M, 2000a). Cleanup actions were selected based upon a Focused Feasibility Study (Geraghty & Miller, 1997). Elements of the selected cleanup actions include:

- Pumping and treatment for the LNAPL plume and dissolved hydrocarbon recovery at Plant 1.
- Excavation of accessible TPH impacted soil "hot spots" in inland portions of Plant 1 and Plant 2.
- Air Sparging and Soil Vapor Extraction (SVE) for accelerated mass removal of residual hydrocarbons in inaccessible soils at Plant 1.
- Groundwater compliance monitoring.
- Monitored natural attenuation.
- Deed restrictions.
- Institutional controls.

An 18 month period was established for LNAPL removal beneath the warehouse, and 5 years for groundwater restoration as measured at property boundaries. Additional contingency actions have been implemented at the Site, including continued operation of the Waterfront Groundwater/LNAPL Recovery System beyond 5 years, and installation of the Inland SVE System to address inland Plant inaccessible hot spot soils, as further discussed in Section 2.3.3.

The following sections summarize selected remedial actions and the status of their implementation and cleanup success. Accessible soil remedies have been completed and are detailed in referenced documents. Inaccessible soil and groundwater remedies are ongoing and are, therefore, discussed at greater detail in this report.

2.3.1 Waterfront Remedial Actions

Groundwater remedial actions have been conducted along the waterfront at Plant 1 since 1992. An interim groundwater/LNAPL recovery system operated from 1992 through 2002, and an interim SVE system operated from 1996 through 2002. Final remediation systems described in the EDR and installed in 2002 are summarized below and shown in Figure 15.

Final remediation system designs consisted of SVE, groundwater/LNAPL recovery, and air sparging. The Groundwater/LNAPL Recovery System was designed to capture LNAPL and dissolved hydrocarbons in groundwater and provide hydraulic control along the waterfront. The Air Sparging System was designed to mobilize LNAPL to aide in capture, to enhance in-situ biodegradation of residual hydrocarbons, and to strip volatile hydrocarbons from groundwater. The SVE System was designed to capture volatile hydrocarbons vapors and enhance in-situ biodegradation of residual hydrocarbons in the vadose zone (unsaturated zone above the groundwater table). The main components of these systems are located along the waterfront at Plant 1 in Figure 15 and are further discussed below.

System construction was detailed in the Construction Completion Report (CCR) (TechSolv, 2003c), prepared following system testing and startup to document that Consent Decree and EDR requirements were followed. Operation and maintenance (O&M) requirements for the final remediation system were presented in the Final O&M Manual (TechSolv, 2003d). These documents were approved by Ecology in 2004 (Ecology, 2004a).

2.3.1.1 Groundwater/LNAPL Recovery System Design

The Groundwater/LNAPL Recovery System captures LNAPL and groundwater containing dissolved hydrocarbons along the waterfront at Plant 1. The system utilizes total-fluid pumps in 10 recovery wells (GM-11S, RW-1, RW-2, RW-4, RW-5, RW-6, RW-7, RW-8, RW-9, RW-10) to pump LNAPL and groundwater through a treatment system illustrated in Figure 15. Recovered LNAPL and groundwater are pumped into an oil/water separator, which separates LNAPL from groundwater. LNAPL is recycled off-site. Separated groundwater enters a diffused air stripper, which strips dissolved volatile hydrocarbons from groundwater. Treated groundwater flows to the sanitary sewer in compliance with KCDNR Wastewater Discharge Permit 7592-04. Air discharges from the air stripper are currently below PSCAA's exemption threshold for soil and groundwater remediation projects listed in PSCAA Regulation I, Article 6, Section 6.03(c)(94). The system is monitored weekly and maintenance is performed as needed to ensure that it operates as designed and in accordance with permit requirements.

2.3.1.2 Groundwater/LNAPL Recovery System History

Groundwater Recovery well RW-1 has operated since interim system startup in 1992. Well RW-4 operated as part of the interim system from 1998 to 1999 and was brought back online in 2001 with wells RW-2, RW-5, and RW-6, following system installation activities north of the warehouse. Well GM-11S was converted from a monitoring well to a recovery well in 2000 after LNAPL was observed in the well (Section 2.2.1.3). Wells RW-7, RW-8, RW-9, and RW-10 were completed during final system construction and brought on-line during startup in 2002.

Groundwater samples are voluntarily collected by BP semi-annually from each recovery well to evaluate IHS concentration trends in shallow groundwater. The data are presented in Table 5 and line charts of this data over time are presented in Appendix D. Data show that concentrations of dissolved hydrocarbons in shallow groundwater have been below cleanup levels (Section 2.4.) in half the recovery wells (RW-10, RW-8, RW-7, RW-6, and RW-1) for the past four years or more. Much of the available TPH-D, TPH-G, and benzene in shallow groundwater along the waterfront appears to have been recovered by the system. Sampling results indicate the system is recovering groundwater with concentrations of TPH-G, TPH-D and benzene above cleanup levels north of the warehouse and south of the truck loading rack area by wells RW-2, RW-4, RW-5, and GM-11S. At the southern end of the warehouse, LNAPL and TPH-D above cleanup level is still being recovered by recovery well RW-9.

A 2003 soil investigation at Plant 1 (TechSolv, 2003b) analyzed soil cores for LNAPL presence. The investigation showed no LNAPL existing outside recovery wells' capture zones, supporting data showing most LNAPL has been recovered from the warehouse area.

Effluent discharges are monitored for volume and for chemicals of concern. Analytical results from compliance testing listed on Table 6 show that the Groundwater/LNAPL Recovery System effectively treats recovered groundwater and meets KCDNR discharge compliance requirements. Effluent wastewater monitoring results show discharges have been below permitted limits during all monitoring periods.

Data results from Groundwater/LNAPL Recovery System operation support that most LNAPL has been removed along the waterfront. Table 6 details quantities and concentrations of recovered LNAPL and dissolved hydrocarbons since final system startup in October 2002. Low LNAPL and dissolved hydrocarbon recovery rates in recent years indicate a minor amount of LNAPL remains. LNAPL collection data results on Table 6 are recorded when 55-gallons or more has been generated, which has not occurred since 2008. LNAPL is currently recovered as a sheen or thin film, often removed with biological residue as waste and not quantified as LNAPL recovery.

Total LNAPL recovered by interim and final Groundwater/LNAPL Recovery Systems is estimated at 10,098 gallons as shown on Figure 16 and Appendix E. The final system has recovered 395 gallons of LNAPL from October 2002 through September 2014, and 391 gallons of dissolved hydrocarbons. The total combined recovery including recovered LNAPL, dissolved hydrocarbons, historical SVE recovery, and biodegradation processes is about 29,755 gallons of LNAPL recovered to date. Influent concentrations of IHSs in recovered groundwater are listed on Table 6.

Influent concentrations of dissolved IHSs in recovered groundwater have decreased over time, as listed on Table 6. These results are consistent with decreasing concentrations seen in individual recovery wells, indicating improved groundwater conditions at the Site. Concentrations of IHSs do vary over time and often appear higher during winter months when the overall groundwater elevation is generally higher, as discussed in Section 2.2.1.5. Data results indicate that the source of dissolved hydrocarbons is primarily residual hydrocarbons in the smear zone at the water table and that groundwater recovery continues to be an effective means of reducing dissolved hydrocarbon concentrations in groundwater and preventing sheens from occurring on the adjacent Duwamish Waterway, as further discussed in Section 2.3.2.

2.3.1.3 Groundwater/ LNAPL Recovery System Modification Review

In September 2010, EPA published the Third Five-Year Review Report for the Harbor Island Superfund Site, Seattle, Washington (EPA, 2010). EPA made several recommendations within the report, including that BP "Evaluate hydraulic containment and perform investigations or modify the remediation system as necessary." This recommendation was in response to historically elevated concentrations of benzene detected in Compliance Monitoring Wells AMW-01 and AMW-02 near the Duwamish West Waterway. Groundwater monitoring in these wells is further discussed in Section 2.2.1.1 and show that benzene is now mainly below the cleanup level in these shoreline wells.

BP and Ecology discussed EPA's recommendations from the 2010 Five-Year Review (Ecology, 2012), and Ecology agreed that the evaluation of hydraulic containment could be delayed until after BP's voluntarily proposed installation of a new seawall along the waterfront was completed (Section 2.6). BP also evaluated implementing temporary modifications to the Groundwater/ LNAPL Recovery System prior to seawall installation. These evaluations included continued operation of the current system and potential installation of deeper recovery wells in the area of wells AMW-01 and AMW-02 near the shoreline.

Continued operation of the Groundwater/LNAPL Recovery System above wells AMW-01 and AMW-02 was evaluated and implemented. Existing recovery wells RW-8, RW-9, and RW-10 (Figure 15) capture shallow groundwater and provide hydraulic control in the area of wells AMW-01 and AMW-02. A previous capture zone analysis and pumping test (TechSolv, 1999a) determined that the operation of recovery wells in this area at flow rates of 0.7 to 0.9 gpm per wells can provide vertical capture from 20 to 40 feet below ground surface, and provide effective groundwater capture at the depths to which wells AMW-01 and AMW-02 are screened. The modeling and calculations utilized in the pumping test and capture zone analysis were reevaluated by BP and determined to still be applicable at this Site area, and indicating that the current recovery system provides adequate groundwater capture in this Site area.

Installation of new deeper groundwater capture wells connected to the Groundwater/LNAPL Recovery System near wells AMW-01 and AMW-02 was considered and rejected due to the potential risk of increased sheens and discharge of free LNAPL to surface water. Installation and operation of deeper recovery wells would extend the capture zone in and around AMW-01 and AMW-02. However, deeper recovery could vertically extend the smear zone, allowing transfer of free LNAPL beneath the existing bulkhead to the Duwamish Waterway by eliminating the damming effect provided by the existing bulkhead, which acts as a hanging wall.

Voluntary monitoring discussed previously and listed on Table 5 for recovery well RW-9, located between wells AMW-01 and AMW-02 (Figure 17), shows that shallow groundwater in this area continues to be impacted by TPH-D and LNAPL. Additionally, groundwater drawdown in RW-9 is routinely monitored, indicating that maximum well drawdown is achieved and is to the base of the well. The exact depth of the bulkhead is estimated to be only 5 to 7 feet beneath the base of the screened interval of RW-9 (Figure 17), indicating that existing recovery wells are likely screened to the maximum depth that maintains the damming effect provided by the existing seawall. Increasing deeper groundwater capture by extending drawdown below the existing bulkhead was eliminated from consideration due to the high risk of increasing LNAPL discharge to surface water.

A new seawall is scheduled to be installed along the waterfront at Plant 1 (Section 2.6). The design calls for driven interlocking sheet piling to extend approximately 70 feet below ground surface. This will create a deeper barrier to groundwater exchange with the Duwamish West Waterway. Once the new seawall is installed further analysis will be conducted to determine if recovery well modification is warranted. Note, new seawall materials are temporarily stockpiled at Plant 1 and shown in photograph, see Appendix F and installation is planned in 2015.

2.3.1.4 Groundwater/LNAPL Recovery System Drawdown

The Groundwater/LNAPL Recovery System was designed to pump shallow groundwater with drawdown extending to the bottom of the LNAPL smear zone, and approximately 4 feet in total. Results of operation to date listed on Table 6 show that desired drawdown and hydraulic capture/control are being achieved along the waterfront despite reduction in pumping rates from some wells. Pumping rate reductions in recent years have been attributed to biological fouling in the shallow aquifer due to high concentrations of iron and sulfate present in the brackish water along the waterfront. Maintenance is performed on these wells and recovery pumps to maintain and improve groundwater capture and to ensure that adequate drawdown is achieved.

Tidal fluctuations in the adjacent Duwamish Waterway affect groundwater elevations along the waterfront. While the Duwamish Waterway can fluctuate up to 14 feet during a daily tidal cycle, shallow groundwater fluctuates approximately 1 foot (TechSolv, 2004). Fluctuations in deeper groundwater were determined to be as high as 7 to 8 feet over a similar tidal cycle. Earlier work indicated that differences in tidal response for shallow versus deeper groundwater is from the dampening effect of the western warehouse foundation (driven interlocking sheet piling underlying the warehouse foundation), bulkheads at the island edge, and decreased seepage through a silty/clay layer that partially separates upper and lower water tables in some areas.

Groundwater recovery pumping rate data results are collected several times a day during various tidal stages and show a correlation between tidal elevation and groundwater recovery and shown in Figure 18. These data results show fluctuations in tidal elevations affect system pumping rates and that the system achieves desired drawdown despite these fluctuations, as recovery pumps automatically pump faster during periods of high tides.

BP is planning to install a new seawall along the shoreline at Plant 1 in 2015 to enhance seismic stability of the Site and greater protection for the facilities. The final design of the seawall is anticipated to reduce tidal fluctuations in groundwater and will likely affect the operation of the Groundwater/LNAPL Recovery System.

2.3.1.5 Soil Vapor Extraction System

Operation of the SVE System along the waterfront was discontinued in May 2008 as the system no longer recovered measurable concentrations of hydrocarbons and was not influencing biodegradation of inaccessible hot spot soil areas. The SVE shutdown was approved by Ecology during a 5-year review (Ecology, 2008).

About 3,582 gallons of TPH-G as vapor were recovered by the SVE System. Additionally, enhanced biodegradation from SVE system operation added about 16,075 gallons, for a total of 19,657 gallons of petroleum hydrocarbons recovered or degraded by SVE as shown in Figure 16 and listed in Appendix E. These results were calculated from SVE effluent monitoring data.

2.3.1.6 Air Sparging System

Air sparging along the waterfront was discontinued in May 2008 as SVE air monitoring data results indicated air-sparging operations were no longer volatilizing measurable quantities of hydrocarbons. Additionally, air-sparging operations were likely causing increased fouling in the Groundwater/LNAPL Recovery System. Additional information on air sparging system operation was presented in previous Annual Reports (e.g. TechSolv, 2009).

Restarting air sparging operations in deeper sparge wells near Wells AMW-01 and AMW-02 was reevaluated in response to EPA's comments in the 2010 EPA Five-Year Review that "BP evaluate modifications to remediation system."

Two sparge wells (AS-1 and AS-2) originally installed for pilot testing are located and screened in the area of wells AMW-01 and AMW-02 shown in Figure 17. In 2005 it was proposed to Ecology to restart sparging in wells AS-1 and AS-2 to help address the benzene detected in AMW-01, as it was determined that more shallowly screened sparge wells operating at the time were not adequately addressing benzene in well AMW-01 (TechSolv, 2006).

Air sparging in wells AS-1 and AS-2 was conducted from 2005 through 2007 (TechSolv, 2008). However, decreases in benzene concentrations in AMW-01 were not observed over this time. Wells AS-1 and AS-2 needed to be operated at conservative flows and pressures to prevent the injected air from short-circuiting into the neighboring Duwamish Waterway. The conservative flow rates and pressures to these sparge wells likely minimized sparging effectiveness.

Operating sparge wells at increased flow rates and pressures was evaluated. However, short circuiting of sparge air would be magnified under increased flows and pressures, resulting in minimal volatilization of hydrocarbons in this deeper groundwater. Additionally, the creation of preferential pathways could reduce effective capture of the Groundwater/LNAPL Recovery System in this area and potentially provide a more direct pathway for surface water and groundwater exchange in this area. For these reasons sparging in the deeper groundwater near wells AMW-01 and AMW-02 was rejected from consideration.

2.3.2 Containment Boom Monitoring

Two petroleum sorbent booms are maintained in the West Duwamish Waterway adjacent to Plant 1 to contain petroleum sheen historically appearing on water. Booms locations, shown in Figure 15 and site photographs in Appendix F, were selected to best contain occasional sheens, likely originating from small cracks and discontinuities in the warehouse foundation or island bulkhead/seawall. The foundation and bulkhead/seawall act as a "hanging" wall, trapping LNAPL while allowing groundwater to flow beneath the base.

The petroleum booms are monitored weekly, at a minimum, for the presence of sheen and integrity, and are replaced as necessary. The Containment Boom Log provided in Appendix G documents sheen presence or absence within the booms and the inspection date and time. Observed sheens are recorded on a scale from zero to two, with zero representing no sheen, one representing a light sheen in a portion of the boom, and two representing a heavy sheen throughout the boom. The Duwamish Waterway tidal stage is also recorded to evaluate if sheens correlate with tidal stage. Results of containment boom monitoring are shown for loading rack area and warehouse area booms in Appendix G.

Sheen monitoring data indicate sheens on the Duwamish Waterway are infrequent and minor since startup of groundwater and soil remediation systems along the waterfront in October 2002. Recent sheen monitoring of the southernmost boom continues a decreasing trend of sheen presence when compared to previous years. No sheens have been observed in the northernmost boom since February 2009.

Recorded sheens often occur during periods when the Groundwater/LNAPL Recovery System is temporarily offline. Sheen observances typically decrease once system operations resume, which indicates that Groundwater/LNAPL Recovery System operation prevents sheen occurrences, as designed.

2.3.3 Inland Soil and Groundwater Remedial Actions

The primary remedy for soils above subsurface soil cleanup action levels for TPH was excavation of accessible “hot spot” soils. In-situ treatment methods, including Monitored Natural Attenuation (MNA) and Soil Vapor Extraction (SVE), were also selected to treat remaining inaccessible hot spot soils beneath buildings, paved drive area, and above ground storage tanks. Additionally, a Restrictive Covenant, effective May 30, 2000 (Section 2.5.), imposes property restrictions in these areas. Excavation and in-situ soil remedy plans were described in the EDR (TechSolv and AG&M, 2000a) and in the Inland Soils Plans and Specifications (TechSolv and AG&M, 2000b).

Cleanup excavations for accessible inland soils at Plants 1 and 2 were completed in 2000. Excavations focused on predetermined areas with additional areas excavated as needed. A total of 3,470 cubic yards of contaminated soil was removed from Plant 1 and Plant 2, as detailed in the TPH Hot Spot Soils Excavation Completion Report (TechSolv and AG&M, 2001). Cleanup of inaccessible areas is discussed below.

Ongoing performance groundwater monitoring conducted following soil excavations showed that cleanup objectives for inland soils at Plant 2 had been met. In 2004, Ecology agreed that cleanup objectives at Plant 2 appeared to have been met, that remaining inaccessible TPH in soils is being adequately treated by monitored natural attenuation, and that remedial actions appeared complete (Ecology, 2004a).

Inaccessible hot spot soils were identified at the southern property boundary of Plant 1 following the soil “hot spot” excavations listed above. Groundwater monitoring indicated that excavations had not restored groundwater quality to meet cleanup standards within the 5 years restoration period, most notably in well AR-03 (Section 2.2.1.2). Groundwater monitoring in well AR-03 shown in Figure 6 detected fluctuating concentrations of benzene and TPH-G, often in excess of associated cleanup levels. Fluctuating concentrations of TPH-G and benzene in well AR-03 directly correlated to seasonal water table elevation fluctuations indicating that the source was located in the vadose zone, which would become saturated during periods of high precipitation.

A focused soil probing investigation conducted in 2005 in the drive area south of the Plant 1 Tank Farm showed TPH-G and benzene to exist within an approximate one-acre source area in soils south of the Plant 1 Tank Farm. This source area was determined to be responsible for continued groundwater impacts at the property boundary (TechSolv, 2006). Additional wells were installed in this area in 2006 to monitor groundwater conditions, as discussed in Section 2.2.1, and contingency remedial actions were implemented as discussed below.

2.3.3.1 Inland SVE System

Contingency remedial actions for soil and groundwater were evaluated in 2007 to remediate the hydrocarbon source area south of Plant 1 as described above. SVE with catalytic oxidation (CATOX) emission control was selected as the preferred remedial alternative. Installation, pilot testing, and startup occurred in 2008, and the system continues in operation to date. The system layout and design is shown in Figure 19.

The system is inspected weekly, when operating, and air samples are collected and analyzed monthly to ensure compliance with PSCAA Notice of Construction No. 9858, to monitor changes in the vapor stream, and to calculate hydrocarbon recovery rates.

To date the Inland SVE System has recovered approximately 7,933 pounds (1,290 gallons) of TPH-G and see Table 7 and Figure 20. Influent concentrations of TPH-G and benzene in the vapor streams decreased sharply after initial system startup and are generally well below PSCAA discharge limits of 50 parts per million by volume (ppmv) for TPH-G and 0.5 ppmv for benzene since late 2008. Influent hydrocarbon vapor concentrations are now below PSCAA treatment thresholds and CATOX emission control has been discontinued (TechSolv, 2010).

In addition to direct hydrocarbon recovery, SVE enhances biodegradation of residual hydrocarbons is soil due from the induced airflow SVE creates within these soils. Biodegradation calculations use influent flow rates and carbon dioxide levels above background (atmospheric) to estimate the hydrocarbon mass reduced by enhanced biodegradation. To date enhanced biodegradation is estimated to have reduced 4,355 gallons of hydrocarbons, bringing combined biodegradation and vapor recovery of petroleum hydrocarbons to 5,642 gallons shown on Table 7 and Figure 20. Carbon dioxide concentrations are now at atmospheric levels, indicating that the bulk of hydrocarbons available to aerobic biodegradation have been reduced or captured.

Inland SVE System operation is periodically discontinued due to high seasonal groundwater elevations, discussed in Section 2.2.1.5. High groundwater increases water capture, system fouling, and can submerge horizontal SVE well screens. System operation is discontinued during these periods until groundwater elevations fall to acceptable levels.

System operation is currently adjusted to pull more vapors from the southwestern horizontal recovery wells by throttling back the northeastern recovery wells. This system modification was conducted in response to concentrations of benzene and TPH-G detected in groundwater above cleanup levels in monitoring wells GM-15S and MW-3-T9 (Section 2.2.1.2) and to respond to the downgradient benzene detected in wells AMW-01 and AMW-02. While groundwater concentrations of IHSs in wells GM-15S, MW-3-T9, AMW-01, and AMW-02 are now mostly below cleanup levels, SVE remains in operation and is adjusted to maximize vapor recovery and biodegradation by these wells.

Groundwater monitoring data results for wells located within the Inland SVE System's capture zone show that the system has improved inland groundwater quality for benzene and TPH-G in this area as listed on Table 1 and plotted on line charts in Appendix C. Groundwater trends in this area are further discussed in Section 2.2.1.2. Overall cleanup actions have been successful for these areas, and cleanup action has improved substantially during this last review period for 2010 through 2014.

2.4 Cleanup Levels

Indicator hazardous substances (IHSs) for the Site were identified and defined in the Cleanup Action Plan. The following section provides a summary of IHSs and Site cleanup levels.

The subsurface soil cleanup action level for TPH at the primary area of concern (Plant 1) was set to meet remedial objectives of protecting surface water at property boundaries and shorelines. The total TPH (TPH-G+TPH-D+TPH-O) cleanup level is also protective for other chemical constituents in petroleum product, such as benzene, toluene, ethylbenzene, xylenes [BTEX]) and total TPH is:

Total TPH	10,000 milligrams/kilogram (mg/kg or parts per million)

The subsurface soil cleanup action level for TPH at the secondary area of concern (Plant 2) was set to meet remedial objectives of protecting surface water at property boundaries by improving general groundwater conditions at the source. This cleanup level was also set to enhance the timely restoration of impacted areas through monitored natural attenuation, and is:

Total TPH	20,000 mg/kg or ppm

Site groundwater cleanup levels established by Ecology were based on surface water standards, to be protective of aquatic organisms in the Duwamish River. These standards are adopted ambient water quality criteria in WAC 173-201A and Section 304 of the Federal Clean Water Act. Surface water standards were not established for TPH when the CAP was approved, so groundwater cleanup levels for TPH-G, TPH-D, and TPH-O were selected by Ecology as protective cleanup goals. Site groundwater cleanup levels are:

Product (LNAPL)	No sheen
Benzene	71 micrograms/liter (µg/L or parts per billion)
Carcinogenic Polycyclic Aromatic Hydrocarbons cPAHs	0.031 µg/L or ppb
Copper	2.9 µg/L or ppb
TPH-G	1,000 µg/L or ppb
TPH-D	10,000 µg/L or ppb
TPH-O	10,000 µg/L or ppb

2.5 Restrictive Covenant

A Restrictive Covenant was recorded for the Site in May 2000 as part of the Consent Decree (Ecology, 2000b), attached in this report in Appendix A which imposed the following limitations:

- The Property shall be used only for traditional industrial uses, as described in RCW 70.105D.020(22) and defined in and allowed under the City of Seattle's zoning regulations codified in the City of Seattle Zoning Code as of May 2000.

- No groundwater may be taken for any purpose from the Property that is inconsistent with the Remedial Action implementation.

- As of the date the Consent Decree was entered, a portion of the Property contains total petroleum hydrocarbons in soils; dissolved total petroleum hydrocarbons, and carcinogenic polycyclic aromatic hydrocarbons (cPAHs) in groundwater; floating product on the water table; and vapors in soil located under the warehouse and near the loading rack. The owner shall not alter, modify, or remove the existing structure(s) in any manner that may result in the release or exposure to the environment of the contaminated soil or create a new exposure pathway without prior written approval from Ecology, which approval will not be unreasonably withheld. Site workers conducting construction activities within the protective zone of contamination will be instructed on precautionary actions to avoid direct contacts with contaminated soils, groundwater or exposure to vapor and fumes and on appropriate methods for handling such wastes.

- Elevated concentrations of residual petroleum hydrocarbons are also present in the area of above-ground storage tanks no. 1, 4, 5, 6, 8, 9, 11, 13 and the loading rack in Plant 1; and near tanks 20001, 20007, 20008 and 59001 in Plant 2. These areas are shown in the figures in the Restrictive Covenant. Site workers conducting construction activities within these areas will follow the Safety and Health Plan. Also they will be instructed on precautionary actions to avoid direct contact with contaminated soils and groundwater to ensure protection of Site workers.

- Any activity on the Property that is inconsistent with the Remedial Action [Consent Decree and Cleanup Action Plan] implementation, or may create a new pathway to the existing contamination that endangers the public health and the environment, is prohibited without written approval from Ecology, which approval shall not be unreasonably withheld.

- The owner of the Property must give thirty (30) days advance written notice to Ecology prior to a conveyance or transfer of any interest in the Property. No conveyance of title, easement, lease, or other interest in the Property shall be consummated by the owner without adequate and complete provision for continued monitoring, operation, and maintenance of the Remedial Action if such Remedial Action is necessary and ongoing at the time of any conveyance or transfer of any interest in the Property.

- The owner must restrict leases to uses and activities consistent with the Restrictive Covenant and notify all lessees of the restrictions on the use of the Property.

- The owner must notify and obtain approval from Ecology prior to any use of the Property that is inconsistent with the terms of this Restrictive Covenant. Ecology may approve any inconsistent use only after public notice and comment. Approval by Ecology shall not be unreasonably withheld.

- The owner shall allow authorized representatives of Ecology the right to enter the Property at reasonable times for the purpose of evaluating the Remedial Action; to take samples, to inspect Remedial Actions conducted at the Property, and to inspect records that are related to the Remedial Action. Ecology will provide ARCO [BP] with advance notice of its entrance on the Property when appropriate. Ecology shall adhere to Access and Operating Procedures, which is attached to the Consent Decree as Exhibit C.

- The owner of the Property reserves the right under WAC 173-340-440 to record an instrument that provides that this Restrictive Covenant shall no longer limit use of the Property or be of any further force or effect. However, such an instrument may be recorded only if Ecology, after public notice and opportunity for comment, concurs, which concurrence shall not be unreasonably withheld.

2.6 Proposed Seawall Installation

BP initiated plans to install a new seawall waterward of the existing timber bulkhead at Duwamish West Waterway. Seawall design details were provided to Ecology (TechSolve, 2013). The project is intended to provide a long-term solution to the seismic protection of the Site, essential for supporting upland infrastructure and maintaining Site facilities function. The existing bulkhead wall, which borders the Plant 1 shoreline, is likely part of the original Harbor Island bulkhead constructed in the early 1900s and was not designed for current seismic stability of upland infrastructure. Settling of the warehouse foundation as a result of the 2001 Nisqually earthquake indicated that the Site was seismically vulnerable. Additionally, signs of bulkhead deterioration are present including splitting along the top of piles and missing horizontal timber lagging have been observed at several locations.

The new seawall has been designed as a vertical steel combination sheet pile wall anchored with grouted ground tiebacks. This proposed seawall will be offset waterward of the existing bulkhead to the minimum extent possible, with a maximum span of approximately 720 linear feet from the northern property boundary to the southern property boundary including return walls.

The seawall design was selected from several alternatives after geotechnical analysis and engineering review determined that it implements necessary seismic upgrades, meets current standards, and allows the existing bulkhead to remain in place during construction, which is necessary to maintain structural stability in upland areas. This design also poses the least disturbance to ongoing remediation activities near the waterfront, and the Groundwater/LNAPL Recovery System. The design also results in the smallest construction footprint waterward of the Ordinary High Water Mark (OHWM) of the potential design alternatives.

A seawall installed waterward of the existing bulkhead was the preferred design alternative, in part, because it benefits ongoing remedial actions by:

- Creating an additional barrier to groundwater migration waterward of the existing seawall.
- Allowing the existing bulkhead to remain intact during construction.
- Allowing for the continued operation of the Groundwater/LNAPL Recovery System during construction.

Installing a new seawall inward of the exiting bulkhead was eliminated from consideration early in the evaluation stage. Construction of an inward seawall would damage Site infrastructure including the existing bulkhead, remediation systems, and monitoring wells. An inward seawall would also require shutdown of remediation systems during construction, and potentially allow contamination waterward of the new seawall to migrate to the Duwamish during construction.

The proposed project was initially intended to be installed in two phases, in subsequent years. Phase I would consist of construction of the “north” bulkhead, representing approximately 325 linear feet to the north of the pier shown in Figure 15. Phase II would consist of installation of the “south” bulkhead, representing approximately 390 linear feet south of the pier walkway, including a southern return wall. Work windows were designed to correspond with the approved Lower Duwamish work window for fish protections authorized by the Washington State Department of Fish and Wildlife.

The proposed Seawall project components include:

- Temporary removal of portions of the existing concrete pier walkway and dock pipelines.
- Interlocking steel sheet pile installation to a depth of approximately 70 feet below ground surface.
- Demolition of the existing elevated catwalk along the north bulkhead.
- Partial demolition of creosote-coated timber piles, lagging, and crossbeams where practicable above the riprap and or mudline.
- Placement of clean, granular engineered structural fill between bulkhead walls.

- Grouted ground tieback anchor installations.
- Concrete cap initial construction.
- Anchor proof and performance testing.
- Final concrete pour.
- Cathode protection installation.

Construction plans have been evaluated and modified as necessary to avoid damaging existing remediation systems and monitoring wells. These evaluations determined that seven monitoring wells (AMW-01 through AMW-05, GM-10D, and GM-13D) located along the waterfront (Figure 6) could be damaged during tieback drilling and grouting operations. These wells are completed in locations and screened at depths (from 20 feet below ground surface and deeper) where damage from tieback installation may occur. Engineers designed tiebacks to slope inland to the maximum angle allowable (1.5 vertical to 1 horizontal) in order to avoid most waterfront wells, which are more shallowly screened. Designs were modified to provide maximum protective horizontal spacing between these seven deeper wells and planned tieback installation locations.

Best management practices will be implemented during construction, such as booming waterways during vibratory sheet pile driving and tieback anchor installations, to ensure that any sheens generated by construction activities are captured and contained. Recovery system components located adjacent to the seawall will be inspected for integrity throughout seawall construction. Remediation system components and wells damaged during construction will be repaired or replaced, as needed.

The timeline for installing the northern 325 linear feet of seawall and temporary demolition of a portion of the pier walkway has been delayed until late summer 2015 at the earliest, as the Army Corp of Engineers (ACOE) is yet to approve project permitting. Delays in permitting completion have been attributed to staffing changes within the ACOE and from the negotiation of mitigation requirements for the conversion of approximately 2,150 square feet of aquatic intertidal land to upland. Land conversion will occur as the proposed seawall is designed to be installed 3.4 feet (on average) waterward of and paralleling the existing bulkhead.

BP is required to mitigate waterward conversion. BP is evaluating mitigation options that will satisfy Corps of Engineers requirements, including BP led onsite mitigation and buying credits from a mitigation bank to satisfy compensatory mitigation requirements. The option that appears preferred is to buy credits from the In-Lieu Fee Program operated under the King County Mitigation Reserves Program. BP is currently working with the King County Mitigation Reserves Program to obtain a legal agreement for securing the required credits.

BP has continued to prepare for the planned installation of the northern portion of the seawall by purchasing and staging of interlocking steel sheet pile onsite (see photos in Appendix F) and installing of a test anchor in the northwest corner of Plant 1. The test anchor was installed to establish and verify the required bond length for the tieback anchors.

Seawall designs and construction activities have been reviewed by BP to ensure compliance with Consent Decree and Groundwater Compliance Monitoring and Contingency Program requirements. Ecology will be notified and consulted if modifications or alterations to the monitoring well network or the Groundwater/LNAPL Recovery System are required.

The construction contractor for the project has been selected and final designs for the northern phase of the installation were included in the 2012 Annual Site Report (TechSolve, 2013). Designs for the southern portion of the seawall have been developed and a final design package will be provided to Ecology when available.

Installation of the seawall will affect hydrology at the Site and groundwater capture by the Groundwater/LNAPL Recovery System. The new seawall will protect the Duwamish West Waterway by creating an additional barrier to shallow groundwater discharge from the Site to the Duwamish Waterway, further isolating groundwater behind the seawall. This determination is based upon a detailed review of the construction plans, evaluations on the affects to the Site Hydrologic Model, and review of similar affects observed at the adjacent Lockheed Martin property, to the south of the Site, following installation of a shallower seawall of similar design. Preliminary evaluations are being conducted in advance of the seawall installation to estimate the impact of the seawall on hydrology at the Site.

Formal evaluations of the seawall’s impact on Site hydrology will be conducted following completion of the seawall installation, as agreed to by Ecology (Ecology, 2012). This evaluation is planned to include a review of hydraulic containment, as recommended by EPA in the Third Five-Year Review Report (EPA, 2010). EPA’s recommendation to review hydraulic containment was due to historically elevated benzene concentrations in compliance monitoring wells AMW-01 and AMW-02. Benzene concentrations in these wells have markedly decreased since the time of the Third Five-Year Review, and are mainly below the benzene cleanup level since 2013 and discussed earlier in Section 2.2.1.1. While the original driver to review hydraulic containment may be eliminated by the time the new seawall is installed, BP will evaluate hydraulic containment following seawall installation to evaluate the effects of the seawall to current hydrology at the Site.

3.0 PERIODIC REVIEW

3.1 Effectiveness of completed cleanup actions

The Restrictive Covenant for the Site was recorded and is in place. This Restrictive Covenant prohibits activities that will result in the release of contaminants at the Site without Ecology's approval, and prohibits any use of the property that is inconsistent with the Covenant. This Restrictive Covenant serves to ensure the long term integrity of the remedy (Appendix A).

Based upon the Site visit conducted on December 4, 2014, the buildings, asphalt cover, and ongoing cleanup action operations at the Site continue to eliminate exposure to contaminated soils by ingestion and contact. The asphalt appears in satisfactory condition and no repair, maintenance, or contingency actions have been required. The Site continues operation as a major petroleum distribution and storage facility. A photo log is available in Appendix F with EPA Five-Year Review Form.

Soils with petroleum and petroleum related substances show concentrations higher than MTCA cleanup levels are still present at the Site. However, the remedy prevents human exposure to this contamination by ingestion and direct contact with soils. The Restrictive Covenant for the property will ensure that the contamination remaining is contained and controlled.

3.2 New scientific information for individual hazardous substances for mixtures present at the Site

There is no new scientific information for the contaminants related to the Site.

3.3 New applicable state and federal laws for hazardous substances present at the Site

The cleanup at the Site was governed by a formal consent decree entered into between Ecology and ARCO [BP] and is not subject to MTCA Revisions.

3.4 Current and projected Site use

The Site is currently used for industrial purposes as a bulk fuel terminal. There have been no changes in current or projected future Site or resource uses.

3.5 Availability and practicability of higher preference technologies

The remedy implemented included containment of hazardous substances, and it continues to be protective of human health and the environment. While higher preference cleanup technologies may be available, they are still not practicable at this Site.

3.6 Availability of improved analytical techniques to evaluate compliance with cleanup levels

The analytical methods used at the time of the remedial action were capable of detection below selected Site cleanup levels. The presence of improved analytical techniques would not affect decisions or recommendations made for the Site.

4.0 CONCLUSIONS

The following conclusions have been made as a result of this periodic review:

- The cleanup actions completed at the Site appear to be protective of human health and the environment.

- Soil cleanup levels have not been met at all the standard points of compliance for the Site; however, the cleanup actions have been determined to comply with the cleanup standards since the long-term integrity of the containment system is ensured, and the requirements for containment technologies are being met.

- Benzene groundwater concentrations measured in compliance monitoring wells AMW-01 and AMW-02 were identified as an area of concern in EPA's Third Five Year Review Report for the Harbor Island Superfund Site from 2010. Benzene concentration measured in these wells have decreased markedly since the 2010 review and are now mainly below the Site cleanup level. BP reviewed historical capture zone analyses performed along the waterfront and have determined that the calculations are valid for current Site conditions and that the existing Groundwater/ LNAPL Recovery System provides adequate groundwater capture in this area.

- BP is in the process of voluntarily replacing portions of the existing seawall along the waterfront and has agreed to perform additional hydraulic modeling along the waterfront after the new seawall is installed to evaluate changes to Site hydrology.

- BP evaluated several remedial strategies to reduce benzene groundwater concentrations in wells AMW-01 and AMW-02 and choose to continue operation of the Inland SVE System that is capturing the only known upgradient source of benzene in the area. BP is also continuing operation of the existing Groundwater/ LNAPL Recovery System that actively captures shallow groundwater above these monitoring wells. Changes to the operation of this exiting Groundwater/LNAPL Recovery System were evaluated, including the installation of deeper recovery wells and restarting air sparging in the deeper aquifer around these wells. Operation of more deeply screened recovery wells was eliminated from consideration as deeper wells could pull the smear zone down below the existing seawall, creating a more direct pathway for LNAPL and shallow groundwater contamination to discharge to surfacewater. Deeper sparging was eliminated from consideration as this technology was utilized onsite from 2005 to 2007 in deeper wells but was found to create preferential pathways to the Duwamish West Waterway, which could potentially reduce effective capture in this area.

- Benzene is now mainly below the cleanup level in the AMW-01 and AMW-02 area, and appears that the remedial strategies implemented are effectively improving groundwater conditions in this area. Additional hydraulic evaluations will be conducted in this area once the new seawall installation is completed.

- The Restrictive Covenant for the property is in place and continues to be effective in protecting public health and the environment from exposure to hazardous substances and protecting the integrity of the cleanup action.

Based on this periodic review, the Department of Ecology has determined that the requirements of the Restrictive Covenant continue to be met. No additional cleanup actions are required by the property owner. It is the property owner's responsibility to continue to inspect the Site periodically to assure that the integrity of the remedy is maintained.

4.1 Next Review

The next review for the Site will be scheduled five years from the date of this periodic review in 2019. In the event that additional cleanup actions or institutional controls are required, the next periodic review will be scheduled five years from the completion of those activities.

Ecology recommends continued cleanup action and compliance monitoring and to review the Restrictive Covenant in 2019 prior to the next review.

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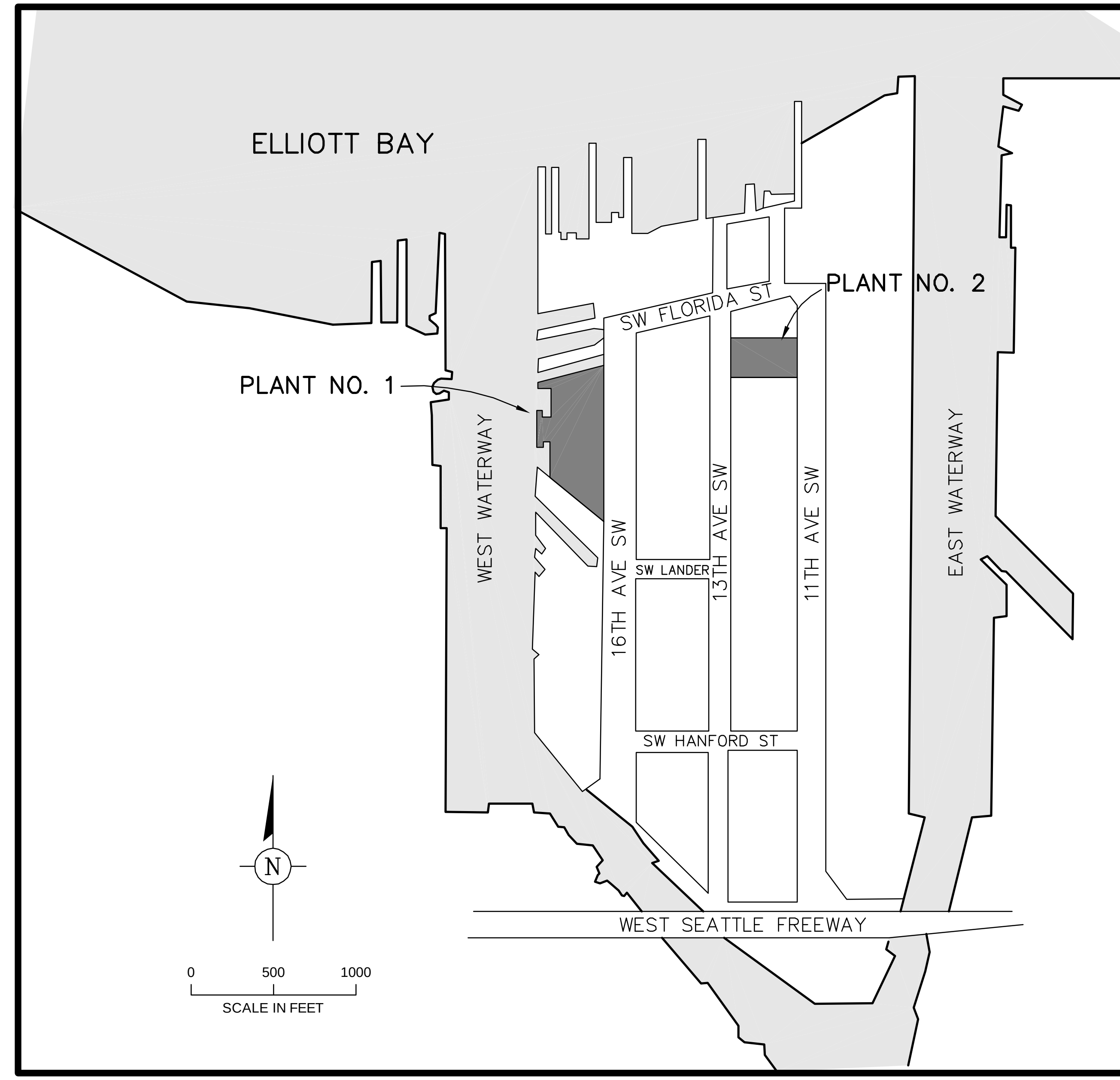
Figures

Tables

AREA PLAN



SITE PLAN

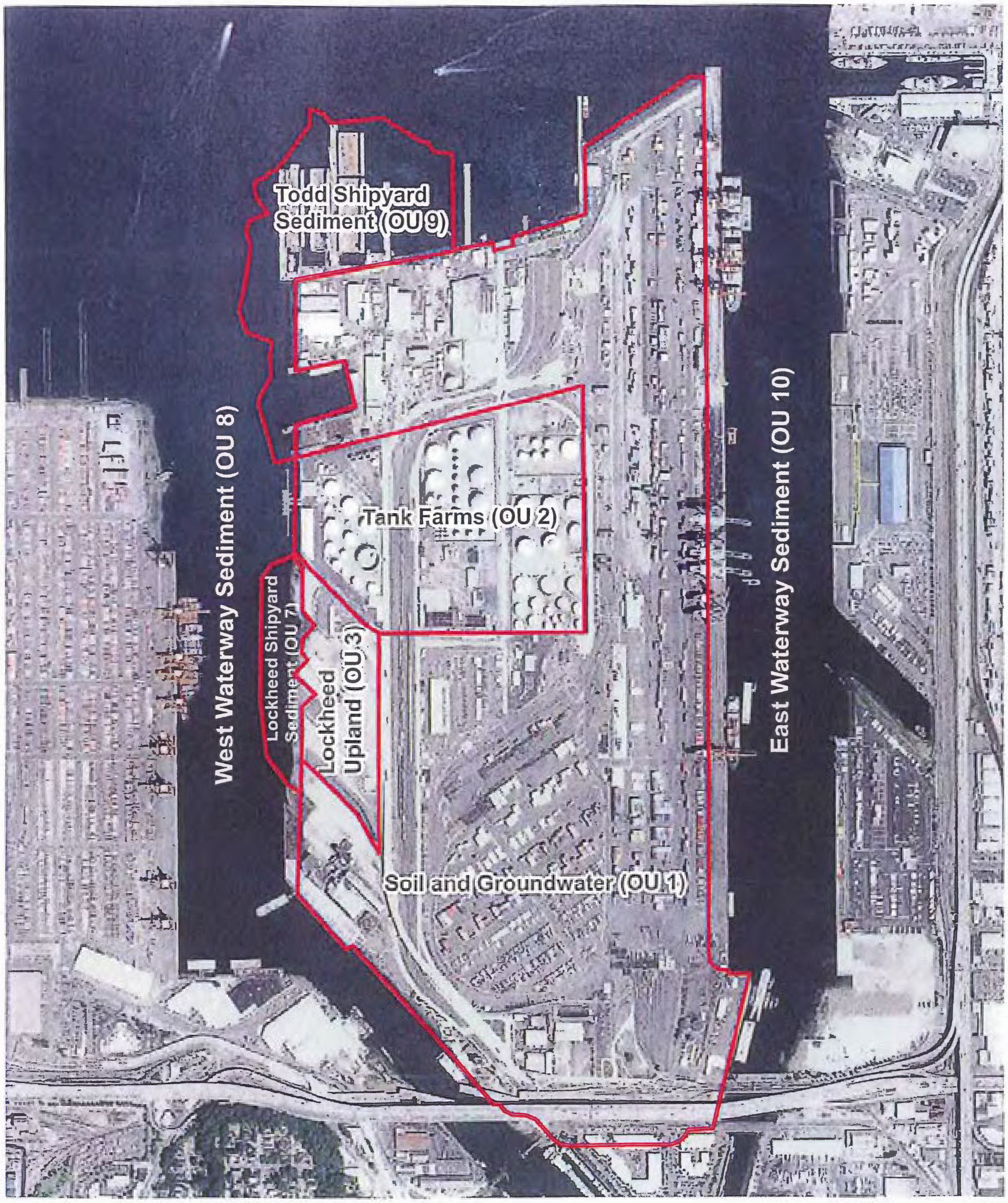
TECHSOLVE ENVIRONMENTAL
7518 NE 169th Street, Kenmore WA 98028
(425) 402-8277 FAX (425) 402-7917

Site Location Map

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

FIGURE

1



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SCALE IN FEET

Operable Unit Boundary

Figure 2

Harbor Island Operable Units

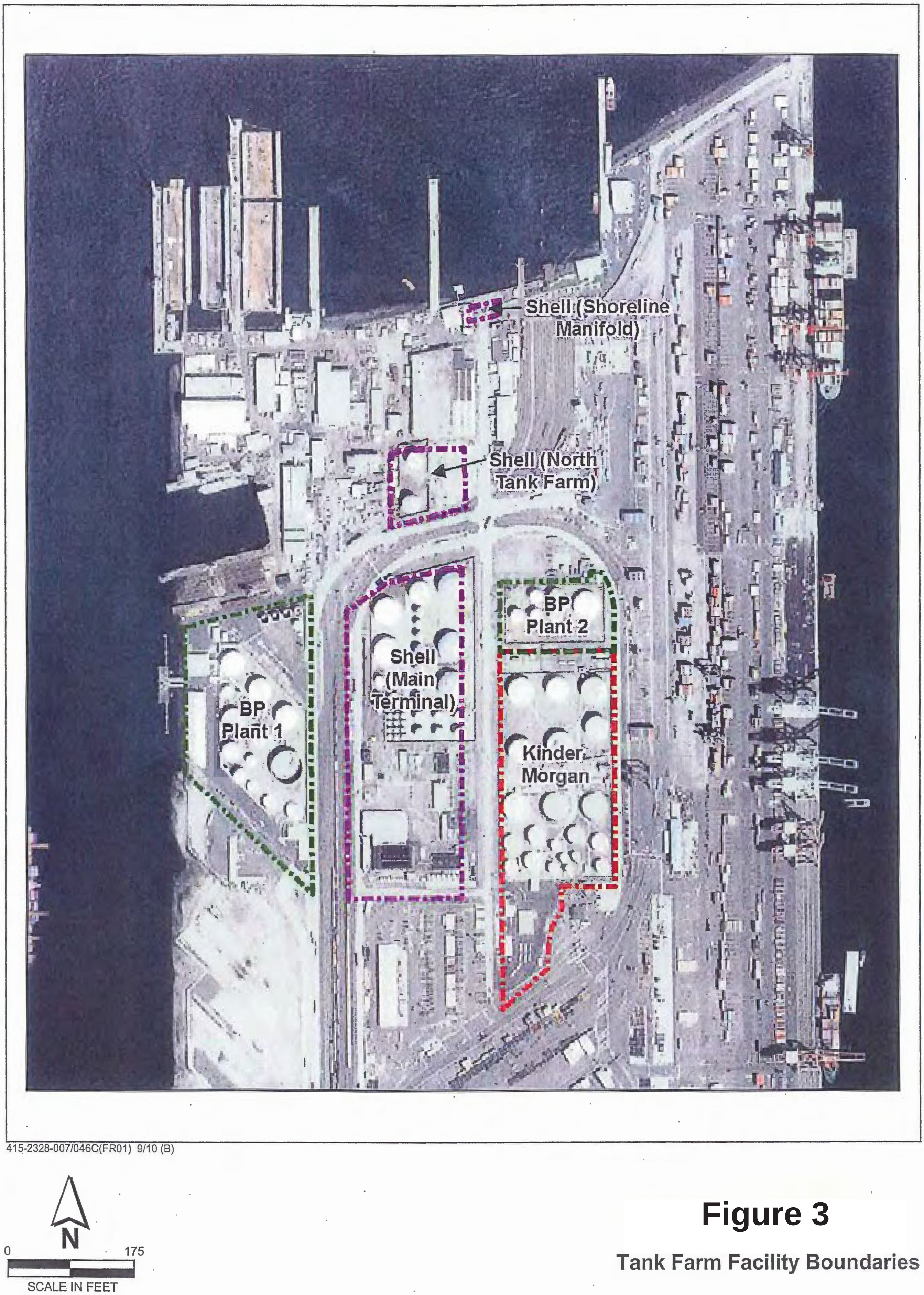
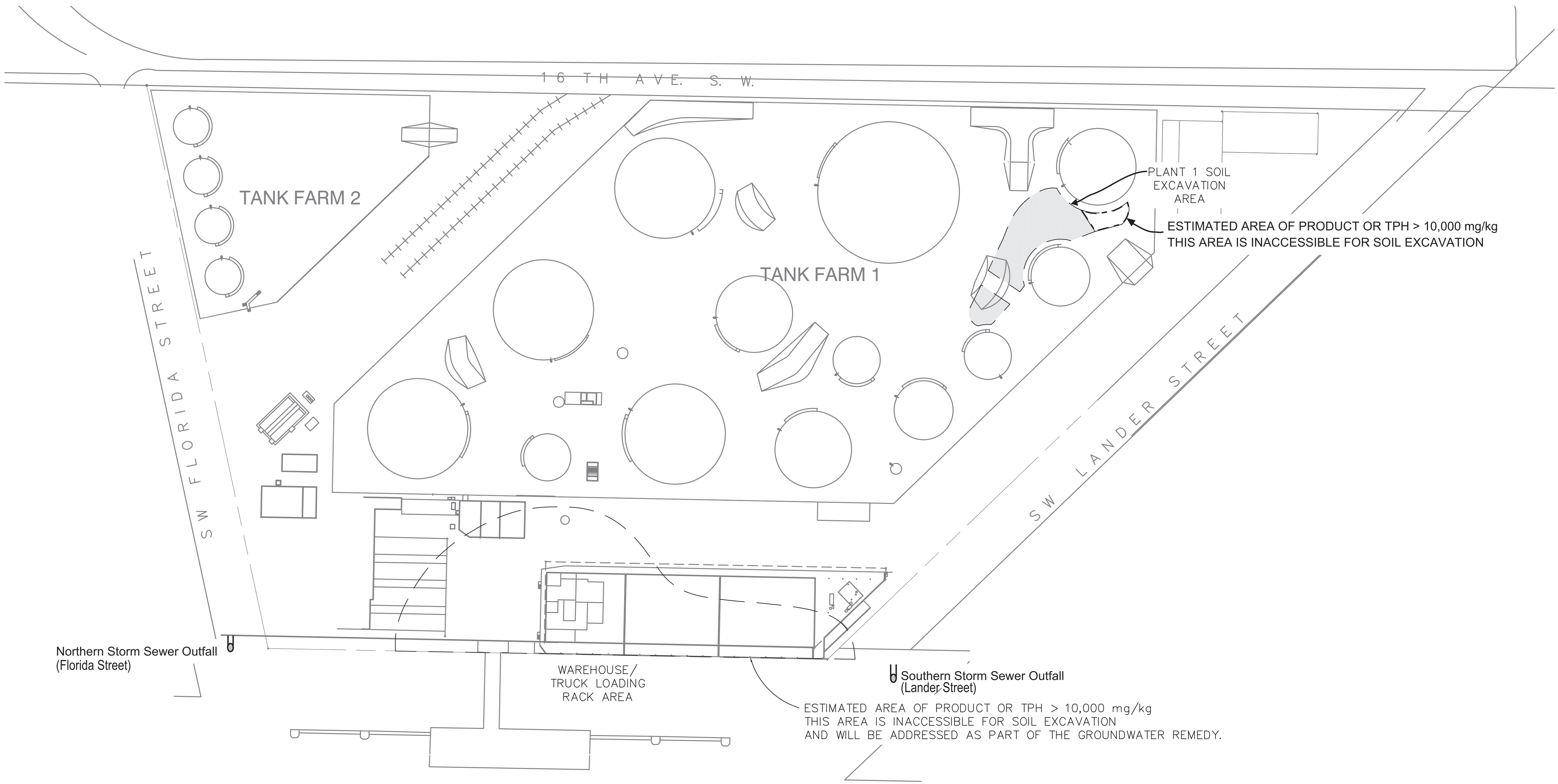


Figure 3

Tank Farm Facility Boundaries



LEGEND

ESTIMATED AREA WITH PRODUCT OR TPH > 20,000 ppm

EXCAVATED REMEDIATION AREAS

N

0 50 100
SCALE IN FEET

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Areas of Remediation - Plant 1

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

FIGURE
4

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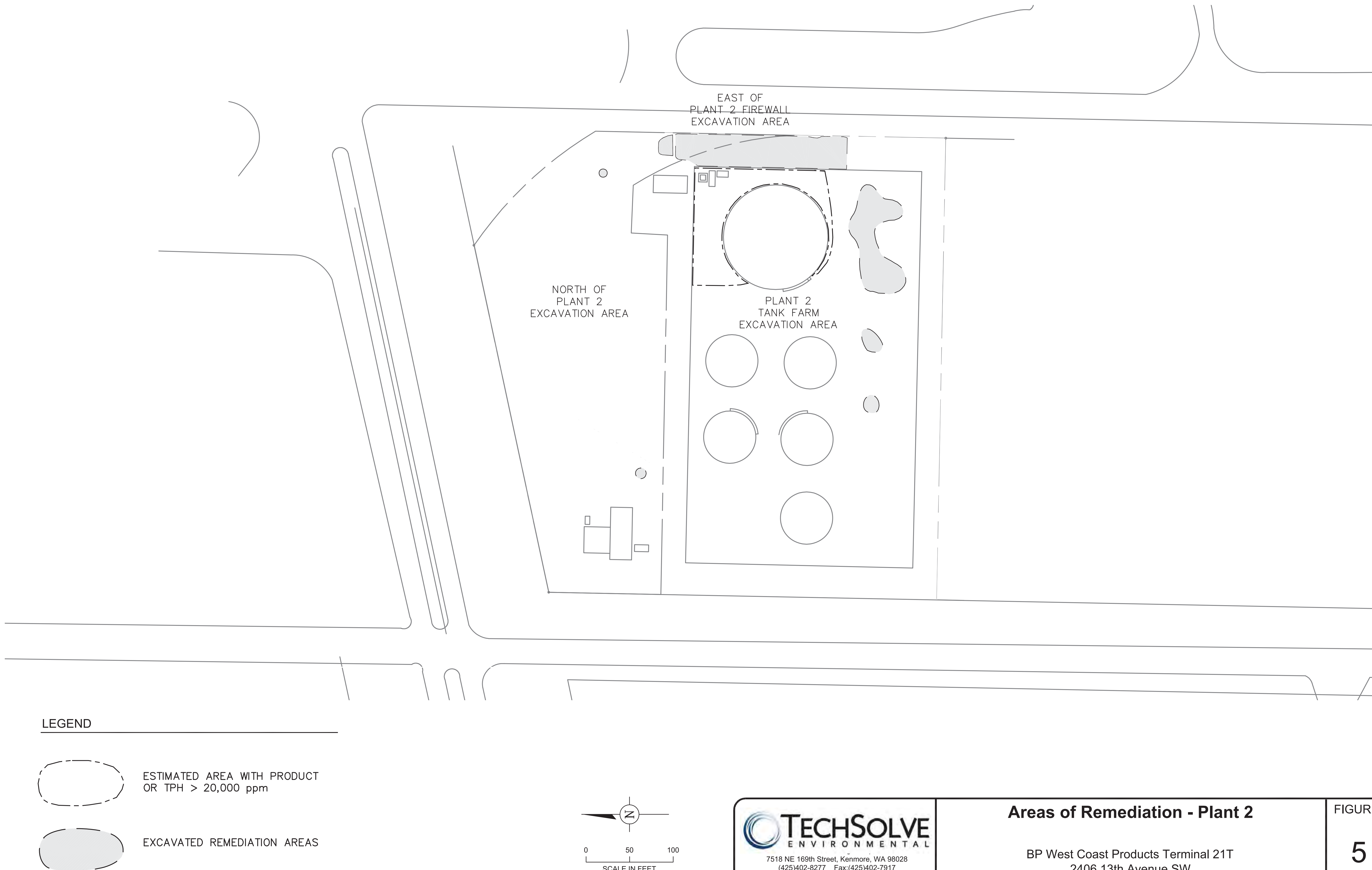

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Areas of Remediation - Plant 2

BP West Coast Products Terminal 21T
2406 13th Avenue SW
Seattle, WA 98134

FIGURE
5

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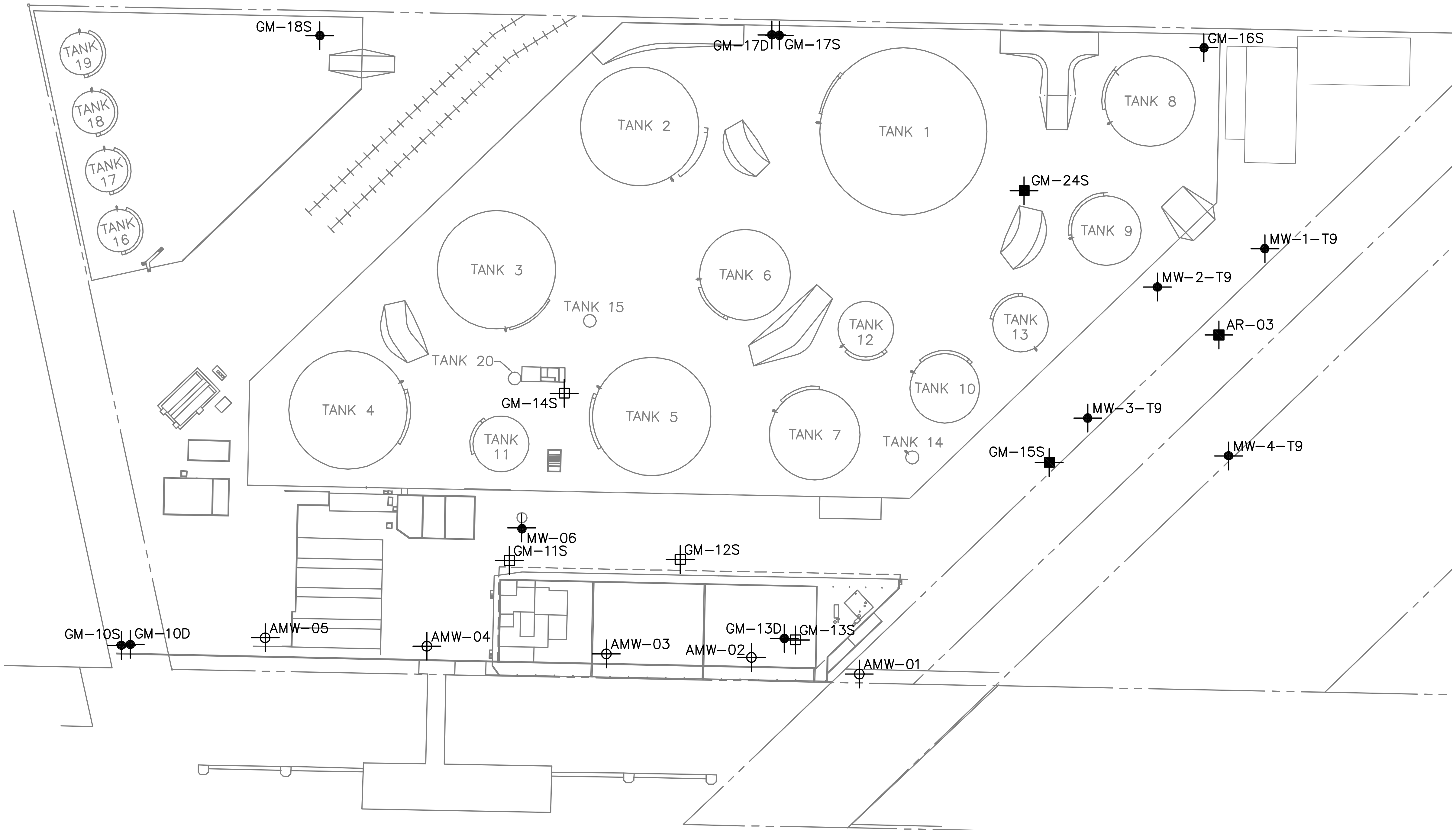

LEGEND

GM-16S	MONITORING WELL
AMW-01	PERFORMANCE/CONFIRMATION WELL
GM-13D	PERFORMANCE WELL
GM-13S	PRODUCT PERFORMANCE WELL

N

0 50 100

SCALE IN FEET

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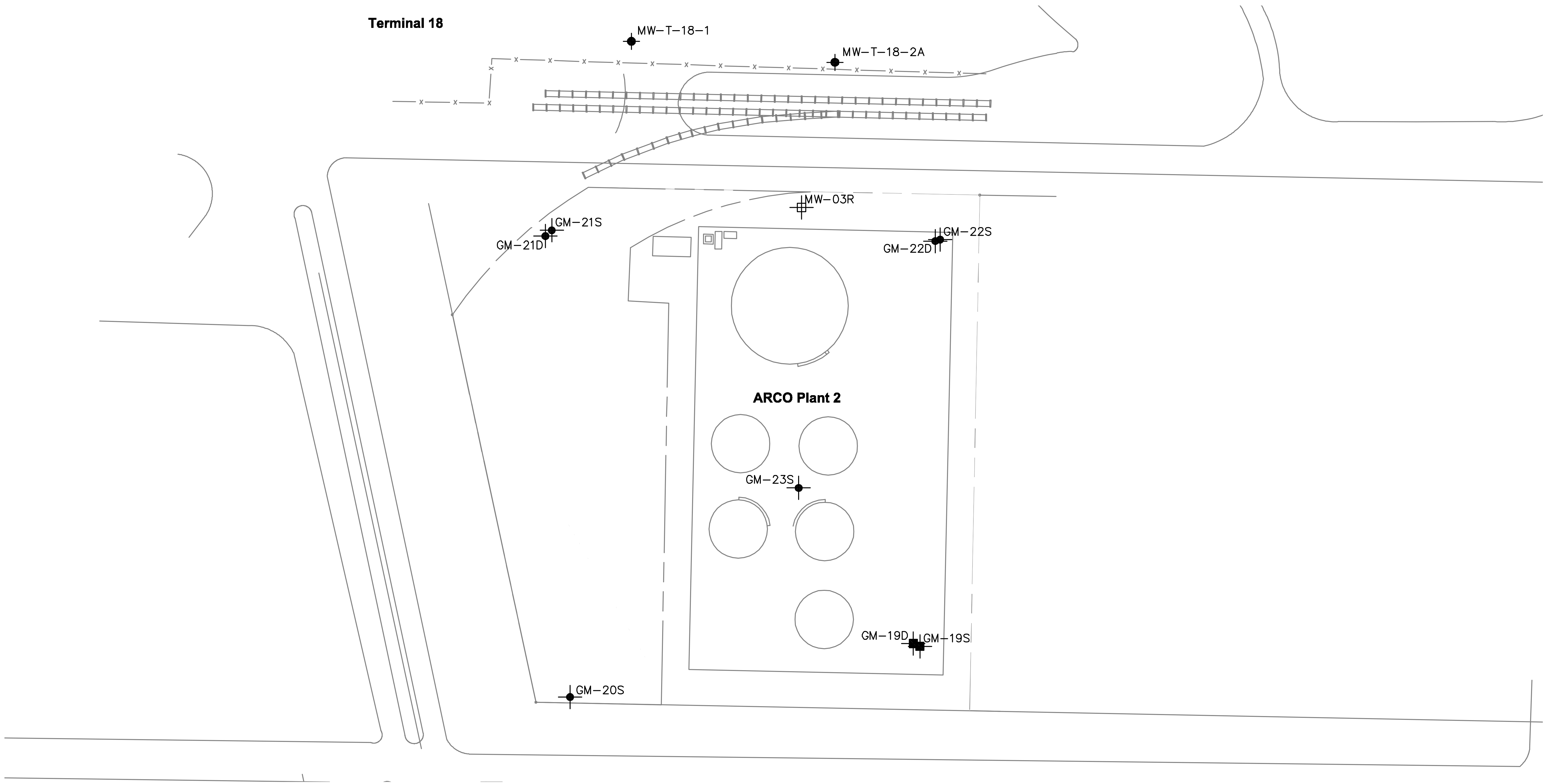
Plant 1 Monitoring Well Network

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

FIGURE
6



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LEGEND

GROUNDWATER MONITORING WELL
PRODUCT PERFORMANCE WELL
PERFORMANCE WELL

N

0 50 100
SCALE IN FEET

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Plant 2 Monitoring Well Network

BP West Coast Products Terminal 21T
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Seattle, WA 98134

FIGURE
7

Figure 8. AMW-01 Hydrocarbon Analytical

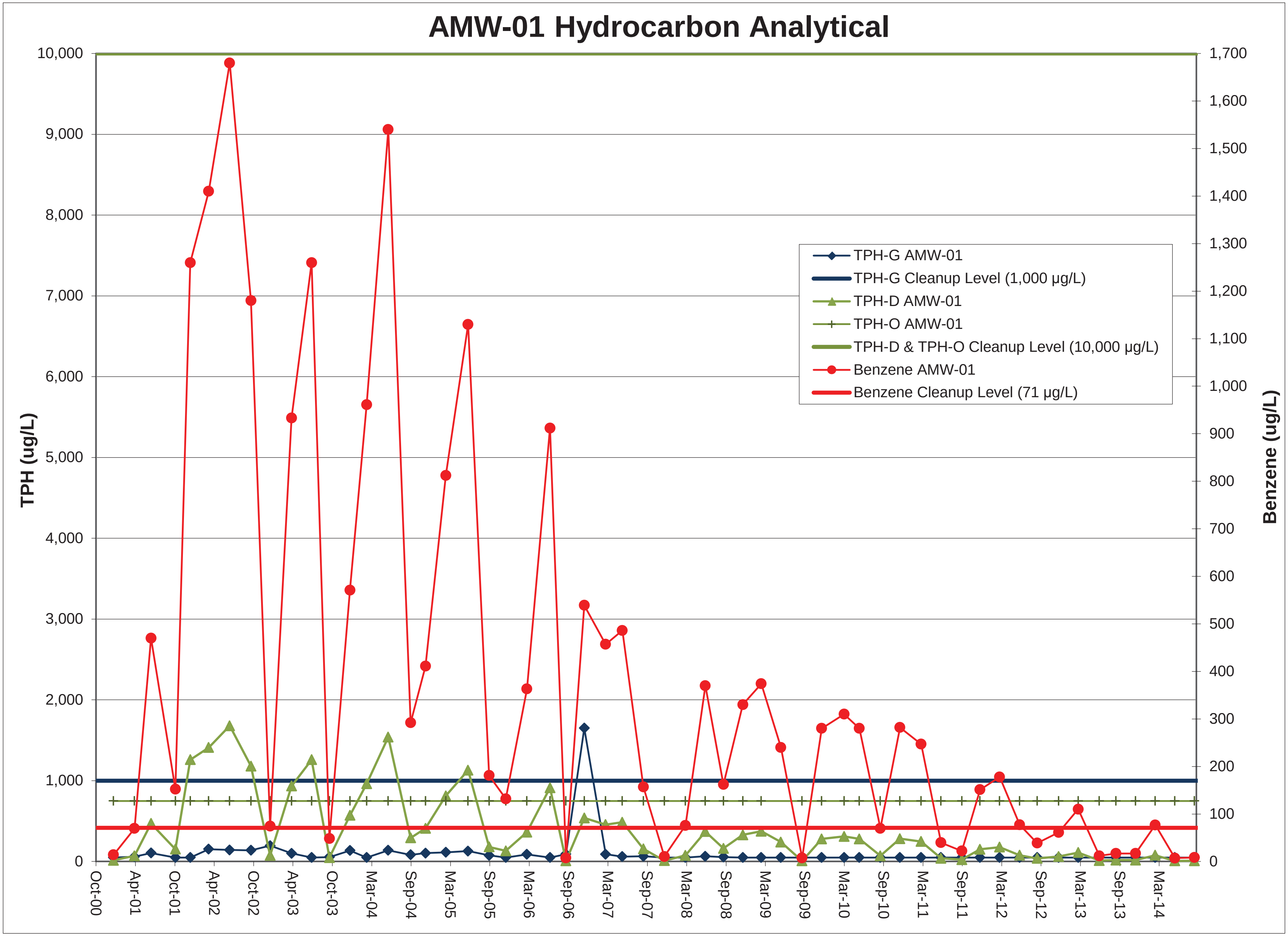


Figure 9. AMW-02 Hydrocarbon Analytical

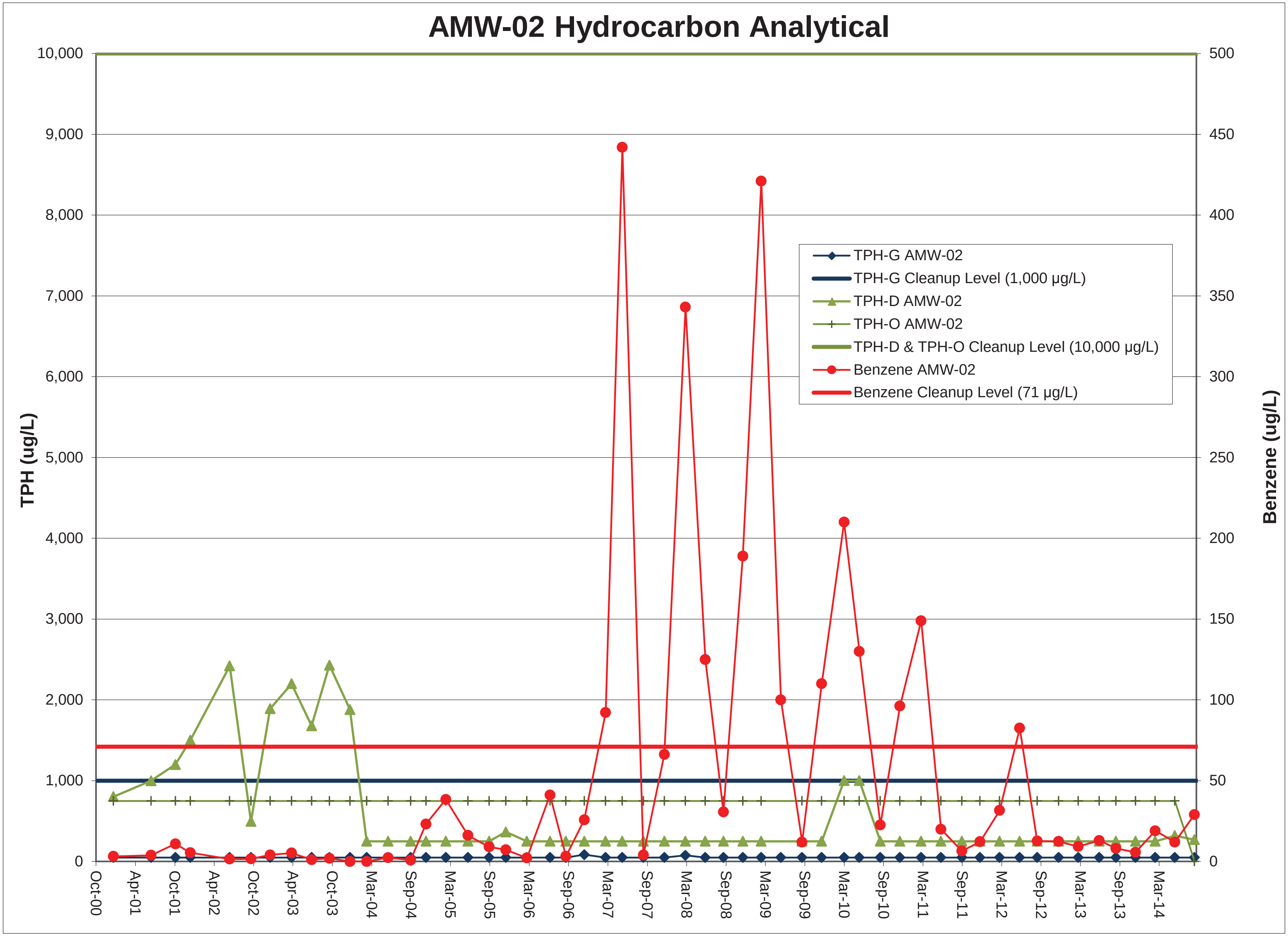


Figure 10. MW-3-T9 Hydrocarbon Analytical

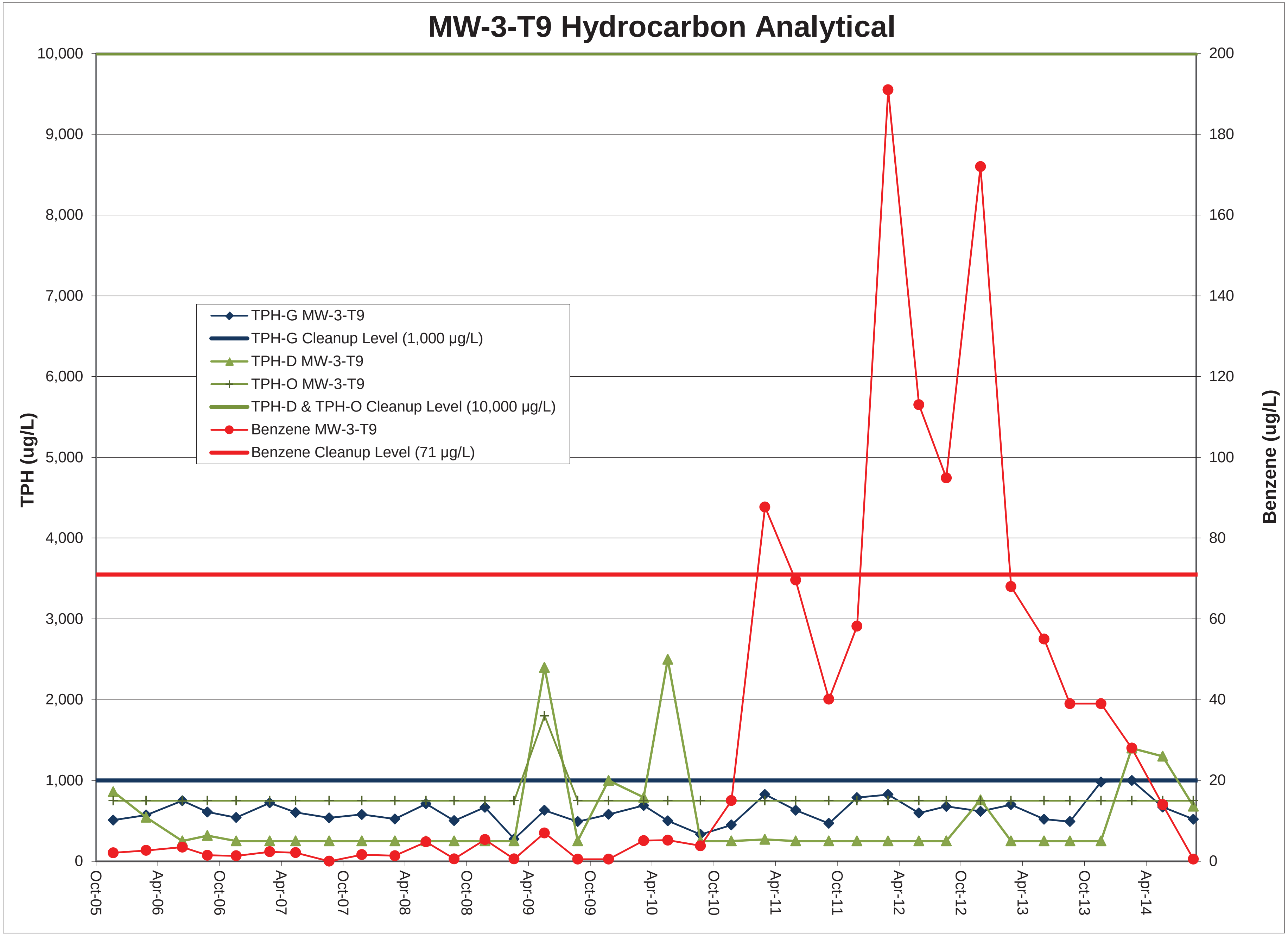


Figure 11. Inland Plant 1 Quarterly Groundwater Hydrograph
1998 to 2014
BP West Coast Products Terminal 21T, Harbor Island, Seattle, Washington

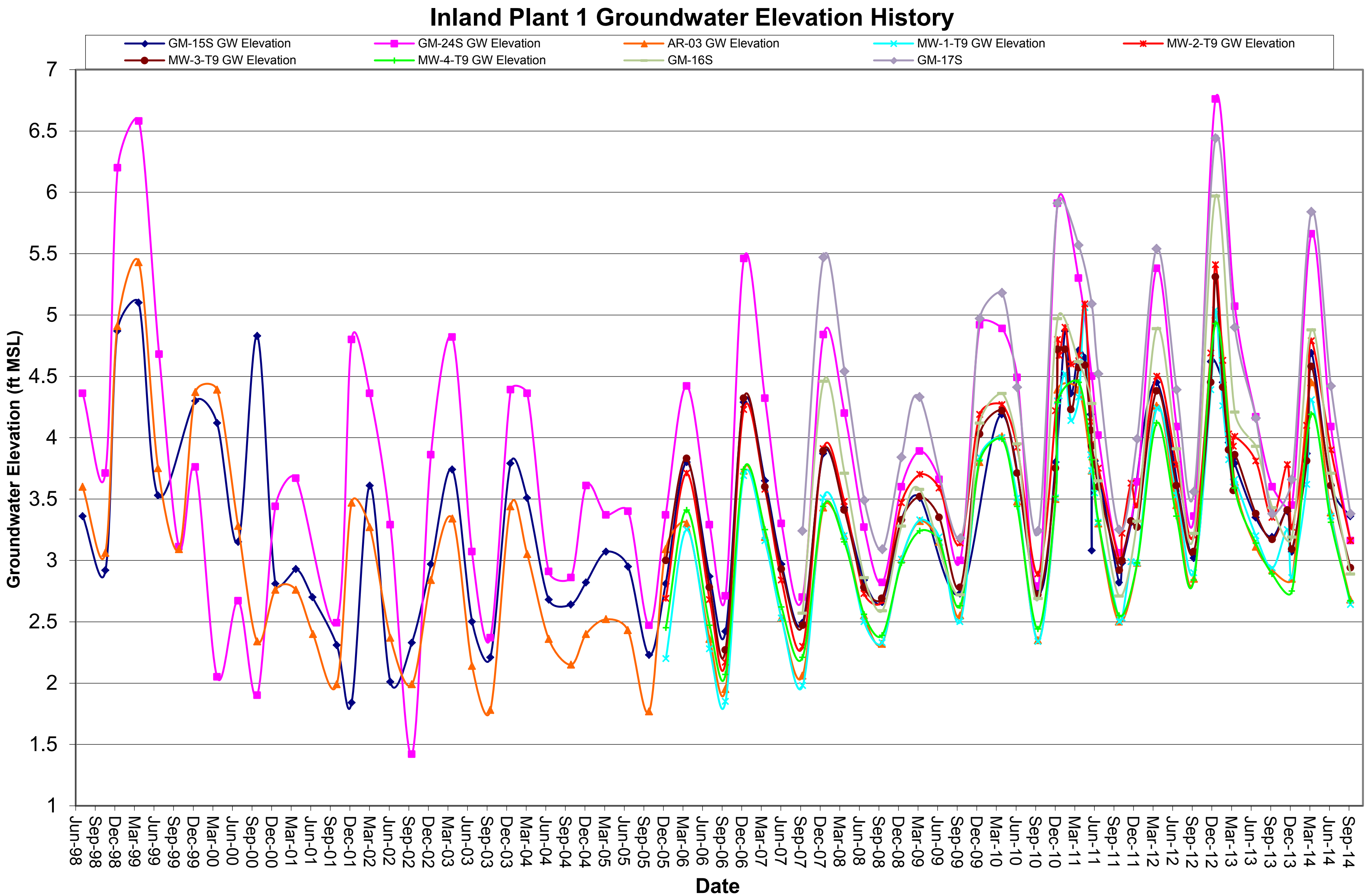
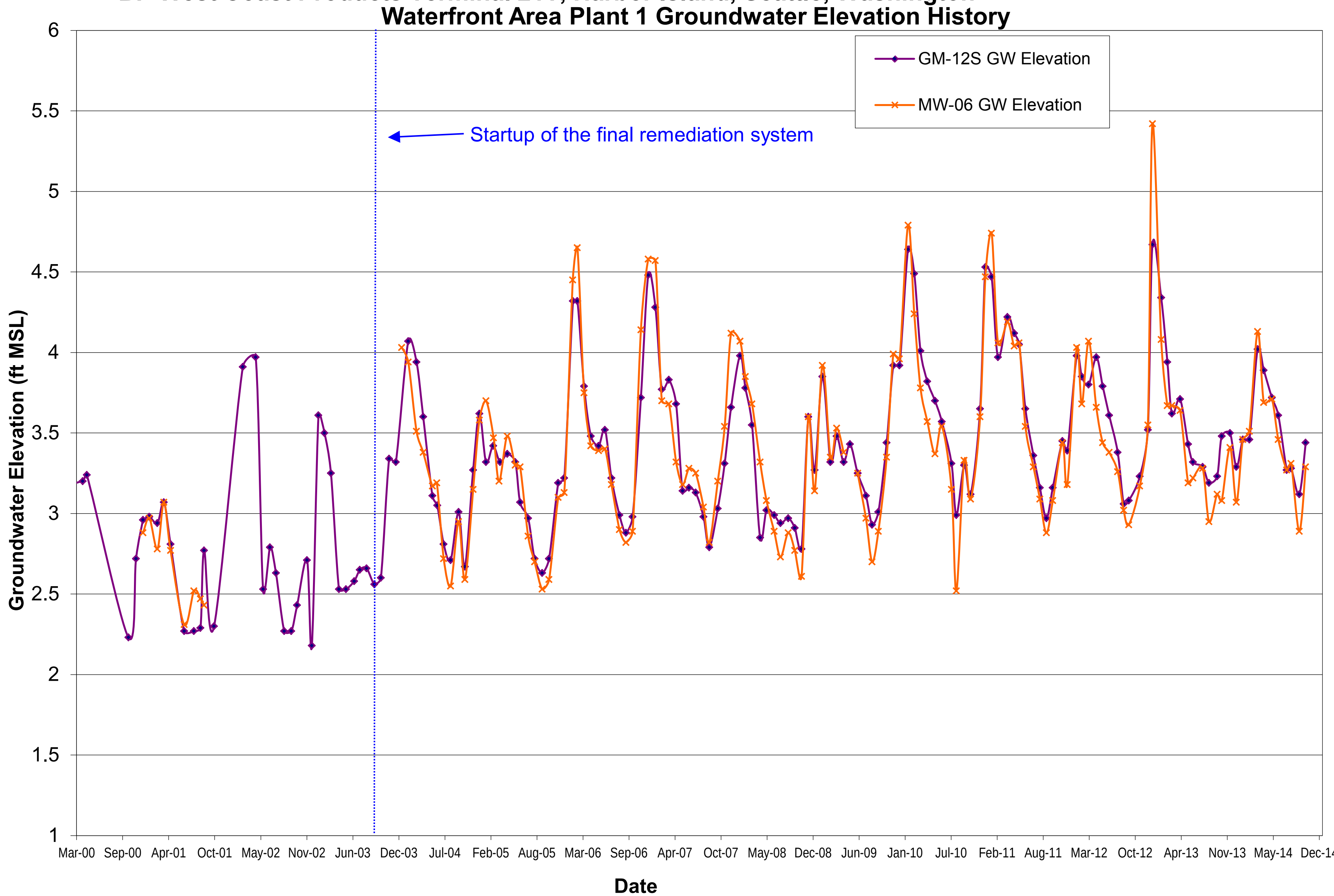
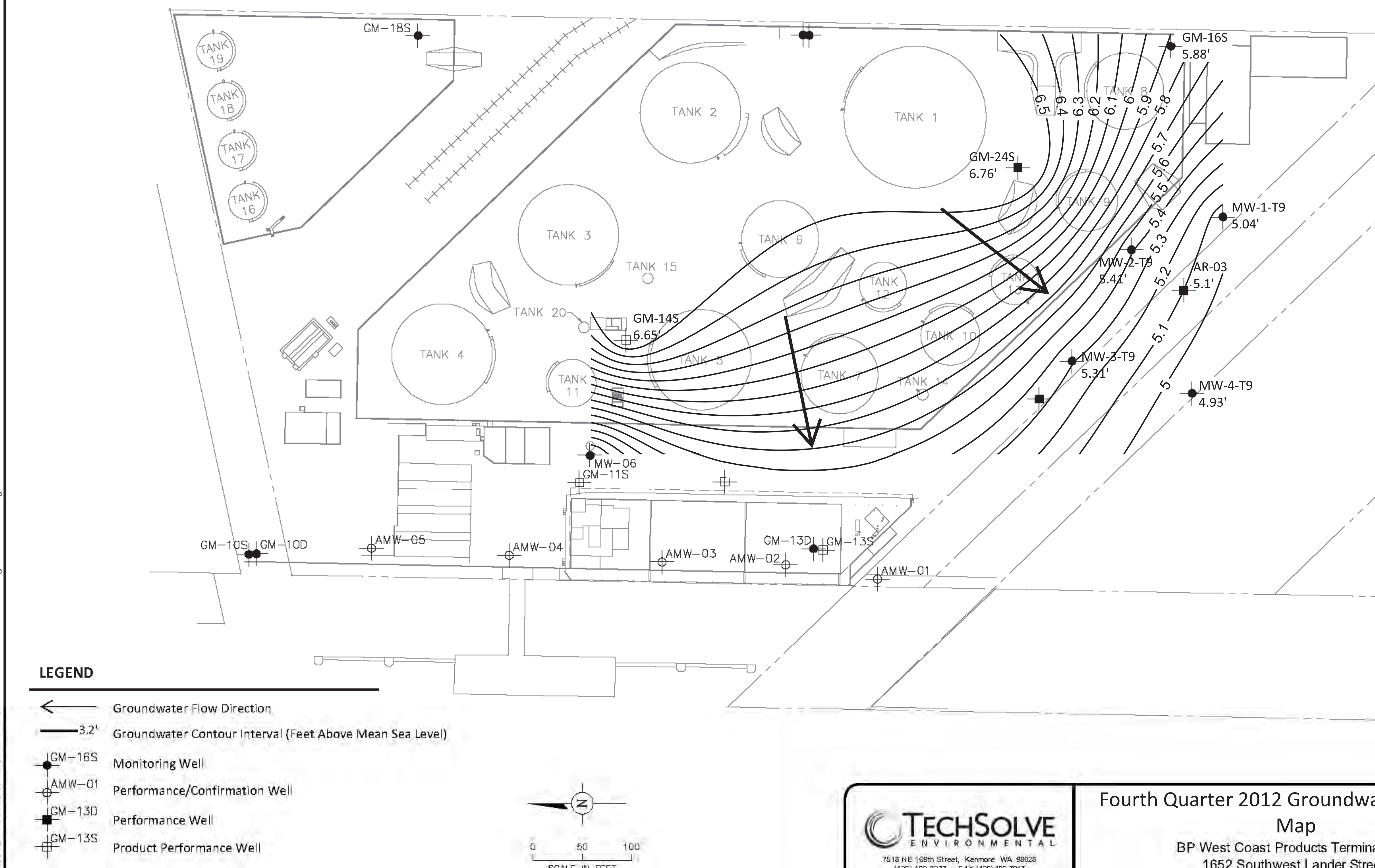


Figure 12. Plant 1 Waterfront Hydrograph
March 2000 through October 2014
BP West Coast Products Terminal 21T, Harbor Island, Seattle, Washington



Note: Groundwater monitoring in well MW-06 is conducted voluntarily by TechSolv and is not part of the required monitoring program.



LEGEND

- Groundwater Flow Direction
- 3.2' Groundwater Contour Interval (Feet Above Mean Sea Level)
- GM-16S Monitoring Well
- AMW-01 Performance/Confirmation Well
- GM-13D Performance Well
- GM-13S Product Performance Well

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Fourth Quarter 2012 Groundwater Elevation Map
BP West Coast Products Terminal 21T
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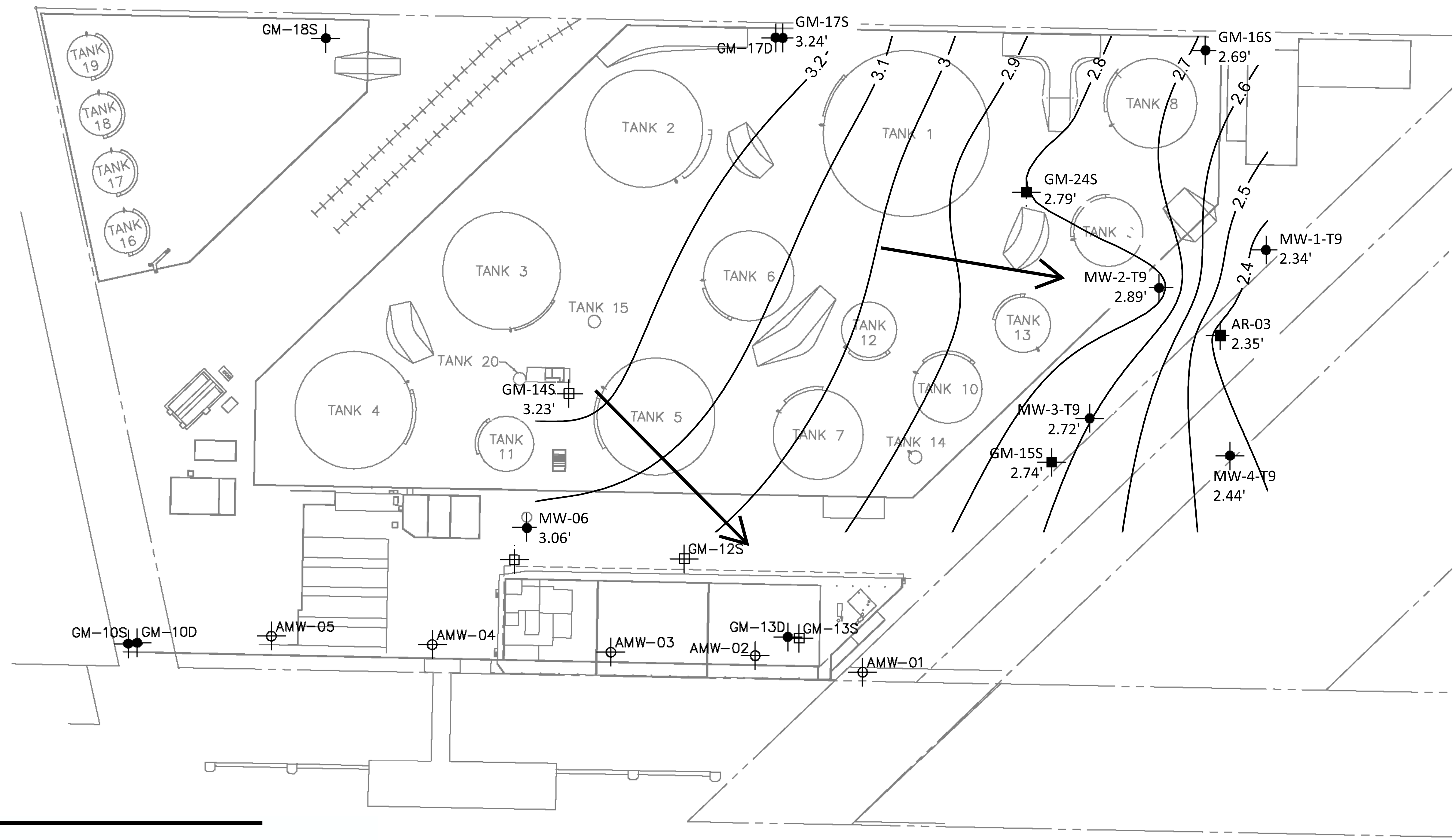
FIGURE 13



LEGEND

Groundwater Flow Direction Arrow

4.2' Groundwater Contour Interval (feet above mean sea level)

GM-16S Monitoring Well

AMW-01 Performance/Confirmation Well

GM-13D Performance Well

GM-13S Product Performance Well

N

0 50 100

SCALE IN FEET

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Third Quarter 2010 Groundwater Elevation Map

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

FIGURE
14

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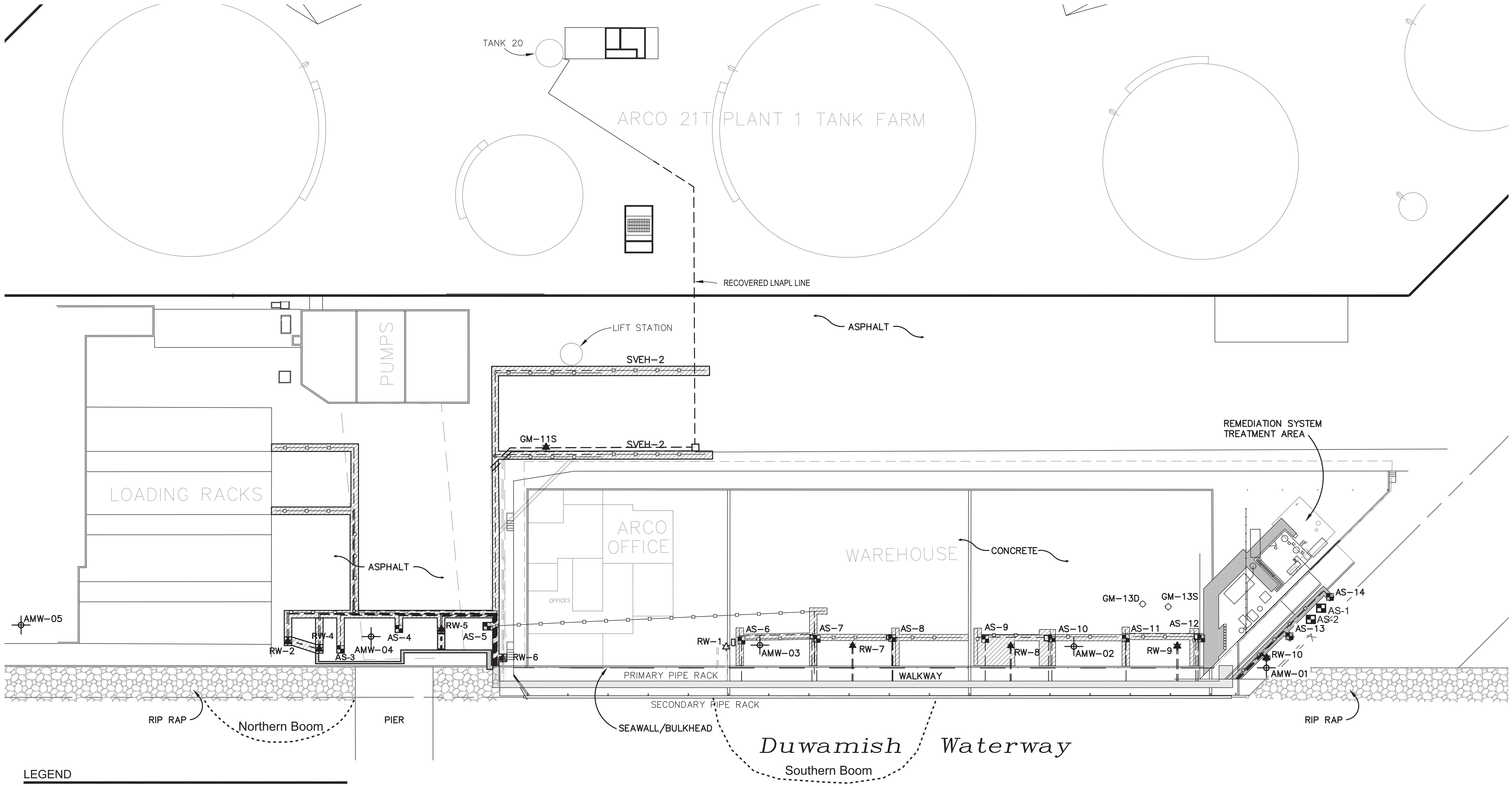

LEGEND

RW-5	GROUNDWATER RECOVERY WELL
	HORIZONTAL SOIL VAPOR EXTRACTION WELL SCREEN
MW-2	GROUNDWATER MONITORING WELL
AS-1	AIR SPARGE WELL
AMW-04	PERFORMANCE/CONFIRMATION WELL
	LNAPL LINE TO TANK 20
	AIR SPARE LINES

0 20 40
SCALE IN FEET

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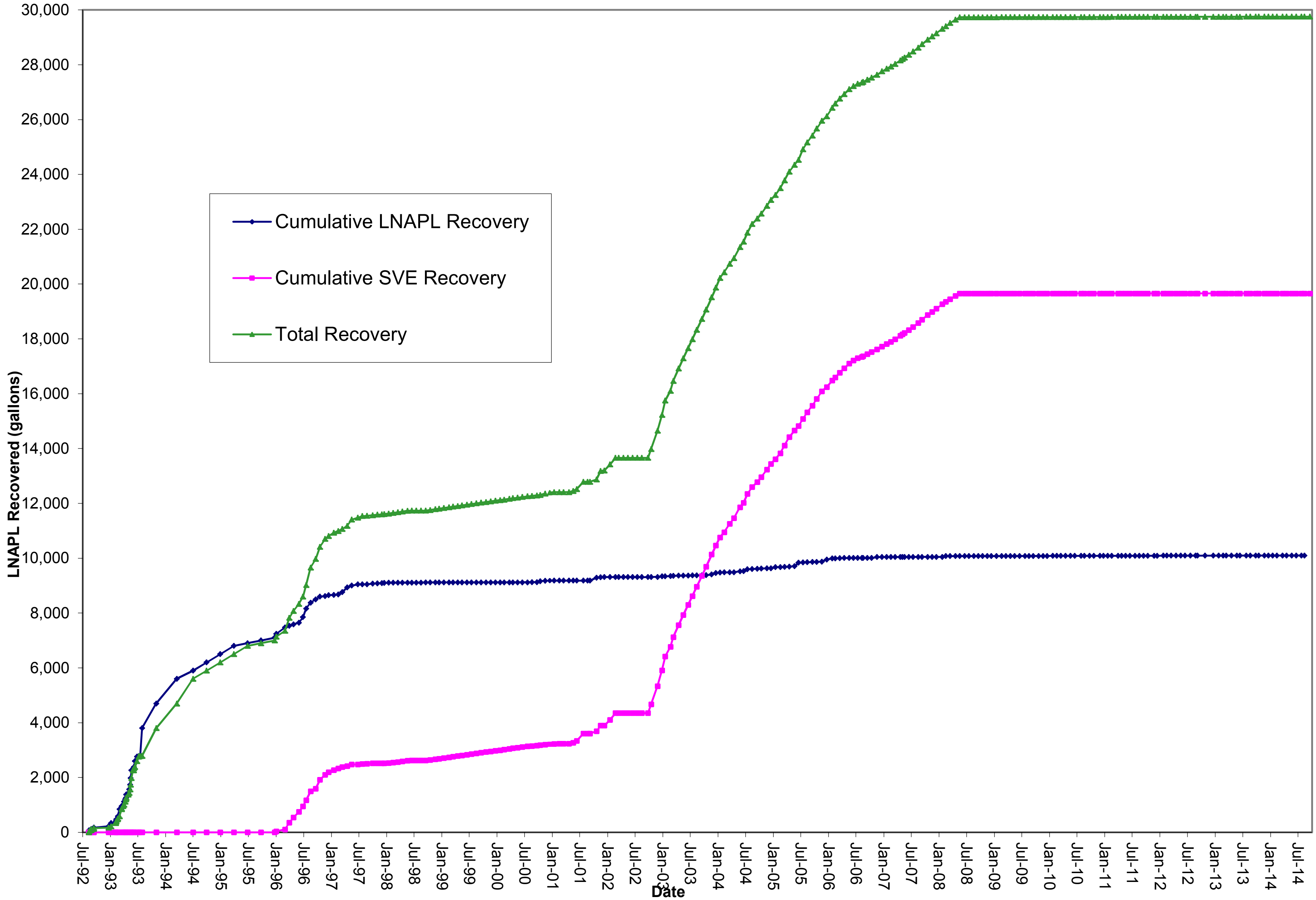
Plant 1 Remediation System

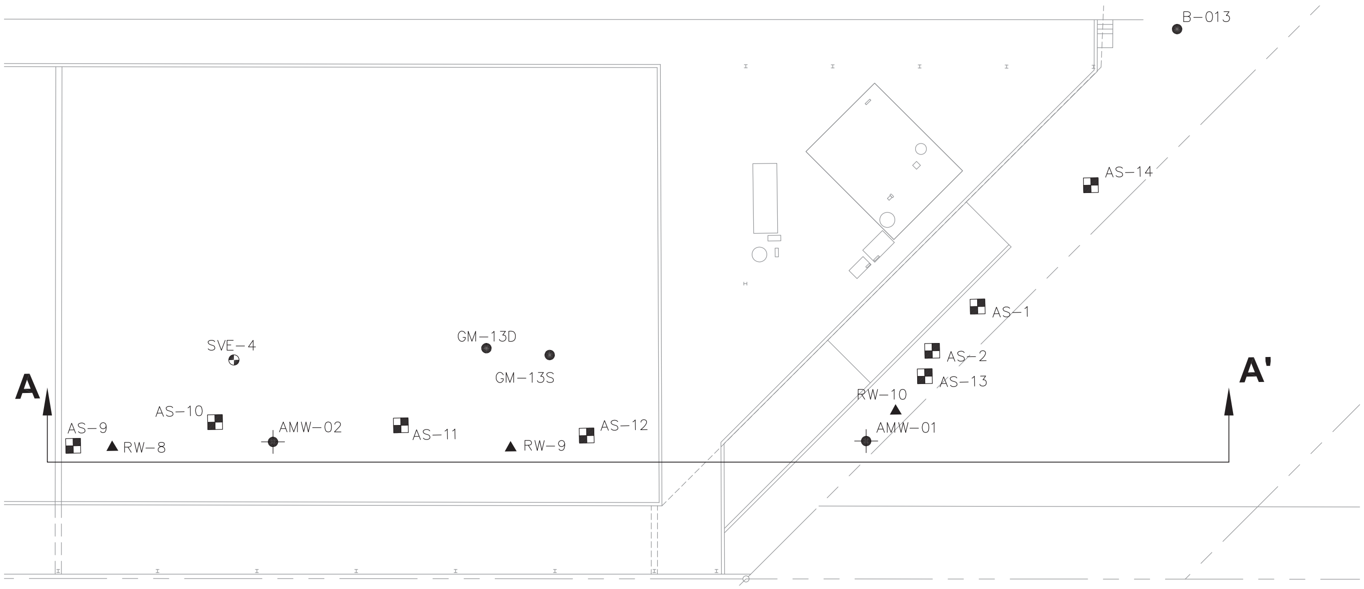
BP West Coast Products Terminal 21T
1652 Southwest Lander Street
Seattle, WA 98134

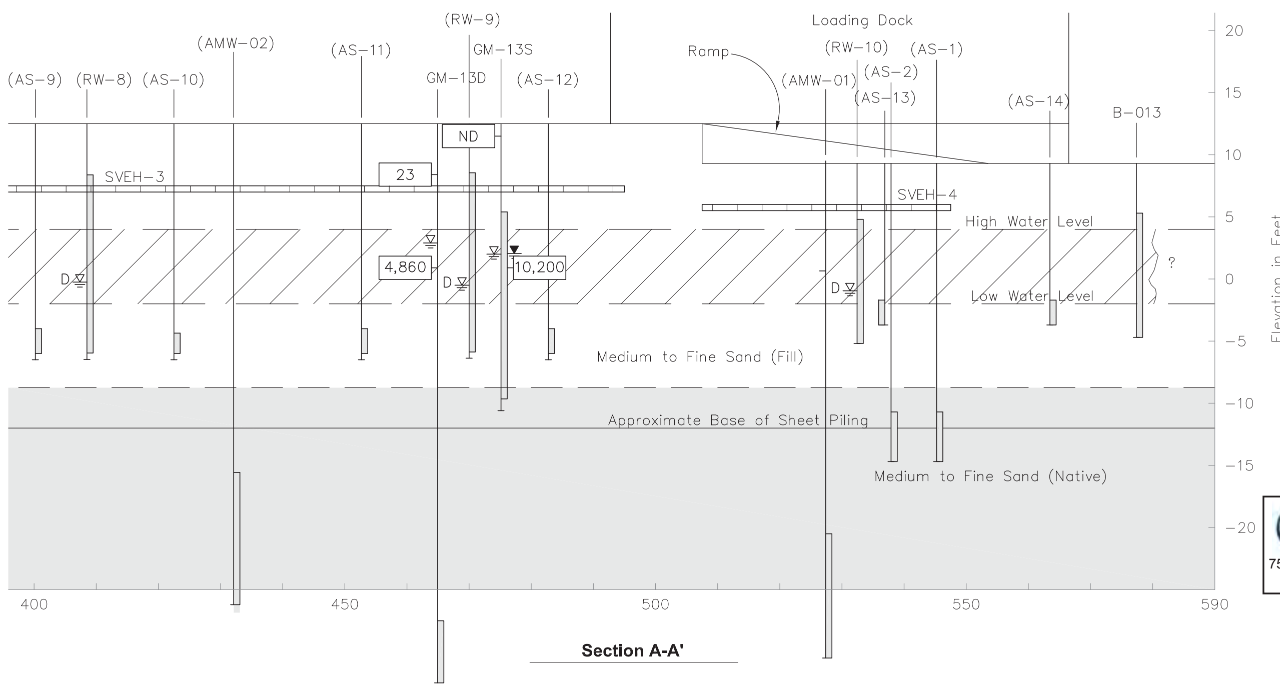
FIGURE
15

Figure 16. **Cumulative LNAPL Recovery Through September 2014**
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington



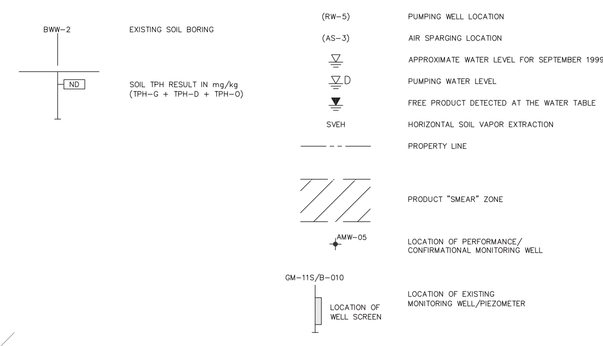
Note: Soil Vapor Extraction recovery began in January, 1996





Section A-A'

LEGEND



DESCRIPTION OF WORK

ACCESSIBLE SOILS HAVING TOTAL TPH CONCENTRATIONS ABOVE 10,000 MG/KG IN PLANT 1 WILL BE EXCAVATED TO REMOVE THE BULK OF THE CONTAMINATION IN THOSE AREAS. THE ACCESSIBLE TPH HOT SPOTS WILL BE EXCAVATED AT PLANT 1 WITHOUT UNDERMINING THE INTEGRITY OF THE ABOVE GROUND STORAGE TANKS, PIPING OF OTHER STRUCTURES ADJACENT TO THE HOT SPOT. THE EXCAVATED TPH SOIL HOT SPOTS IN PLANT 1 WILL BE TREATED OFF-SITE USING THERMAL DESORPTION AND DISPOSED OF OFF SITE.

LEGAL DESCRIPTION

PLANT 1

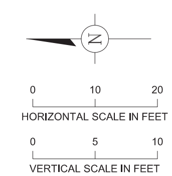
KING COUNTY TAX ASSESSOR PARCEL #: 766670-2900-0

PARCEL C

LOTS 1 THROUGH 14 INCLUSIVE OF BLOCK 405 OF THE SEATTLE TIDELANDS; TOGETHER WITH THE SEATTLE TIDE LANDS EXTENSION NUMBER 1; TOGETHER WITH THE SOUTHERLY 50 FEET IN WIDTH OF VACATED FLORIDA STREET ADJACENT TO SAID BLOCK 405.

SUBJECT TO EASEMENTS OF RECORD

CONTAINING 616,098 SQUARE FEET OR 14.144 ACRES MORE OR LESS.



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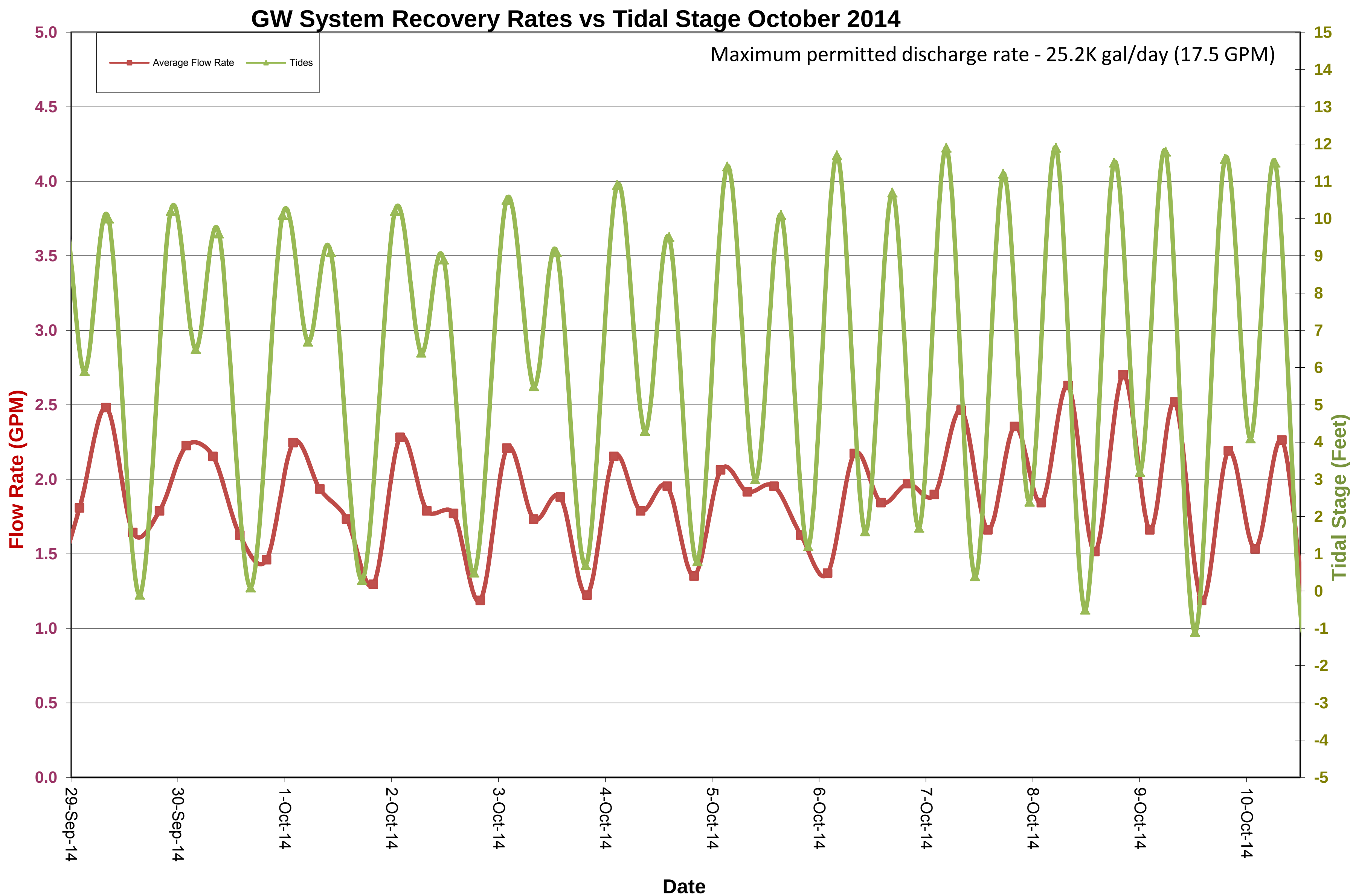
Plant 1 SW Cross Section Map

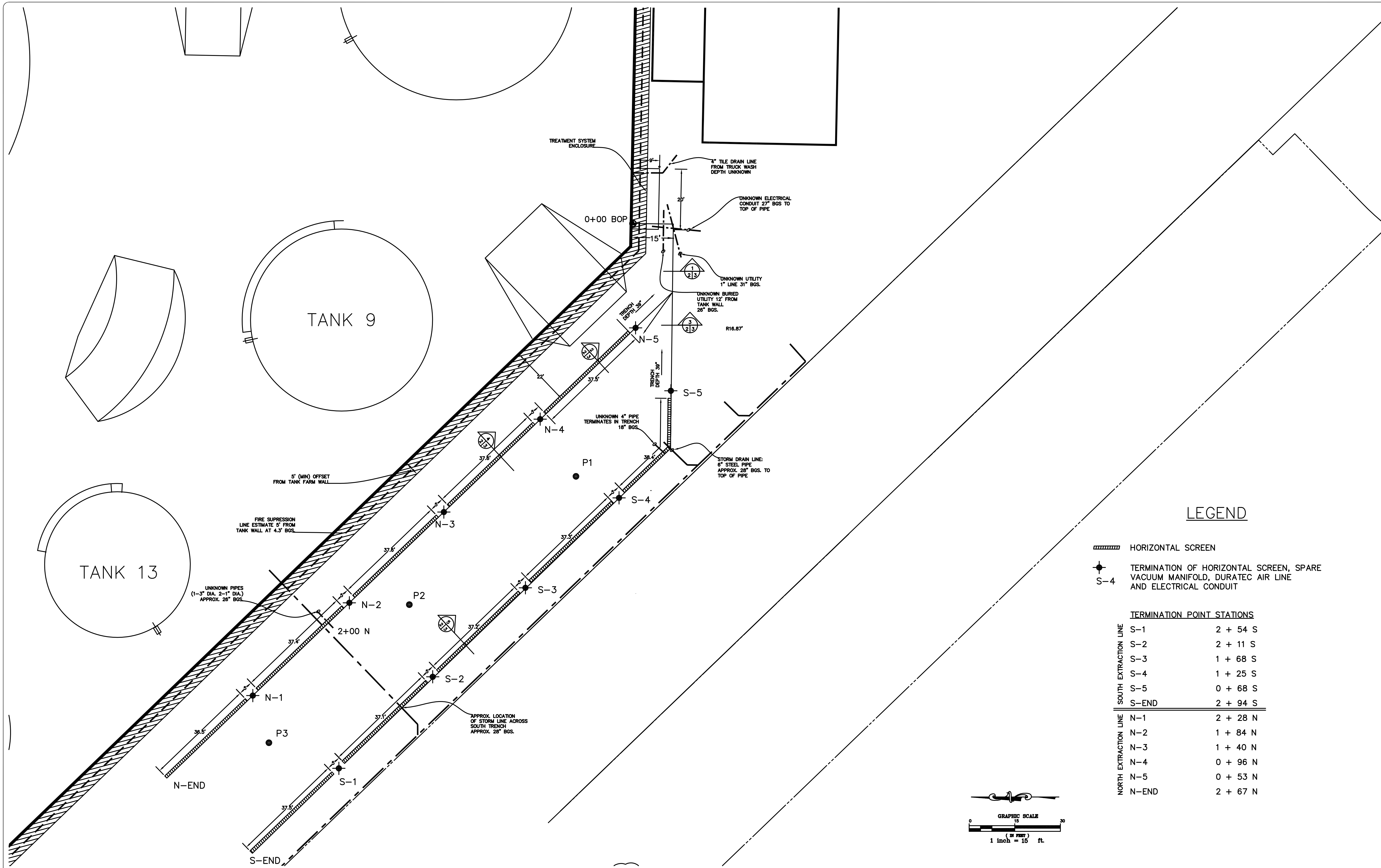
BP West Coast Product Terminal 21T
1652 SW Lander Street
Seattle, WA 98134

FIGURE **17**

Figure 18. Groundwater Recovery Rates vs. Tidal Stage
BP West Coast Products Terminal 21T, Harbor Island, Seattle, Washington



Note: Tidal elevations are from NOAA tidal predictions for Lockheed Shipyard, Harbor Island, WA Station 9447110
Presented data shows the effect of tidal fluctuations on pumping rates. It represents a portion of data collected to date.



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SCALE VERIFICATION
THIS BAR REPRESENTS ONE INCH ON THE ORIGINAL DRAWING
USE TO VERIFY FIGURE REPRODUCTION SCALE

REV. NO.	DATE	DESCRIPTION	BY	APPR.
1	MAR.07	ADDED ELECTRICAL CONDUITS FOR FUTURE USE	DK	LR
2	SEPT.07	RELOCATED NORTH TRENCH AND REDUCED TRENCH DEPTH	DK	LR
3	SEPT.08	AS-BUILT	DK	LR

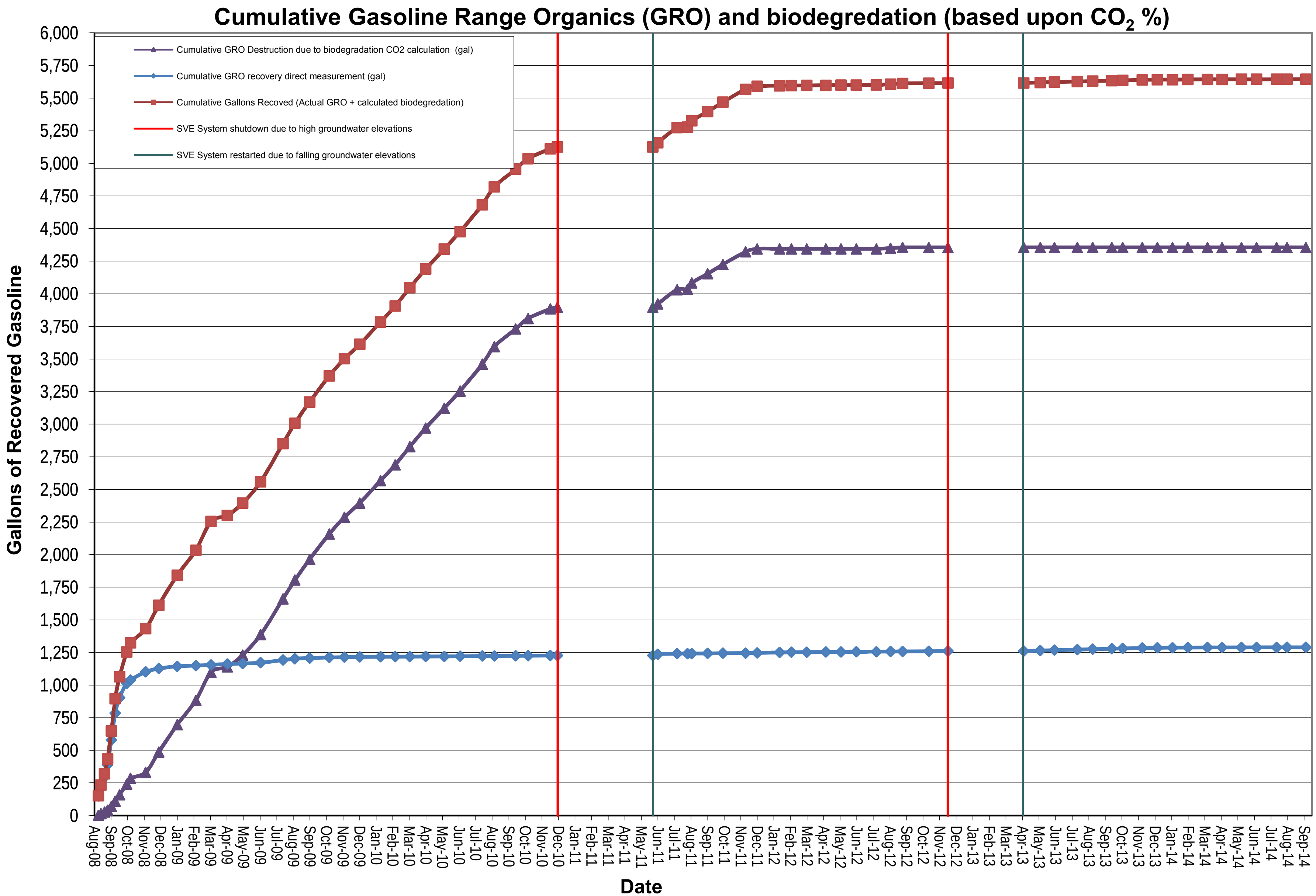
DWG DATE: 4/24/08
PRJCT NO.: ATRI10066.02.G
DRAWING: SVEDESIGN-AS-BUILT.DWG
CHECKED: ROBERTS
APPROVED: D.WHITE/J.KIRKPATRICK
DESIGNER: KIDD

Inland SVE System Remediation System Layout

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

FIGURE
19

Figure 20. Inland SVE Biodegradation and Vapor Recovery
BP West Coast Products Terminal 21T, Harbor Island, Seattle, Washington



Tables

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (μg/L)	Benzene EPA 8021 & 8260 (μg/L)
Plant 1					
AMW-01	12/21/2000	ND	1,310	ND	14.0
AMW-01	3/28/2001	59.3	2,600	ND	69.6
AMW-01	6/13/2001	105 U	944	ND	**470**
AMW-01	10/4/2001	ND	851	ND	**152**
AMW-01	12/12/2001	ND	1700 J	ND UJ	**1,260**
AMW-01	3/7/2002	153	1,410	ND	**1,410**
AMW-01	6/12/2002	143 J	2,100	ND	**1,680**
AMW-01	9/19/2002	139 J	571 J	ND UJ	**1,180**
AMW-01	12/17/2002	196	2,190	ND	**74.6**
AMW-01	3/26/2003	101	2,100	ND	**933**
AMW-01	6/27/2003	ND	2,090	ND	**1,260**
AMW-01	9/18/2003	55	2,140	ND	48.5
AMW-01	12/22/2003	136	1750 J	ND	**571**
AMW-01	3/8/2004	ND UJ	ND	ND	**961**
AMW-01	6/16/2004	138	386	ND	**1,540**
AMW-01	9/28/2004	83	ND	ND	**292**
AMW-01	12/6/2004	103	ND	ND	**411**
AMW-01	3/10/2005	113	ND	ND	**812**
AMW-01	6/21/2005	129	ND	ND	**1,130**
AMW-01	9/27/2005	77	ND UJ	ND	**181 J**
AMW-01	12/13/2005	ND UJ	342	ND	**132**
AMW-01	3/21/2006	88	ND	ND	**363**
AMW-01	7/6/2006	ND UJ	ND	ND	**912**
AMW-01	9/18/2006	91.7	ND	ND	7.38
AMW-01	12/12/2006	**1,650 J**	ND UJ	ND UJ	**539 J**
AMW-01	3/21/2007	89.9	ND	ND	**457**
AMW-01	6/6/2007	61	ND	ND	**486**
AMW-01	9/12/2007	65	ND	ND	**157**
AMW-01	12/18/2007	ND	ND	ND	10.6 J
AMW-01	3/25/2008	ND	ND	ND	**76**
AMW-01	6/25/2008	64.9	ND	ND	**370**
AMW-01	9/17/2008	55.0	ND	ND	**162**
AMW-01	12/16/2008	ND	ND	ND	**330**
AMW-01	3/11/2009	ND	ND	ND	**374**
AMW-01	6/10/2009	ND	R	R	**240 J**
AMW-01	9/16/2009	ND	ND	ND	7.4
AMW-01	12/16/2009	ND	ND	ND	**280**
AMW-01	3/30/2010	ND	ND	ND	**310**
AMW-01	6/9/2010	ND	720	ND	**280**
AMW-01	9/14/2010	ND	ND	ND	69.7
AMW-01	12/14/2010	ND	ND	ND	**282**
AMW-01	3/22/2011	ND	ND	ND	**247**
AMW-01	6/22/2011	ND	300 J	ND	39.6
AMW-01	9/27/2011	ND	ND	ND	22.2
AMW-01	12/20/2011	ND	ND	ND	**151**
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (μg/L)	Benzene EPA 8021 & 8260 (μg/L)
Plant 1, continued					
AMW-01	3/20/2012	ND	ND	ND	**178**
AMW-01	6/21/2012	ND	ND	ND	**77**
AMW-01	9/10/2012	ND	ND	ND	38.7 J
AMW-01	12/19/2012	ND	ND	ND	61.2
AMW-01	3/19/2013	ND	ND	ND	**110**
AMW-01	6/25/2013	ND	ND	ND	12
AMW-01	9/10/2013	ND	ND	ND	17
AMW-01	12/10/2013	ND	ND	ND	17
AMW-01	3/11/2014	ND	990 J	ND	**77**
AMW-01	6/10/2014	ND UJ	1,100	ND	7.3
AMW-01	9/9/2014	ND	440 J	ND	8.4
AMW-01					
AMW-02	12/21/2000	ND	803	ND	3.14
AMW-02	3/28/2001	Not accessible due to earthquake damage to warehouse.			
AMW-02	6/13/2001	ND	999	ND	3.88 U
AMW-02	10/4/2001	ND	1,200	ND	10.90
AMW-02	12/12/2001	ND	1,500 J	ND UJ	5.47
AMW-02	3/7/2002	Not accessible due to repair of earthquake damage to warehouse.			
AMW-02	6/12/2002	ND	2,420	ND	1.49
AMW-02	9/19/2002	ND UJ	495 J	ND UJ	1.61
AMW-02	12/17/2002	ND	1,890	ND	4.08
AMW-02	3/26/2003	ND	2,200	ND	5.23
AMW-02	6/27/2003	ND	1,680	ND	1.11
AMW-02	9/18/2003	ND	2,430	790	2.01
AMW-02	12/22/2003	ND	1,880 J	ND	ND
AMW-02	3/8/2004	ND	ND	ND	ND
AMW-02	6/16/2004	ND	ND	ND	2.40
AMW-02	9/28/2004	ND	ND	ND	0.85
AMW-02	12/8/2004	ND	ND	ND	23.2
AMW-02	3/10/2005	ND	ND	ND	38.4
AMW-02	6/21/2005	ND	ND	ND	16.1
AMW-02	9/27/2005	ND	ND	ND	9.04
AMW-02	12/13/2005	ND	366	ND	7.26
AMW-02	3/21/2006	ND	ND	ND	2.16
AMW-02	7/6/2006	ND	ND	ND	41.1
AMW-02	9/18/2006	ND	ND	ND	3.18
AMW-02	12/12/2006	84.5 UJ	ND UJ	ND UJ	25.8 J
AMW-02	3/21/2007	ND	ND	ND	**92.2**
AMW-02	6/6/2007	ND	ND	ND	**442**
AMW-02	9/12/2007	ND	ND	ND	4.03 J
AMW-02	12/18/2007	ND	ND	ND	66.2
AMW-02	3/25/2008	75.9	ND	ND	**343**
AMW-02	6/25/2008	ND	ND	ND	**125**
AMW-02	9/17/2008	ND	ND	ND	30.7
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (μg/L)	Benzene EPA 8021 & 8260 (μg/L)
Plant 1, continued					
AMW-02	12/16/2008	ND	ND	ND	**189**
AMW-02	3/11/2009	ND	ND	ND	**421**
AMW-02	6/10/2009	ND	R	R	**100**
AMW-02	9/14/2010	ND	ND	ND	22.6
AMW-02	12/14/2010	ND	ND	ND	**96.2**
AMW-02	9/16/2009	ND	ND	ND	12
AMW-02	12/16/2009	ND	ND	ND	**110**
AMW-02	3/30/2010	ND	1,000	ND	**210**
AMW-02	6/9/2010	ND	1,000	260	**130**
AMW-02	3/22/2011	ND	ND	ND	**149**
AMW-02	6/22/2011	ND	ND	ND	20.0
AMW-02	9/27/2011	ND	ND	ND	6.5
AMW-02	12/20/2011	ND	ND	ND	12.2
AMW-02	3/20/2012	ND	ND	ND	31.6
AMW-02	6/21/2012	ND	ND	ND	**82.5**
AMW-02	9/10/2012	ND	ND	ND	12.7 J
AMW-02	12/19/2012	ND	ND	ND	12.4
AMW-02	3/19/2013	ND	ND	ND	9.3
AMW-02	6/25/2015	ND	ND	ND	13.0
AMW-02	9/10/2013	ND	ND	ND	8.1
AMW-02	12/10/2013	ND	ND	ND	5.7
AMW-02	3/11/2014	ND	ND	ND	19.0
AMW-02	6/10/2014	ND UJ	320	ND	12.0
AMW-02	9/9/2014	ND	270	ND	29.0
AMW-02					
AMW-03	12/21/2000	127	1,420	ND	ND
AMW-03	3/28/2001	Not accessible due to earthquake damage to warehouse.			
AMW-03	6/13/2001	ND	745	ND	ND
AMW-03	10/4/2001	ND	1,210	ND	ND
AMW-03	12/12/2001	ND	1,080 J	ND UJ	ND
AMW-03	3/7/2002	Not accessible due to earthquake damage to warehouse.			
AMW-03	6/12/2002	ND	1,070	ND	ND
AMW-03	9/19/2002	ND UJ	643 J	ND UJ	ND UJ
AMW-03	12/17/2002	ND	1,160	ND	ND
AMW-03	3/26/2003	ND	1,240	ND	ND
AMW-03	6/27/2003	ND	713	ND	ND
AMW-03	9/18/2003	ND	1,050	ND	ND
AMW-03	12/22/2003	ND	374 J	ND	ND
AMW-03	3/8/2004	ND	ND	ND	ND
AMW-03	6/16/2004	ND	ND	ND	1.02
AMW-03	9/28/2004	ND	ND	ND	ND
AMW-03	12/8/2004	ND	ND UJ	ND UJ	ND
AMW-03	3/10/2005	ND	ND	ND	1.56
AMW-03	6/21/2005	ND	ND	ND	0.99
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (μg/L)	Benzene EPA 8021 & 8260 (μg/L)
Plant 1, continued					
AMW-03	9/27/2005	ND	ND UJ	ND	0.997
AMW-03	12/13/2005	ND	ND	ND	0.828
AMW-03	3/21/2006	ND	ND	ND	2.770
AMW-03	7/6/2006	ND	ND	ND	2.28
AMW-03	9/18/2006	ND	ND	ND	ND
AMW-03	12/12/2006	ND UJ	ND UJ	ND UJ	0.974 J
AMW-03	3/21/2007	ND	ND	ND	ND
AMW-03	6/6/2007	ND	ND	ND	ND
AMW-03	9/12/2007	ND	ND	ND	ND UJ
AMW-03	12/18/2007	ND	ND	ND	ND
AMW-03	3/25/2008	ND	ND	ND	ND
AMW-03	6/25/2008	ND	ND	ND	ND
AMW-03	9/17/2008	ND	ND	ND	ND
AMW-03	12/16/2008	ND	ND	ND	ND
AMW-03	3/11/2009	ND	ND	ND	ND
AMW-03	6/10/2009	ND	R	R	ND
AMW-03	9/16/2009	ND	ND	ND	ND
AMW-03	12/16/2009	ND	ND	ND	ND
AMW-03	3/30/2010	ND	400	ND	ND
AMW-03	6/9/2010	ND	230	ND	ND
AMW-03	9/14/2010	ND	ND	ND	ND
AMW-03	12/14/2010	ND	ND	ND	ND
AMW-03	3/22/2011	ND	ND	ND	0.54
AMW-03	6/22/2011	ND	ND	ND	ND
AMW-03	9/27/2011	ND	ND	ND	ND
AMW-03	12/20/2011	ND	ND	ND	ND
AMW-03	3/20/2012	ND	ND	ND	0.52
AMW-03	6/21/2012	ND	ND	ND	ND
AMW-03	9/10/2012	ND	ND	ND	ND
AMW-03	12/19/2012	ND	ND	ND	ND
AMW-03	3/19/2013	ND	ND	ND	ND
AMW-03	6/25/2013	ND	ND	ND	ND
AMW-03	9/10/2013	ND	ND	ND	ND
AMW-03	12/10/2013	ND	ND	ND	ND
AMW-03	3/11/2014	ND	320 J	ND	ND
AMW-03	6/10/2014	ND UJ	430	ND	ND
AMW-03	9/9/2014	ND	360	ND	ND
AMW-03					
AMW-04	12/21/2000	ND	1,570	ND	0.66
AMW-04	3/28/2001	ND	1,660	ND	0.766
AMW-04	6/13/2001	ND	987	ND	ND
AMW-04	10/4/2001	ND	379	ND	ND
AMW-04	12/12/2001	ND	930 J	ND UJ	ND
AMW-04	3/7/2002	ND	519	ND	2.94
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (μg/L)	Benzene EPA 8021 & 8260 (μg/L)
Plant 1, continued					
AMW-04	6/12/2002	ND	1,200	ND	0.63
AMW-04	9/19/2002	ND UJ	760 J	ND UJ	1.45 J
AMW-04	12/17/2002	ND	1,070	ND	ND
AMW-04	3/26/2003	ND	1,240	ND	0.84
AMW-04	6/27/2003	ND	875	ND	ND
AMW-04	9/18/2003	ND	1,660	ND	ND
AMW-04	12/22/2003	ND	686 J	ND	1.73
AMW-04	3/8/2004	ND	ND	ND	ND
AMW-04	6/16/2004	ND	ND	ND	ND
AMW-04	9/27/2004	ND	ND	ND	ND
AMW-04	12/6/2004	ND	ND	ND	ND
AMW-04	3/10/2005	ND	ND	ND	ND
AMW-04	6/21/2005	ND	ND	ND	ND
AMW-04	9/27/2005	ND	ND UJ	ND	ND
AMW-04	12/13/2005	ND UJ	ND	ND	ND UJ
AMW-04	3/21/2006	ND	ND	ND	0.65
AMW-04	7/6/2006	ND UJ	ND	ND	ND UJ
AMW-04	9/18/2006	ND	ND	ND	ND
AMW-04	12/12/2006	ND UJ	ND UJ	ND UJ	ND UJ
AMW-04	3/21/2007	ND	ND	ND	0.64
AMW-04	6/6/2007	ND	ND	ND	ND
AMW-04	9/12/2007	ND	ND	ND	ND UJ
AMW-04	12/18/2007	ND	ND	ND	ND
AMW-04	3/26/2008	ND	ND	ND	ND
AMW-04	6/25/2008	ND	ND	ND	ND
AMW-04	9/17/2008	ND	ND	ND	ND
AMW-04	12/16/2008	ND	ND	ND	0.63
AMW-04	3/11/2009	ND	ND	ND	ND
AMW-04	6/10/2009	ND	R	R	ND
AMW-04	9/16/2009	ND	ND	ND	ND
AMW-04	12/16/2009	ND UJ	ND	ND	ND
AMW-04	3/30/2010	ND	610	ND	0.57
AMW-04	6/9/2010	ND	430	ND	ND
AMW-04	9/14/2010	ND	ND	ND	ND
AMW-04	12/14/2010	ND	ND	ND	ND
AMW-04	3/22/2011	ND	ND	ND	ND
AMW-04	6/22/2011	ND	ND	ND	ND
AMW-04	9/27/2011	ND	ND	ND	ND
AMW-04	12/27/2011	ND	ND	ND	ND
AMW-04	3/20/2012	ND	ND	ND	ND
AMW-04	6/21/2012	ND	ND	ND	ND
AMW-04	9/10/2012	ND	ND	ND	ND
AMW-04	12/19/2012	ND	ND	ND	ND
AMW-04	3/19/2013	ND	ND	ND	ND
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (µg/L)	TPH-D WTPH-DX (µg/L)	TPH-O WTPH-DX (µg/L)	Benzene EPA 8021 & 8260 (µg/L)
Plant 1, continued					
AMW-04	6/25/2013	ND	ND	ND	ND
AMW-04	9/10/2013	ND	ND	ND	ND
AMW-04	12/10/2013	ND	ND	ND	ND
AMW-04	3/11/2014	ND	780 J	ND	ND
AMW-04	6/10/2014	ND UJ	400	ND	ND
AMW-04	9/9/2014	ND	480	ND	ND
AMW-04					
AMW-05	12/21/2000	ND	1,450	ND	ND
AMW-05	3/28/2001	ND	1,360	ND	ND
AMW-05	6/13/2001	ND	440	ND	ND
AMW-05	10/4/2001	71.4 U	318	ND	ND
AMW-05	12/12/2001	ND	940 J	ND UJ	ND
AMW-05	3/7/2002	ND	1,100	ND	2.12
AMW-05	6/12/2002	78	1,180	ND	0.701
AMW-05	9/19/2002	ND UJ	760 J	ND UJ	1.45 J
AMW-05	12/17/2002	ND	1,820	ND	ND
AMW-05	3/26/2003	ND	1,900	ND	0.577
AMW-05	3/27/2003	ND	381 J	ND UJ	ND
AMW-05	9/19/2003	ND	2,150	ND	ND
AMW-05	12/22/2003	ND	1,420 J	ND	0.833
AMW-05	3/8/2004	ND	ND	ND	ND
AMW-05	6/16/2004	ND	ND	ND	ND
AMW-05	9/27/2004	ND	ND	ND	ND
AMW-05	12/6/2004	ND	ND	ND	ND
AMW-05	3/10/2005	ND	ND	ND	ND
AMW-05	6/21/2005	ND	ND	ND	ND
AMW-05	9/27/2005	ND	ND UJ	ND	ND
AMW-05	12/13/2005	ND	ND	ND	0.727
AMW-05	3/21/2006	ND	ND	ND	0.692
AMW-05	7/6/2006	ND	ND	ND	ND
AMW-05	9/18/2006	ND	ND	ND	ND
AMW-05	12/12/2006	ND UJ	ND UJ	ND UJ	0.565 J
AMW-05	3/21/2007	ND	ND	ND	1.11
AMW-05	6/6/2007	ND	ND	ND	ND
AMW-05	9/12/2007	ND	ND	ND	ND UJ
AMW-05	12/18/2007	ND	ND	ND	ND
AMW-05	3/26/2008	ND	ND	ND	ND
AMW-05	6/25/2008	ND	ND	ND UJ	ND
AMW-05	9/17/2008	ND	ND	ND UJ	ND
AMW-05	12/16/2008	ND	ND	ND	0.768
AMW-05	3/11/2009	ND	ND	ND	0.885
AMW-05	6/10/2009	ND	R	R	ND
AMW-05	9/16/2009	54	ND	ND	ND
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (μg/L)	Benzene EPA 8021 & 8260 (μg/L)
Plant 1, continued					
AMW-05	12/16/2009	ND UJ	ND	ND	ND
AMW-05	3/30/2010	ND	890	ND	1.3
AMW-05	6/9/2010	ND	640	ND	ND
AMW-05	9/14/2010	ND	ND	ND	ND
AMW-05	12/14/2010	ND	ND	ND	ND
AMW-05	3/22/2011	ND	ND	ND	ND
AMW-05	6/22/2011	ND	ND	ND	ND
AMW-05	9/27/2011	ND	ND	ND	ND
AMW-05	12/20/2011	ND	ND	ND	ND
AMW-05	3/20/2012	ND	ND	ND	ND
AMW-05	6/21/2012	ND	ND	ND	ND
AMW-05	9/10/2012	ND	ND	ND	ND
AMW-05	12/19/2012	ND	ND	ND	ND
AMW-05	3/19/2013	ND	ND	ND	ND
AMW-05	6/25/2013	ND	ND	ND	ND
AMW-05	9/10/2013	ND	ND	ND	ND
AMW-05	12/10/2013	ND	ND	ND	ND
AMW-05	3/11/2014	ND	ND	ND	ND
AMW-05	6/10/2014	ND UJ	560	ND	ND
AMW-05	9/9/2014	ND	300	ND	ND
AMW-05					
GM-11S	4/10/1997	**3,910**	2,210	1,230	**616 J**
GM-11S	7/8/1997	960 J	1,090	ND	46.9 J
GM-11S	10/21/1997	**1,570**	1,260	ND	**126**
GM-11S	1/21/1998	390	788	ND	**250**
GM-11S	3/11/1998	**1,800**	776	ND	**640**
GM-11S	7/6/1998	680	470 J	ND	41
GM-11S	10/20/1998	260	584	ND	27
GM-11S	12/15/1998	**1,300**	1,090	ND	**500**
GM-11S	3/26/1999	**1,100**	779	ND	**220**
GM-11S	6/23/1999	710	520	ND	**92**
GM-11S	CONVERTED TO RECOVERY WELL - SAMPLING DISCONTINUED				
GM-12S	4/10/1997	140	4,500	2,720	42.9
GM-12S	7/8/1997	160	4,590	3,450	ND
GM-12S	10/20/1997	ND	600	1,630	ND
GM-12S	1/21/1998	ND	1,210	2,040	ND
GM-12S	3/10/1998	ND	2,040	ND	ND
GM-12S	7/6/1998	140	2,830	1,980	0.8
GM-12S	10/20/1998	77	1,200	775	ND
GM-12S	3/26/1999	280	2,080 J	1,100 J	0.5
GM-12S	6/23/1999	260	1,530	ND	ND
GM-12S	WELL DELETED FROM MONITORING PROGRAM				
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (µg/L)	TPH-D WTPH-DX (µg/L)	TPH-O WTPH-DX (µg/L)	Benzene EPA 8021 & 8260 (µg/L)
Plant 1, continued					
GM-14S	9/13/2007	608	1020	ND	0.97
GM-14S	12/20/2007	389	341	ND	1.02
GM-14S	3/27/2008	172	ND	ND	0.538
GM-14S	6/27/2008	**2,680 J**	577	ND	2.5 J
GM-14S	9/19/2008	**1,440**	719	ND	1.32
GM-14S	12/17/2008	**1,630 J**	963	ND	1.6
GM-14S	3/12/2009	**1,300**	562	ND	7.98
GM-14S	6/11/2009	**2,500**	R	R	ND
GM-14S	9/18/2009	**2,300**	1,600	ND	ND
GM-14S	12/17/2009	750	870	ND	ND
GM-14S	4/1/2010	**2,000**	880	ND	ND
GM-14S	6/10/2010	**1,900 J**	3,200	560	11 J
GM-14S	9/16/2010	**2,070**	690	ND	ND
GM-14S	12/15/2010	245	400	ND	ND
GM-14S	3/23/2011	748	350	ND	ND
GM-14S	6/23/2011	**2,190**	590	ND	ND
GM-14S	9/28/2011	**3,660**	840	ND	ND
GM-14S	12/21/2011	**3,150**	1,200	ND	ND
GM-14S	3/21/2012	903	480	ND	ND
GM-14S	6/22/2012	**3,050**	500	ND	ND
GM-14S	9/11/2012	**3,330**	920	ND	ND
GM-14S	12/20/2012	464	480	ND	ND
GM-14S	3/20/2013	**1,400**	340	ND	ND
GM-14S	6/26/2013	**2,200**	770	ND	1.3
GM-14S	9/11/2013	**1,700**	810	ND	0.77
GM-14S	12/11/2013	**3,300**	570	ND	ND
GM-14S	3/12/2014	760	1,600	940	0.53
GM-14S	6/11/2014	**2,000 J**	1,300	ND	1.2
GM-14S	9/10/2014	**2,900 J**	1,100	ND	0.87
GM-14S					
GM-15S	4/9/1997	ND	290	ND	ND
GM-15S	7/8/1997	170	800	ND	1.4
GM-15S	10/21/1997	ND	ND	ND	ND
GM-15S	1/21/1998	ND	293	ND	ND
GM-15S	3/11/1998	ND	ND	ND	ND
GM-15S	7/7/1998	54	253	ND	ND
GM-15S	10/21/1998	310	550	ND	ND
GM-15S	12/15/1998	120	342	ND	ND
GM-15S	3/25/1999	ND	ND	ND	ND
GM-15S	6/23/1999	76	ND	ND	ND
GM-15S	9/27/1999	NS	NS	NS	NS
GM-15S	12/14/1999	160 U	316	ND	ND
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (µg/L)	TPH-D WTPH-DX (µg/L)	TPH-O WTPH-DX (µg/L)	Benzene EPA 8021 & 8260 (µg/L)
Plant 1, continued					
GM-15S	3/24/2000	ND	451	ND	ND
GM-15S	6/30/2000	167	1,200	ND	ND
GM-15S	9/27/2000	355 J	1,130 J	ND	ND UJ
GM-15S	12/21/2000	801	1,990	ND	ND
GM-15S	3/27/2001	548	2,810	ND	0.747 J
GM-15S	6/12/2001	909	1,040	ND	2.58 U
GM-15S	10/3/2001	955	1,220	ND	10.9 J
GM-15S	12/11/2001	578	1,100	ND	9.62
GM-15S	3/6/2002	434	1,430	ND	12.1
GM-15S	6/10/2002	786	2,530	ND	14.7
GM-15S	9/18/2002	825 J	1,320 J	ND UJ	9.38 J
GM-15S	12/16/2002	738	1,690 J	ND	4.16
GM-15S	3/25/2003	833 J	2,920	ND	3.57 J
GM-15S	6/26/2003	616	2,940 J	ND	2.49 J
GM-15S	9/19/2003	636	1,530	ND	1.58
GM-15S	12/22/2003	672	647 J	ND	1.47 J
GM-15S	3/8/2004	458 J	ND	ND	2.83 J
GM-15S	6/17/2004	836 J	356	ND	1.26
GM-15S	9/28/2004	655	ND	ND	1.62 J
GM-15S	12/8/2004	847	ND	ND	1.53
GM-15S	3/11/2005	587	ND	ND	1.07 J
GM-15S	6/22/2005	984 J	ND	ND	0.682
GM-15S	9/28/2005	840	ND	ND	1.43 J
GM-15S	12/14/2005	702	ND	ND	1.27
GM-15S	3/22/2006	317	ND	ND	0.614
GM-15S	7/7/2006	647	ND	ND	0.767
GM-15S	9/19/2006	533	ND	ND	0.836
GM-15S	12/13/2006	494 J	ND UJ	ND UJ	ND UJ
GM-15S	3/22/2007	420	ND	ND	ND
GM-15S	6/7/2007	404	ND	ND	0.505
GM-15S	9/13/2007	180	ND	ND	ND UJ
GM-15S	12/19/2007	549	ND	ND	0.943
GM-15S	3/26/2008	404	ND	ND	0.613
GM-15S	6/26/2008	480	ND	ND	0.665
GM-15S	9/18/2008	445	ND	ND	0.599
GM-15S	12/17/2008	Well not sampled, sampling reduced to a semi-annual event			
GM-15S	3/12/2009	695	ND	ND	19.6
GM-15S	9/16/2009	390	ND	ND	ND
GM-15S	3/30/2010	670	520	ND	1.1
GM-15S	9/15/2010	269	ND	ND	6.6
GM-15S	3/23/2011	ND	ND	ND	ND
GM-15S	9/27/2011	427	ND	ND	0.79
GM-15S	3/20/2012	143	ND	ND	ND
GM-15S	9/10/2012	ND	ND	ND	ND
GM-15S	3/19/2013	92	ND	ND	**100**
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (µg/L)	TPH-D WTPH-DX (µg/L)	TPH-O WTPH-DX (µg/L)	Benzene EPA 8021 & 8260 (µg/L)
Plant 1, continued					
GM-15S	6/25/2013	**1,300**	ND	ND	**400**
GM-15S	9/10/2013	270	ND	ND	**110**
GM-15S	12/11/2013	320	ND	ND	1.3
GM-15S	3/12/2014	110	430 J	ND	ND
GM-15S	6/11/2014	ND	ND	ND	ND
GM-15S	9/9/2014	180	870	ND	ND
GM-15S					
GM-15S					
GM-16S	4/9/1997	ND	3,980	1,630	
GM-16S	7/8/1997	ND	3,890	1,710	ND
GM-16S	10/21/1997	ND	720	ND	ND
GM-16S	1/21/1998	ND	1,390	ND	ND
GM-16S	3/12/1998	ND	5,780	1,620	ND
GM-16S	7/7/1998	ND	1,310	ND	ND
GM-16S	10/20/1998	ND	ND	ND	ND
GM-16S	12/17/1998	ND	2,170	871	ND
GM-16S	3/26/1999	NS	1,990	960	NS
GM-16S	6/28/1999	NS	480	ND	NS
GM-16S	WELL DELETED FROM MONITORING PROGRAM / REINITIATED 3RD QUARTER 2007				
GM-16S	9/13/2007	ND	ND	ND	ND UJ
GM-16S	12/20/2007	ND	ND	ND	ND
GM-16S	3/27/2008	65.3	ND	ND	ND
GM-16S	6/27/2008	81.1	ND	ND	ND
GM-16S	9/19/2008	72.7	ND	ND	ND
GM-16S	12/17/2008	Well not sampled, sampling has been reduced to a semi-annual event			
GM-16S	3/12/2009	ND	456	ND	ND
GM-16S	9/18/2009	300	750	ND	ND
GM-16S	3/31/2010	390	1800	ND	ND
GM-16S	9/16/2010	263	490	ND	ND
GM-16S	3/23/2011	193	350	ND	ND
GM-16S	9/28/2011	377	400	ND	ND
GM-16S	3/21/2012	ND	290	ND	ND
GM-16S	9/11/2012	ND	ND	ND	ND
GM-16S	3/20/2013	79	ND	ND	ND
GM-16S	9/11/2013	62	ND	ND	ND
GM-16S	3/12/2014	ND	1600	ND	ND
GM-16S	9/10/2014	960	1200	ND	ND
GM-17S	4/9/1997	ND	1,720	900	ND
GM-17S	7/9/1997	ND	720	ND	ND
GM-17S	10/21/1997	ND	ND	ND	ND
GM-17S	1/22/1998	ND	320	ND	ND
GM-17S	3/11/1998	ND	926	ND	ND
GM-17S	7/7/1998	52 J	410 J	ND UJ	ND UJ
GM-17S	10/21/1998	ND	ND	ND	ND
Cleanup Level		1,000	10,000	10,000	71

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (μg/L)	Benzene EPA 8021 & 8260 (μg/L)
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (μg/L)	Benzene EPA 8021 & 8260 (μg/L)
Plant 1, continued					
GM-17S	12/15/1998	ND	1,060	ND	ND
GM-17S	3/26/1999	NS	851	ND	NS
GM-17S	6/28/1999	NS	393	ND	NS
GM-17S	WELL DELETED FROM MONITORING PROGRAM / REINITIATED 3RD QUARTER 2007				
GM-17S	9/13/2007	ND	ND	ND	ND UJ
GM-17S	12/20/2007	ND	ND	ND	ND
GM-17S	3/27/2008	ND	ND	ND	ND
GM-17S	6/27/2008	ND	ND	ND	ND
GM-17S	9/19/2008	ND	ND	ND	ND
GM-17S	12/17/2008	Well not sampled, sampling has been reduced to a semi-annual event			
GM-17S	3/12/2009	ND	ND	ND	ND
GM-17S	9/18/2009	53	ND	ND	ND
GM-17S	3/31/2010	ND	ND	ND	ND
GM-17S	9/16/2010	ND	ND	ND	ND
GM-17S	3/23/2011	ND	ND	ND	ND
GM-17S	9/28/2011	ND	ND	ND	ND
GM-17S	3/21/2012	ND	ND	ND	ND
GM-17S	9/11/2012	ND	ND	ND	ND
GM-17S	3/20/2013	ND	ND	ND	ND
GM-17S	9/11/2013	ND	ND	ND	ND
GM-17S	3/12/2014	ND	420	ND	ND
GM-17S	9/10/2014	ND	ND	ND	ND
GM-24S	4/9/1997	970	2,180	1,070	ND
GM-24S	7/9/1997	**4,040**	1,200	ND	ND
GM-24S	10/22/1997	**2,760**	710	ND	1.1
GM-24S	1/22/1998	**1,300**	841	ND	2.1
GM-24S	3/11/1998	370	765	ND	ND
GM-24S	7/7/1998	**1,500 J**	762 J	ND UJ	ND UJ
GM-24S	10/20/1998	800	929	ND	1.6
GM-24S	12/17/1998	**1,100**	867	ND	ND
GM-24S	3/26/1999	**3,500**	1,470	ND	ND
GM-24S	6/28/1999	**2,600**	1,390	ND	**2,600**
GM-24S	9/29/1999	**2,200**	1,030	ND	0.8
GM-24S	12/14/1999	**1,900**	857	ND	1.3 U
GM-24S	3/24/2000	**2,860**	1,230	ND	ND
GM-24S	6/30/2000	**4,570**	2,110	ND	ND
GM-24S	9/27/2000	**3,080 J**	2,690 J	ND	ND UJ
GM-24S	12/21/2000	**3,420**	4,100	947	ND
GM-24S	3/27/2001	**2,570**	3,120	884	0.704 J
GM-24S	6/12/2001	Tank Farm was inaccessible to sampling activities			
GM-24S	10/3/2001	**2,820**	1,800	ND	3.88 J
GM-24S	12/11/2001	**1,560**	2,250	ND	1.13 J
GM-24S	3/6/2002	**2,180**	2,170	ND	12.1
GM-24S	6/10/2002	**2,230**	1,800	ND	2.2 J
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (µg/L)	TPH-D WTPH-DX (µg/L)	TPH-O WTPH-DX (µg/L)	Benzene EPA 8021 & 8260 (µg/L)
Plant 1, continued					
GM-24S	9/18/2002	**1,930 J**	1,130 J	ND UJ	3.79 J
GM-24S	12/16/2002	**1,330**	4,250	949	2.32
GM-24S	3/25/2003	**1,510**	1,930	850	0.667 J
GM-24S	6/25/2003	**3,510 J**	ND UJ	ND UJ	3.38 J
GM-24S	9/19/2003	**2,490**	1,610	ND	3.49
GM-24S	12/23/2003	**2,890**	2,220 J	ND	1.66 J
GM-24S	3/9/2004	**2,850**	345	ND	0.928 J
GM-24S	6/17/2004	**2,800**	567	ND	1.66
GM-24S	9/29/2004	**2,190**	0.365	ND	2.25
GM-24S	12/9/2004	**1,910**	ND	ND	2.34
GM-24S	3/11/2005	**2,670**	0.365	ND	1.61
GM-24S	6/22/2005	**3,990**	261	ND	3.68
GM-24S	9/28/2005	**4,190**	296	ND	3.23 J
GM-24S	12/14/2005	**2,430**	293	ND	2.79
GM-24S	3/22/2006	**2,310**	303	ND	1.95 J
GM-24S	7/7/2006	**2,700**	ND	ND	1.82
GM-24S	9/19/2006	**2,480**	535	ND	2.03
GM-24S	12/14/2006	**1,070 J**	ND UJ	ND UJ	ND UJ
GM-24S	3/22/2007	**2,750 J**	427 J	ND	2.97 J
GM-24S	6/7/2007	**2,600 J**	429	ND	2.25
GM-24S	9/13/2007	**1,390 J**	346 J	ND	1.16 J
GM-24S	12/20/2007	**ND UJ**	ND	ND	ND
GM-24S	3/27/2008	578	ND	ND	0.59
GM-24S	6/26/2008	**1,980**	439	ND	2.13
GM-24S	9/19/2008	**1,210**	252	ND	1.34
GM-24S	12/17/2008	**1,260**	ND	ND	1.32 J
GM-24S	3/12/2009	**1,260**	309	ND	1.35
GM-24S	6/11/2009	**1,200**	R	R	ND
GM-24S	9/17/2009	**1,600 J**	850	ND	ND
GM-24S	12/17/2009	620 J	430	ND	ND
GM-24S	4/1/2010	990 J	370	ND	ND
GM-24S	6/10/2010	**1,200**	760 J	ND	2.9 J
GM-24S	9/16/2010	**1,480 J**	460 J	ND	ND
GM-24S	12/15/2010	448	ND	ND	ND
GM-24S	3/23/2011	**2,260**	350	ND	ND
GM-24S	6/23/2011	**1,140 J**	380	ND	ND
GM-24S	9/28/2011	806 J	710 J	ND	ND
GM-24S	12/21/2011	**2,080**	260	ND	ND
GM-24S	3/21/2012	462 J	260	ND	ND
GM-24S	6/22/2012	**1,220**	270	ND	ND
GM-24S	9/11/2012	**2,460**	550	ND	ND
GM-24S	12/20/2012	244	ND	ND	ND
GM-24S	3/20/2013	**1,100**	270	ND	ND
GM-24S	6/26/2013	850 J	390	ND	ND
GM-24S	9/11/2013	500 J	470	ND	ND UJ
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (μg/L)	Benzene EPA 8021 & 8260 (μg/L)
Plant 1, continued					
GM-24S	12/11/2013	**1,700**	450 J	ND	ND
GM-24S	3/12/2014	200 J	300 J	ND	ND
GM-24S	6/11/2014	**1,000**	450	ND	ND
GM-24S	9/10/2014	620 J	720	ND	ND
GM-24S					
AR-03	4/9/1997	**4,560**	5,890 J	1,070 J	**2,780 J**
AR-03	7/8/1997	**2,690**	7,600	1,640	**311**
AR-03	10/21/1997	**2,460**	730	ND	**204**
AR-03	1/21/1998	570	1,740	ND	41
AR-03	3/10/1998	**2,800**	2,490	ND	**850**
AR-03	7/6/1998	**2,900**	2,030	ND	35
AR-03	10/20/1998	990	2,230	ND	ND
AR-03	12/15/1998	780	1,200	ND	50
AR-03	3/25/1999	**3,800**	2,480	ND	**1,600**
AR-03	6/23/1999	**3,300**	2,390	ND	**290**
AR-03	9/29/1999	**3,400**	2,570	ND	10
AR-03	12/14/1999	**2,400**	1,390	ND	**340**
AR-03	3/24/2000	**1,380**	3,600	ND	**574**
AR-03	6/30/2000	**3,230**	7,980	1,040	**523**
AR-03	9/27/2000	**2,320 J**	3,700 J	772	ND UJ
AR-03	12/21/2000	**2,480**	5,140	ND	41.9
AR-03	3/27/2001	**2,050**	3,500	812	**583**
AR-03	6/14/2001	**1,330 J**	2,220	ND	1.59 R
AR-03	10/3/2001	533	1,640	ND	ND
AR-03	12/11/2001	**1,870**	1,790	ND	**661**
AR-03	3/6/2002	**2,890**	4,520	ND	**1800**
AR-03	6/10/2002	**2280 J**	5,590	794	**160 J**
AR-03	9/18/2002	484 J	1,890 J	ND UJ	6.01 J
AR-03	12/16/2002	321	2,830	ND	ND
AR-03	3/26/2003	**2,090**	6,190	ND	**1070 J**
AR-03	6/26/2003	610 J	2,790	ND	28.1
AR-03	9/19/2003	297	1,630	ND	ND
AR-03	12/23/2003	918	1640 J	ND	**228**
AR-03	3/9/2004	**2,350**	ND	ND	**659**
AR-03	6/17/2004	769 J	675	ND	34.3
AR-03	9/29/2004	332	ND	ND	ND
AR-03	12/8/2004	344	ND	ND	6.65
AR-03	3/11/2005	454	ND	ND	12.6
AR-03	6/22/2005	288	ND	ND	1.47
AR-03	9/28/2005	389	ND	ND	ND
AR-03	12/14/2005	520	408	ND	32.7
AR-03	3/22/2006	**2,450**	947	ND	**451**
AR-03	7/7/2006	860	ND	ND	67.3
AR-03	9/19/2006	323	ND	ND	ND
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (μg/L)	Benzene EPA 8021 & 8260 (μg/L)
Plant 1, continued					
AR-03	12/13/2006	**1,210 J**	ND UJ	ND UJ	**134 J**
AR-03	3/22/2007	**1,880 J**	518	ND	**304**
AR-03	6/7/2007	**1,503**	ND	ND	**148**
AR-03	9/13/2007	186	ND	ND	ND
AR-03	12/19/2007	317	ND	ND	1.59
AR-03	3/26/2008	**2,010**	263	ND	172
AR-03	6/26/2008	**2,580**	ND	ND	**72.0**
AR-03	9/17/2008	758	ND	ND	0.79
AR-03	12/17/2008	**1,030 J**	384	ND	0.94
AR-03	3/13/2009	157	462	ND	ND
AR-03	6/11/2009	940	R	R	3.30
AR-03	9/17/2009	**1,200**	590	ND	ND
AR-03	12/16/2009	160	1,100	ND	ND
AR-03	3/31/2010	230	3,700	ND	ND
AR-03	6/10/2010	810	**14,000**	930	ND
AR-03	9/15/2010	676	180	ND	ND
AR-03	12/15/2010	ND	130	ND	ND
AR-03	3/24/2011	ND	390	ND	ND
AR-03	6/23/2011	297	380	ND	ND
AR-03	9/28/2011	821	270	ND	ND
AR-03	12/21/2011	940	170	ND	ND
AR-03	3/21/2012	ND	ND	ND	ND
AR-03	6/21/2012	ND	340	ND	ND
AR-03	9/10/2012	815 J	650 J	ND	ND
AR-03	12/20/2012	ND	460	ND	ND
AR-03	3/20/2013	78	ND	ND	ND
AR-03	6/26/2013	370	ND	ND	ND
AR-03	9/11/2013	540	280	ND	ND
AR-03	12/11/2013	390	560	ND	ND
AR-03	3/12/2014	ND	1,100 J	ND	ND
AR-03	6/10/2014	ND UJ	2,700	ND	ND
AR-03	9/9/2014	260	3,100	850	ND
AR-03					
MW-1-T9	12/15/2005	434	785	ND	ND
MW-1-T9	3/22/2006	**1,600**	214	ND	**78.9**
MW-1-T9	7/7/2006	816	ND	ND	0.852
MW-1-T9	9/19/2006	236	ND	ND	ND
MW-1-T9	12/13/2006	307 J	ND UJ	ND UJ	ND UJ
MW-1-T9	3/22/2007	922 J	510	ND	15.8 J
MW-1-T9	6/7/2007	**1,130**	428	ND	0.779
MW-1-T9	9/14/2007	536	ND	ND	ND
MW-1-T9	12/19/2007	120	ND	ND	ND
MW-1-T9	3/26/2008	879	467	ND	18.3
MW-1-T9	6/26/2008	**1,050 J**	ND	ND	7.02
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (μg/L)	Benzene EPA 8021 & 8260 (μg/L)
Plant 1, continued					
MW-1-T9	9/18/2008	919	ND	ND	0.5
MW-1-T9	12/17/2008	374	ND	ND	ND
MW-1-T9	3/13/2009	377	445	ND	0.666
MW-1-T9	6/11/2009	**1,000**	R	R	1.7
MW-1-T9	9/17/2009	980	770	ND	0.5
MW-1-T9	12/17/2009	98	590	ND	ND
MW-1-T9	3/31/2010	**1,300 J**	**11,000**	ND	1.4
MW-1-T9	6/10/2010	820	**14,000**	1,200	0.7
MW-1-T9	9/15/2010	473	160	ND	ND
MW-1-T9	12/15/2010	147	120	ND	ND
MW-1-T9	3/24/2011	256	440	ND	ND
MW-1-T9	6/22/2011	437	370	ND	ND
MW-1-T9	9/29/2011	338	ND	ND	ND
MW-1-T9	12/21/2011	438	110	ND	ND
MW-1-T9	3/22/2012	121	ND	ND	ND
MW-1-T9	6/22/2012	268	260	ND	ND
MW-1-T9	9/10/2012	338	580	ND	ND
MW-1-T9	12/20/2012	170	530	ND	ND
MW-1-T9	3/20/2013	300	ND	ND	ND
MW-1-T9	6/26/2013	380	ND	ND	ND
MW-1-T9	9/11/2013	270	ND	ND	ND
MW-1-T9	12/11/2013	560	160	ND	ND
MW-1-T9	3/12/2014	160	3,700 J	890 J	ND
MW-1-T9	6/11/2014	360	5,800	940	ND
MW-1-T9	9/10/2014	350	3,700	700	ND
MW-1-T9					
MW-2-T9	12/15/2005	**7,870**	2,270	ND	63.9
MW-2-T9	3/22/2006	**8,070**	212	ND	49.6
MW-2-T9	7/7/2006	**2,670 J**	ND	ND	17.8
MW-2-T9	9/19/2006	**1,280**	ND	ND	13.4
MW-2-T9	12/13/2006	**1,980 J**	ND UJ	ND UJ	7.17 J
MW-2-T9	3/22/2007	**3,700 J**	ND	ND	24.1 J
MW-2-T9	6/7/2007	**2830 J**	0.261	ND	16.6 J
MW-2-T9	9/14/2007	748	ND	ND	4.69 J
MW-2-T9	12/19/2007	869	ND	ND	3.82
MW-2-T9	3/26/2008	**3,420**	ND	ND	21.5
MW-2-T9	6/26/2008	**1,170 J**	ND	ND	7.1
MW-2-T9	9/18/2008	**1,100**	ND	ND	1.62
MW-2-T9	12/17/2008	**1,110**	ND	ND	1.93
MW-2-T9	3/13/2009	**1,140**	ND	ND	2.92
MW-2-T9	6/11/2009	**2,200**	R	R	0.75
MW-2-T9	9/17/2009	940	370	ND	ND
MW-2-T9	12/17/2009	**1,200**	1,500	ND	ND
MW-2-T9	3/31/2010	**2,200 J**	1,100	ND	0.75
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (μg/L)	Benzene EPA 8021 & 8260 (μg/L)
Plant 1, continued					
MW-2-T9	6/10/2010	**1500 J**	3,100	340	1.5
MW-2-T9	9/15/2010	683	ND	ND	ND
MW-2-T9	12/15/2010	**1,810**	390	ND	0.53
MW-2-T9	3/24/2011	**2,000**	430	ND	ND
MW-2-T9	6/23/2011	**1,400**	250	ND	ND
MW-2-T9	9/29/2011	962	320	ND	ND
MW-2-T9	12/21/2011	**1,280**	120	ND	ND
MW-2-T9	3/22/2012	426	ND	ND	ND
MW-2-T9	6/22/2012	766	270	ND	ND
MW-2-T9	9/10/2012	**1,710**	460	ND	ND
MW-2-T9	12/20/2012	513	ND UJ	ND UJ	ND
MW-2-T9	3/20/2013	580	ND	ND	ND
MW-2-T9	6/26/2013	650	ND	ND	ND
MW-2-T9	9/10/2013	700	ND	ND	ND
MW-2-T9	12/11/2013	700	240	ND	ND
MW-2-T9	3/12/2014	740	1,400 J	ND	ND
MW-2-T9	6/11/2014	380	1,000	ND	ND
MW-2-T9	9/10/2014	520	680	ND	ND
MW-2-T9					
MW-3-T9	12/15/2005	509	860	ND	2.08
MW-3-T9	3/22/2006	572	543	ND	2.67
MW-3-T9	7/7/2006	749	ND	ND	3.48
MW-3-T9	9/19/2006	609	317	ND	1.48
MW-3-T9	12/13/2006	541	ND	ND	1.33
MW-3-T9	3/22/2007	722	ND	ND	2.33
MW-3-T9	6/7/2007	603	ND	ND	2.1
MW-3-T9	9/14/2007	536	ND	ND	1.68 J
MW-3-T9	12/19/2007	578	ND	ND	1.61
MW-3-T9	3/26/2008	522	ND	ND	1.36
MW-3-T9	6/26/2008	711	ND	ND	4.78
MW-3-T9	9/17/2008	502	ND	ND	0.585
MW-3-T9	12/17/2008	668	ND	ND	5.35
MW-3-T9	3/13/2009	275	ND	ND	0.553
MW-3-T9	6/11/2009	630	2,400	1,800	7
MW-3-T9	9/17/2009	490	ND	ND	ND
MW-3-T9	12/17/2009	580	1,000	ND	ND
MW-3-T9	3/31/2010	690 J	790	ND	5.1
MW-3-T9	6/10/2010	500	2,500	ND	5.2
MW-3-T9	9/15/2010	331	ND	ND	3.8
MW-3-T9	12/15/2010	449	ND	ND	15
MW-3-T9	3/24/2011	826	270	ND	**87.7**
MW-3-T9	6/23/2011	632	ND	ND	69.6
MW-3-T9	9/29/2011	468	ND	ND	40.1
MW-3-T9	12/21/2011	788	ND	ND	58.2
MW-3-T9	3/22/2012	825	ND	ND	**191**
MW-3-T9	6/21/2012	596	ND	ND	**113**
MW-3-T9	9/10/2012	679	ND	ND	**94.9**

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (µg/L)	TPH-D WTPH-DX (µg/L)	TPH-O WTPH-DX (µg/L)	Benzene EPA 8021 & 8260 (µg/L)
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (µg/L)	TPH-D WTPH-DX (µg/L)	TPH-O WTPH-DX (µg/L)	Benzene EPA 8021 & 8260 (µg/L)
Plant 2, continued					
MW-3-T9	12/20/2012	617	760	ND	**172**
MW-3-T9	3/20/2013	700	ND	ND	68
MW-3-T9	6/26/2013	520	ND	ND	55
MW-3-T9	9/10/2013	490	ND	ND	39
MW-3-T9	12/11/2013	980	ND	ND	39
MW-3-T9	3/12/2014	**1,000**	1,400 J	ND	28
MW-3-T9	6/11/2014	670	1,300	ND	14
MW-3-T9	9/10/2014	650	400	ND	14
MW-3-T9					
MW-4-T9	12/15/2005	ND	ND	ND	1.26
MW-4-T9	3/22/2006	ND	ND	ND	0.836
MW-4-T9	7/7/2006	ND	ND	ND	0.745
MW-4-T9	9/19/2006	ND	ND	ND	1.53
MW-4-T9	12/13/2006	ND UJ	ND UJ	ND UJ	1.46
MW-4-T9	3/22/2007	ND	ND	ND	0.625
MW-4-T9	6/7/2007	81	ND	ND	ND
MW-4-T9	9/14/2007	ND	ND	ND	0.599 J
MW-4-T9	12/19/2007	ND	ND	ND	1.55
MW-4-T9	3/26/2008	ND	ND	ND	ND
MW-4-T9	6/26/2008	ND	ND	ND	ND
MW-4-T9	9/18/2008	ND	ND	ND	0.92
MW-4-T9	12/17/2008	ND	ND	ND	1.1
MW-4-T9	3/13/2009	ND	ND	ND	0.506
MW-4-T9	6/11/2009	ND	R	R	ND
MW-4-T9	9/17/2009	60	ND	ND	ND
MW-4-T9	12/16/2009	ND	ND	ND	ND
MW-4-T9	3/31/2010	ND	ND	ND	ND
MW-4-T9	6/10/2010	ND	210	ND	ND
MW-4-T9	9/15/2010	ND	ND	ND	ND
MW-4-T9	12/15/2010	ND	ND	ND	ND
MW-4-T9	3/24/2011	ND	ND	ND	ND
MW-4-T9	6/23/2011	ND	ND	ND	ND
MW-4-T9	9/28/2011	ND	ND	ND	ND
MW-4-T9	12/21/2011	ND	ND	ND	ND
MW-4-T9	3/21/2012	ND	ND	ND	ND
MW-4-T9	6/21/2012	ND	ND	ND	ND
MW-4-T9	9/10/2012	ND	ND	ND	ND
MW-4-T9	12/20/2012	ND	ND	ND	ND
MW-4-T9	3/20/2013	ND	ND	ND	ND
MW-4-T9	6/26/2013	ND	ND	ND	ND
MW-4-T9	9/10/2013	ND	ND	ND	ND
MW-4-T9	12/11/2013	ND	ND	ND	ND
MW-4-T9	3/12/2014	ND	290 J	ND	ND
MW-4-T9	6/11/2014	ND	480	ND	ND
MW-4-T9	9/19/2014	ND	400	ND	ND
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (μg/L)	Benzene EPA 8021 & 8260 (μg/L)
Plant 2					
GM-19S	4/10/1997	**1,070**	4,260	1,840	1.3
GM-19S	7/9/1997	**1,030**	1,840	1,150	0.9 J
GM-19S	10/22/1997	800	370	ND	3.6
GM-19S	1/22/1998	400 J	1,320	ND	1.8
GM-19S	3/12/1998	180	1,860	ND	ND
GM-19S	7/8/1998	**1,000 J**	1,660 J	ND UJ	ND UJ
GM-19S	10/21/1998	570	1,260	ND	2.5
GM-19S	12/17/1998	650	1,970	ND	0.9
GM-19S	3/25/1999	72	1,420	793	ND
GM-19S	6/22/1999	**1,600**	1,100	ND	1.5
GM-19S	9/27/1999	**1,900 J**	NS	NS	44 J
GM-19S	12/13/1999	**1,500 J**	1,160	ND	**470**
GM-19S	3/24/2000	ND	1,530	ND	**955**
GM-19S	7/3/2000	771	1,380	ND	**2,330 J**
GM-19S	9/29/2000	ND UJ	2,290 J	776 J	**4,010 J**
GM-19S	12/21/2000	ND	3,150	806	**2,660**
GM-19S	3/28/2001	**2,940**	2,320	994	**1,730**
GM-19S	6/15/2001	**3,270**	1,230	ND	**3,390**
GM-19S	10/5/2001	Not accessible due to island redevelopment activities			
GM-19S	12/13/2001	**5,140**	2,350	985	**1,990**
GM-19S	3/8/2002	**11,000**	1,940	NS	**723**
GM-19S	6/11/2002	**2,720 J**	3,210	810	**710 J**
GM-19S	9/18/2002	**1,320 J**	2,430 J	ND UJ	**1,960 J**
GM-19S	12/16/2002	730	4590 J	1,770	**2,320 J**
GM-19S	3/25/2003	**9,540**	3,350	960	**1,960**
GM-19S	6/25/2003	**3,640**	3,740 J	1,380 J	**596**
GM-19S	9/19/2003	**1,290**	2,010	ND	**469**
GM-19S	12/23/2003	**1,070 J**	2,190 J	ND	**496**
GM-19S	3/9/2004	**1,450**	ND	ND	**832**
GM-19S	6/17/2004	**1,150**	498	ND	**307**
GM-19S	9/29/2004	679 J	NS	NS	**87.8**
GM-19S	12/9/2004	501	NS	NS	47
GM-19S	3/11/2005	649	NS	NS	**210.0**
GM-19S	6/22/2005	NS	NS	NS	**99.7**
GM-19S	9/28/2005	467	NS	NS	43.9
GM-19S	12/14/2005	581	NS	NS	**508**
GM-19S	3/22/2006	**1,710**	NR	NR	**853**
GM-19S	7/7/2006	850	NR	NR	**426**
GM-19S	9/19/2006	389	NS	NS	63
GM-19S	12/13/2006	445 J	NS	NS	**167 J**
GM-19S	3/22/2007	**1,070 J**	NS	NS	**1,400**
GM-19S	6/7/2007	200 J	NS	NS	15
GM-19S	9/13/2007	484	NS	NS	**956**
GM-19S	12/19/2007	88	NS	NS	**140**
GM-19S	3/27/2008	560	NS	NS	**869**
GM-19S	6/26/2008	958	NS	NS	**164**
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (µg/L)	TPH-D WTPH-DX (µg/L)	TPH-O WTPH-DX (µg/L)	Benzene EPA 8021 & 8260 (µg/L)
Plant 2, continued					
GM-19S	9/19/2008	530	NS	NS	**178**
GM-19S	12/18/2008	Well not sampled, sampling has been reduced to a semi-annual event			
GM-19S	3/12/2009	261	NS	NS	**186**
GM-19S	9/17/2009	510	NS	NS	**140**
GM-19S	3/31/2010	220	NS	NS	**110**
GM-19S	9/15/2010	372	NS	NS	**111**
GM-19S	3/23/2011	56.5	NS	NS	26.9
GM-19S	9/28/2011	709	NS	NS	31.0
GM-19S	3/21/2012	355	NS	NS	8.4
GM-19S	9/11/2012	312	NS	NS	47.0
GM-19S	3/20/2013	330	NR	NR	38.0
GM-19S	9/11/2013	750	NR	NR	**160**
GM-19S	3/12/2014	ND	NR	NR	10
GM-19S	9/10/2014	53	NR	NR	44
GM-19D	4/10/1997	ND	6,680	2,050	**234**
GM-19D	7/9/1997	ND	5,910	1,780	**330**
GM-19D	10/22/1997	70	ND	ND	**263**
GM-19D	1/22/1998	ND	1,820	ND	**260**
GM-19D	3/12/1998	ND	2,630	ND	**140**
GM-19D	7/8/1998	ND UJ	2,120 J	ND UJ	**360 J**
GM-19D	10/21/1998	ND	1,930	ND	**180**
GM-19D	12/17/1998	ND	2,260	ND	**170**
GM-19D	3/25/1999	57	2,280	ND	**150**
GM-19D	6/22/1999	150	1,520	ND	**150**
GM-19D	9/27/1999	75 J	2,460 J	ND UJ	**120 J**
GM-19D	12/13/1999	550 J	1,930	ND	**170**
GM-19D	3/22/2000	ND	2,490	ND	**208**
GM-19D	7/3/2000	ND	5,260	1,280	**225**
GM-19D	9/29/2000	ND UJ	6,490 J	1,470 J	**210 J**
GM-19D	12/21/2000	ND	8,700	984	**225**
GM-19D	3/28/2001	ND	8,100	1,990	**163**
GM-19D	6/12/2001	ND	2,650	ND	**278**
GM-19D	10/5/2001	Not accessible due to island redevelopment activities			
GM-19D	12/13/2001	ND	7,830	1,880	**265**
GM-19D	3/8/2002	ND	3,400	ND	**281**
GM-19D	6/11/2002	63	7,810	1,470	**220**
GM-19D	9/18/2002	59.8 J	1,960 UJ	ND UJ	**215**
GM-19D	12/16/2002	52 J	6880 J	1,020	**263**
GM-19D	3/26/2003	ND	2,880	ND UJ	**270**
GM-19D	6/25/2003	ND	6,930	1,770	**222**
GM-19D	9/19/2003	ND	2,300	ND	**241**
GM-19D	12/23/2003	ND	7710 J	1,140	**261**
GM-19D	3/9/2004	82	ND	ND	**173**
GM-19D	6/17/2004	56.1	3,430	ND	**169**
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (μg/L)	Benzene EPA 8021 & 8260 (μg/L)
Plant 2, continued					
GM-19D		WELL DELETED FROM MONITORING PROGRAM			
GM-21S	4/10/1997	ND	4,640	2,960	ND
GM-21S	7/9/1997	ND	5,080	2,420	ND
GM-21S	10/23/1997	ND	ND	ND	ND
GM-21S	1/23/1998	ND	1,710	ND	ND
GM-21S	3/12/1998	ND	615	ND	ND
GM-21S	7/9/1998	ND	2,190	ND	ND
GM-21S	10/21/1998	ND	694	ND	ND
GM-21S	12/17/1998	ND	1,050	ND	ND
GM-21S	3/25/1999	NS	793	ND	NS
GM-21S	6/22/1999	NS	875	ND	NS
GM-21S	9/27/1999	NS	3,330 J	ND UJ	NS
GM-21S	12/13/1999	NS	648	ND	NS
GM-21S	3/23/2000	ND	1,480	ND	ND
GM-21S	7/6/2000	ND	3,020	ND	ND
GM-21S	9/29/2000	ND UJ	3,310 J	924 J	ND UJ
GM-21S	12/21/2000	NS	NS	NS	NS
GM-21S	3/28/2001	Not accessible due to island redevelopment activities			
GM-21S	6/12/2001	Not accessible due to island redevelopment activities			
GM-21S	10/5/2001	Not accessible due to island redevelopment activities			
GM-21S	12/13/2001	Not accessible due to island redevelopment activities			
GM-21S	3/6/2002	ND	454	ND	ND
GM-21S		WELL DELETED FROM MONITORING PROGRAM			
GM-21D	4/10/1997	ND	1,730 J	810 J	ND
GM-21D	7/9/1997	ND	1,860	ND	ND
GM-21D	10/23/1997	ND	ND	ND	ND
GM-21D	1/23/1998	ND	744	ND	ND
GM-21D	3/12/1998	ND	1,830	ND	ND
GM-21D	7/9/1998	ND	1,030 J	ND UJ	ND
GM-21D	10/21/1998	ND	684	ND	ND
GM-21D	12/17/1998	ND	926	ND	ND
GM-21D	6/22/1999	NS	1,100	ND	NS
GM-21D	9/27/1999	NS	2,330 J	ND UJ	NS
GM-21D	12/13/1999	NS	986	ND	NS
GM-21D		WELL DELETED FROM MONITORING PROGRAM			
GM-22S		WELL NOT SAMPLED BETWEEN 1997 AND 2000			
GM-22S	3/23/2000	ND	5,060	841	0.538
GM-22S	7/6/2000	ND	8,930	1,050	ND
GM-22S	9/29/2000	ND UJ	3,130 J	1,620 J	2.04 J
GM-22S	12/21/2000	ND	5,070	1,720	ND
GM-22S	3/28/2001	ND	5,430	2,500	ND
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (μg/L)	Benzene EPA 8021 & 8260 (μg/L)
Plant 2, continued					
GM-22S	6/15/2001	ND	3,110	ND	ND
GM-22S	10/5/2001	Not accessible due to island redevelopment activities			
GM-22S	12/13/2001	55.3	4,780	2,320	ND
GM-22S	3/8/2002	ND	2,710	831	ND
GM-22S		WELL DELETED FROM MONITORING PROGRAM			
GM-23S	4/10/1997	NS	NS	NS	NS
GM-23S	7/9/1997	750	1,830	1,010	ND
GM-23S	10/22/1997	400	ND	ND	ND
GM-23S	1/23/1998	NS	NS	NS	NS
GM-23S	3/12/1998	NS	NS	NS	NS
GM-23S	7/8/1998	480 J	467 J	ND UJ	ND UJ
GM-23S	10/21/1998	500	1,250	ND	ND
GM-23S	12/17/1998	NS	NS	NS	NS
GM-23S	3/25/1999	NS	NS	NS	NS
GM-23S	6/22/1999	680	801	ND	ND
GM-23S	9/28/1999	940	682	ND	ND
GM-23S		WELL DELETED FROM MONITORING PROGRAM			
T-18-1	6/14/2001	ND	1,670	ND	ND
T-18-1	10/5/2001	ND	1,270	ND	ND
T-18-1	12/13/2001	ND	365	ND	ND
T-18-1	3/6/2002	ND	357	ND	ND
T-18-1		WELL DELETED FROM MONITORING PROGRAM			
T-18-2a	6/14/2001	ND	385	ND	ND
T-18-2a	10/5/2001	ND	339	ND	ND
T-18-2a	12/13/2001	ND	323	ND	ND
T-18-2a	3/6/2002	ND	256	ND	ND
T-18-2a		WELL DELETED FROM MONITORING PROGRAM			
MW-03R	6/11/2002	NS	**20,700**	ND	NS
MW-03R	9/18/2002	NS	9,690 J	1,990 J	NS
MW-03R	12/16/2002	NS	NS	NS	NS
MW-03R	3/25/2003	NS	ND	ND UJ	NS
MW-03R	6/26/2006	NS	**10,200**	2,500	NS
MW-03R	9/19/2003	NS	831	ND	NS
MW-03R	12/23/2003	NS	472 J	ND	NS
MW-03R	3/9/2004	NR	645	ND	NS
MW-03R	6/17/2004	NR	935	ND	NS
MW-03R		WELL DELETED FROM MONITORING PROGRAM			
Cleanup Level		1,000	10,000	10,000	71
Method Reporting Limit		50	250	750	0.5

Table 1. Groundwater Monitoring Analytical Results for TPH and Benzene
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TPH-G WTPH-G (μg/L)	TPH-D WTPH-DX (μg/L)	TPH-O WTPH-DX (μg/L)	Benzene EPA 8021 & 8260 (μg/L)

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

J	Estimated value.
μg/L	Micrograms per liter.
NA	Not analyzed.
ND	Constituent not detected above reporting limit.
NS	Not sampled.
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.
U	Undetected.
WTPH-DX	Washington State Method for Analysis of Diesel and Oil in Water - Extended.
WTPH-G	Washington State Method for Analysis of Gasoline in Water.

EPA 8021 or EPA 9260 - EPA Methods for Analysis of Benzene in Water.

Table 2. Groundwater Monitoring Analytical Results for cPAHs
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Benz(a)anthracene (µg/L)	Benzo(a)pyrene (µg/L)	Benzo(b)fluoranthene (µg/L)	Benzo(k)fluoranthene (µg/L)	Chrysene (µg/L)	Dibenz(a,h)anthracene (µg/L)	Indeno(1,2,3,-cd)pyrene (µg/L)
Plant 1								
GM-11S	4/10/1997	ND	ND	ND	ND	0.01	ND	ND
GM-11S	7/8/1997	ND	ND	ND	ND	0.01 J	ND	0.01 J
GM-11S	10/21/1997	0.02	0.01	0.02	0.01	0.02	0.01	0.01
GM-11S	1/21/1998	ND	ND	ND	ND	0.01 U	ND	ND
GM-11S		WELL DELETED FROM cPAH MONITORING PROGRAM						
GM-12S	4/10/1997	0.02	0.03	**0.04**	**0.04**	**0.06**	ND	**0.04**
GM-12S	7/8/1997	**0.06 J**	**0.07 J**	**0.11 J**	**0.09 J**	**0.13 J**	0.01 J	**0.06 J**
GM-12S	10/20/1997	**0.07 J**	**0.06 J**	**0.1 J**	**0.09 J**	**0.15 J**	0.01	**0.08 J**
GM-12S	1/21/1998	0.1 U	**0.11**	**0.12**	**0.12 U**	**0.16 U**	**0.04**	**0.11**
GM-12S	3/10/1998	**0.05**	**0.06**	**0.1**	**0.07**	**0.12**	0.02	**0.09**
GM-12S	7/6/1998	0.01	0.01	0.03	0.02	**0.04**	ND	0.03
GM-12S	10/20/1998	0.03	0.03	**0.05**	**0.04**	**0.07 J**	0.01	**0.05**
GM-12S	12/15/1998	NS	NS	NS	NS	NS	NS	NS
GM-12S	3/26/1999	0.01	0.01	0.02	0.02	0.02	ND	0.02 U
GM-12S	6/23/1999	ND	0.01	0.01	0.01	0.01	ND	0.01
GM-12S		WELL DELETED FROM cPAH MONITORING PROGRAM						
GM-15S	4/9/1997	ND	ND	ND	ND	ND	ND	ND
GM-15S	7/8/1997	ND	0.01 J	0.02 J	0.01 J	ND	ND	0.01 J
GM-15S	10/21/1997	ND	ND	ND	ND	ND	ND	ND
GM-15S	1/21/1998	ND	ND	ND	ND	ND	ND	ND
GM-15S		WELL DELETED FROM cPAH MONITORING PROGRAM						
GM-16S	4/9/1997	ND	ND	ND	ND	ND	ND	ND
GM-16S	7/8/1997	ND	ND	ND	ND	ND	ND	ND
GM-16S	10/21/1997	ND	ND	ND	ND	ND	ND	ND
GM-16S	1/21/1998	ND	ND	ND	ND	ND	ND	ND
GM-16S		WELL DELETED FROM cPAH MONITORING PROGRAM						
GM-17S	4/9/1997	ND	ND	ND	ND	ND	ND	ND
GM-17S	7/9/1997	0.01 J	ND	0.01 J	0.01 J	0.02 J	0.01 J	0.01 J
GM-17S	10/21/1997	ND	ND	ND	ND	ND	ND	ND
GM-17S	1/22/1998	ND	ND	ND	ND	ND	ND	ND
GM-17S		WELL DELETED FROM cPAH MONITORING PROGRAM						
Cleanup Level		0.031	0.031	0.031	0.031	0.031	0.031	0.031

Table 2. Groundwater Monitoring Analytical Results for cPAHs
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Benz(a)anthracene (µg/L)	Benzo(a)pyrene (µg/L)	Benzo(b)fluoranthene (µg/L)	Benzo(k)fluoranthene (µg/L)	Chrysene (µg/L)	Dibenz(a,h)anthracene (µg/L)	Indeno(1,2,3,-cd)pyrene (µg/L)
Plant 1, continued								
GM-24S	4/9/1997	ND	ND	ND	ND	ND	ND	ND
GM-24S	7/9/1997	ND	ND	ND	ND	ND	ND	ND
GM-24S	10/22/1997	ND	ND	ND	ND	ND	ND	ND
GM-24S	1/22/1998	ND	ND	ND	ND	ND	ND	ND
GM-24S		WELL DELETED FROM cPAH MONITORING PROGRAM						
AR-03	4/9/1997	ND R	ND R	ND R	ND R	ND R	ND R	ND R
AR-03	7/8/1997	ND	ND	ND	ND	ND	ND	ND
AR-03	10/21/1997	ND	ND	ND	ND	ND	ND	ND
AR-03	1/21/1998	ND	ND	ND	ND	ND	ND	ND
AR-03		WELL DELETED FROM cPAH MONITORING PROGRAM						
AMW-01	12/21/2000	ND	ND	0.116	ND	ND	ND	ND
AMW-01	3/28/2001	**0.0372 J**	**0.0821 J**	**0.04585 * J**	**0.04585 * J**	**0.0347 J**	ND UJ	ND UJ
AMW-01	6/13/2001	ND	ND	ND *	ND *	ND	**0.052**	ND
AMW-01	10/4/2001	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-01	12/12/2001	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-01	3/7/2002	ND	ND	ND	ND	ND	ND	ND
AMW-01	6/12/2002	ND	ND	ND	ND	ND	ND	ND
AMW-01	9/19/2002	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-01	12/17/2002	0.0292 J	ND	ND	ND	ND	ND	ND
AMW-01	6/16/2004	ND	ND	ND	ND	ND	ND	ND
AMW-01	9/28/2004	ND	ND	ND	ND	ND	ND	ND
AMW-01	12/6/2004	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-01	3/10/2005	U	U	**0.0509**	U	**0.0637**	**0.0483**	**0.0506**
AMW-01	6/21/2005	0.024	ND	**0.0411**	**0.0502**	**0.0322**	ND	0.0222
AMW-01	9/27/2005	ND	ND	ND	ND	ND	ND	ND
AMW-01	12/13/2005	ND	ND	ND	ND	ND	ND	ND
AMW-01	3/21/2006	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-01	7/6/2006	ND	ND	ND	ND	ND	ND	ND
AMW-01	9/18/2006	ND	ND	ND	ND	ND	ND	ND
AMW-01	12/12/2006	ND R	ND R	ND R	ND R	ND R	NDR	ND R
AMW-01	3/21/2007	**0.212 J**	**0.177 J**	**0.22 J**	**0.29 J**	**0.215 J**	**0.237 J**	**0.229 J**
AMW-01	6/6/2007	ND	ND	ND	ND	ND	ND	ND
AMW-01	9/12/2007	0.0124 J	ND UJ	ND UJ	ND UJ	0.0133 J	ND UJ	ND UJ
AMW-01	12/18/2007	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
Cleanup Level		0.031	0.031	0.031	0.031	0.031	0.031	0.031

Table 2. Groundwater Monitoring Analytical Results for cPAHs
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Benz(a)anthracene (µg/L)	Benzo(a)pyrene (µg/L)	Benzo(b)fluoranthene (µg/L)	Benzo(k)fluoranthene (µg/L)	Chrysene (µg/L)	Dibenz(a,h)anthracene (µg/L)	Indeno(1,2,3,-cd)pyrene (µg/L)
Plant 1, continued								
AMW-01	3/25/2008	ND	ND	ND	ND	ND	ND	ND
AMW-01	6/25/2008	cPAH Sampling Reduced to an Annual Event						
AMW-01	12/16/2008	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-01	12/16/2009	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-01	12/14/2010	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-01	12/21/2011	ND	ND	0.018	ND	ND	ND	ND
AMW-01	12/19/2012	ND	ND	ND	ND	ND	ND	ND
AMW-01	12/10/2013	ND	ND	ND	ND	ND	ND	ND
AMW-02	12/21/2000	ND	ND	ND	ND	ND	ND	ND
AMW-02	3/28/2001	Warehouse not accessible due to earthquake damage.						
AMW-02	6/13/2001	ND UJ	ND UJ	ND UJ *	ND UJ *	ND UJ	**0.052 J**	ND UJ
AMW-02	10/4/2001	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-02	12/12/2001	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-02	3/7/2002	NS	NS	NS	NS	NS	NS	NS
AMW-02	6/12/2002	ND	ND	ND	ND	ND	ND	ND
AMW-02	9/19/2002	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-02	12/17/2002	ND	ND	ND	ND	ND	ND	ND
AMW-02	6/16/2004	ND	ND	ND	ND	**0.0322**	ND	ND
AMW-02	9/28/2004	ND	ND	ND	ND	ND	ND	ND
AMW-02	12/8/2004	ND	ND	ND	ND	ND	ND	ND
AMW-02	3/10/2005	U	U	0.136	U	U	0.0153	0.0143
AMW-02	6/21/2005	ND	ND	ND	ND	ND	ND	ND
AMW-02	9/27/2005	ND	ND	ND	ND	ND	ND	ND
AMW-02	12/13/2005	ND	ND	ND	ND	ND	ND	ND
AMW-02	3/21/2006	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-02	7/6/2006	ND	ND	ND	ND	ND	ND	ND
AMW-02	9/18/2006	ND	ND	ND	ND	ND	ND	ND
AMW-02	12/12/2006	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	NDUJ
AMW-02	3/21/2007	**0.201**	**0.191**	**0.207**	**0.237**	**0.215**	**0.226**	**0.232**
AMW-02	6/6/2007	ND	ND	ND	ND	ND	ND	ND
AMW-02	9/12/2007	ND UJ	ND UJ	ND UJ	ND UJ	0.0117 J	ND UJ	ND UJ
AMW-02	12/18/2008	ND	ND	ND	ND	ND	ND	ND
AMW-02	3/25/2008	ND	ND	ND	ND	ND	ND	ND
AMW-02	6/25/2008	cPAH Sampling Reduced to an Annual Event						
AMW-02	12/16/2008	ND	ND	ND	ND	ND	ND	ND
AMW-02	12/16/2009	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-02	12/14/2010	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-02	12/21/2011	ND	ND	ND	0.017	ND	ND	ND
AMW-02	12/19/2012	ND	ND	ND	ND	ND	ND	ND
AMW-02	12/10/2013	0.016	ND	ND	ND	ND	ND	ND
Cleanup Level		0.031	0.031	0.031	0.031	0.031	0.031	0.031

Table 2. Groundwater Monitoring Analytical Results for cPAHs
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Benz(a)anthracene (µg/L)	Benzo(a)pyrene (µg/L)	Benzo(b)fluoranthene (µg/L)	Benzo(k)fluoranthene (µg/L)	Chrysene (µg/L)	Dibenz(a,h)anthracene (µg/L)	Indeno(1,2,3,-cd)pyrene (µg/L)
Plant 1, continued								
AMW-03	12/21/2000	ND	ND	ND	ND	ND	ND	ND
AMW-03	3/28/2001	Warehouse not accessible due to earthquake damage.						
AMW-03	6/13/2001	ND	ND	ND *	ND *	ND	**0.051**	ND
AMW-03	10/4/2001	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-03	12/12/2001	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-03	3/7/2002	NS	NS	NS	NS	NS	NS	NS
AMW-03	6/12/2002	ND	ND	ND	ND	ND	ND	ND
AMW-03	9/19/2002	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-03	12/17/2002	ND	ND	ND	ND	ND	ND	ND
AMW-03	6/16/2004	ND	ND	ND	ND	ND	ND	ND
AMW-03	9/28/2004	ND	ND	ND	ND	ND	ND	ND
AMW-03	1/20/2005	ND	ND	ND	ND	ND	ND	ND
AMW-03	3/10/2005	U	ND	0.142	U	U	ND	ND
AMW-03	6/21/2005	ND	ND	ND	ND	ND	ND	ND
AMW-03	9/27/2005	ND	ND	ND	ND	ND	ND	ND
AMW-03	12/13/2005	ND	ND	ND	ND	ND	ND	ND
AMW-03	3/21/2006	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-03	7/6/2006	ND	ND	ND	ND	ND	ND	ND
AMW-03	9/18/2006	ND	ND	ND	ND	ND	ND	ND
AMW-03	12/12/2006	**0.0835J**	NDUJ	0.157J	**0.0387J**	**0.0784J**	**0.116J**	**0.125J**
AMW-03	3/21/2007	**0.0714**	**0.0689**	**0.0583**	**0.0773**	**0.0851**	**0.0823**	**0.0752**
AMW-03	6/6/2007	ND	ND	ND	ND	ND	ND	ND
AMW-03	9/12/2007	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-03	12/18/2007	ND	ND	ND	ND	ND	ND	ND
AMW-03	3/25/2008	ND	ND	ND	ND	ND	ND	ND
AMW-03	6/25/2008	cPAH Sampling Reduced to an Annual Event						
AMW-03	12/16/2008	ND	ND	ND	ND	ND	ND	ND
AMW-03	12/16/2009	ND	ND	ND	ND	ND	ND	ND
AMW-03	12/14/2010	ND	ND	ND	ND	ND	ND	ND
AMW-03	12/21/2011	0.017	0.028	**0.051**	0.017	0.030	ND	0.030
AMW-03	12/19/2012	ND	ND	ND	ND	ND	ND	ND
AMW-03	12/10/2013	ND	ND	ND	0.019	0.016	ND	ND
AMW-04	12/21/2000	ND	ND	ND	ND	ND	ND	ND
AMW-04	3/28/2001	**0.0497**	**0.0762 J**	**0.04325 * J**	**0.04325 * J**	**0.0451 J**	ND UJ	ND UJ
AMW-04	6/13/2001	ND	ND	ND *	ND *	ND	**0.054**	ND
AMW-04	10/4/2001	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
Cleanup Level		0.031	0.031	0.031	0.031	0.031	0.031	0.031

Table 2. Groundwater Monitoring Analytical Results for cPAHs
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Benz(a)anthracene (µg/L)	Benzo(a)pyrene (µg/L)	Benzo(b)fluoranthene (µg/L)	Benzo(k)fluoranthene (µg/L)	Chrysene (µg/L)	Dibenz(a,h)anthracene (µg/L)	Indeno(1,2,3,-cd)pyrene (µg/L)
Plant 1, continued								
AMW-04	12/12/2001	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-04	3/7/2002	0.0264	ND	0.0276	ND	**0.0350**	ND	ND
AMW-04	6/12/2002	ND	ND	ND	ND	ND	ND	ND
AMW-04	9/19/2002	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-04	12/17/2002	**0.0396 J**	ND	ND	ND	ND	ND	ND
AMW-04	6/16/2004	ND	ND	ND	ND	ND	ND	ND
AMW-04	9/27/2004	**0.0338**	ND	0.0116	0.0152	**0.0343**	ND	ND
AMW-04	12/6/2004	ND	ND	ND	ND	ND	ND	ND
AMW-04	3/10/2005	ND	ND	ND	ND	ND	ND	ND
AMW-04	6/21/2005	ND R	ND R	ND R	ND R	ND R	ND R	ND R
AMW-04	9/27/2005	ND	ND	ND	ND	ND	ND	ND
AMW-04	12/13/2005	ND	ND	ND	ND	ND	ND	ND
AMW-04	3/21/2006	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-04	7/6/2006	ND	ND	ND	ND	ND	ND	ND
AMW-04	9/18/2006	ND	ND	ND	ND	ND	ND	ND
AMW-04	12/12/2006	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-04	3/21/2007	ND	ND	ND	ND	ND	ND	ND
AMW-04	6/6/2007	ND	ND	ND	ND	ND	ND	ND
AMW-04	9/12/2007	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-04	12/18/2007	ND	ND	ND	ND	ND	ND	ND
AMW-04	3/26/2008	ND	ND	ND	ND	ND	ND	ND
AMW-04	6/25/2008	cPAH Sampling Reduced to an Annual Event						
AMW-04	12/16/2008	ND	ND	ND	ND	ND	ND	ND
AMW-04	12/16/2009	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-04	12/14/2010	**0.031 J**	0.23 J	**0.034 J**	**0.044 J**	**0.043 J**	**0.085 J**	**0.076 J**
AMW-04	12/21/2011	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-04	12/19/2012	ND	ND	ND	ND	ND	ND	ND
AMW-04	12/10/2013	ND	ND	ND	ND	ND	ND	ND
AMW-05	12/21/2000	ND	ND	ND	ND	ND	ND	ND
AMW-05	3/28/2001	0.0280 J	**0.0750 J**	**0.0431 * J**	**0.0431 * J**	0.0301 J	ND UJ	ND UJ
AMW-05	6/13/2001	ND UJ	ND UJ	ND UJ *	ND UJ *	ND UJ	ND UJ	ND UJ
AMW-05	10/4/2001	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-05	12/12/2001	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-05	3/7/2002	ND	ND	ND	ND	ND	ND	ND
AMW-05	6/12/2002	ND	ND	ND	ND	ND	ND	ND
AMW-05	9/19/2002	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-05	12/17/2002	ND	ND	ND	ND	ND	ND	ND
Cleanup Level		0.031	0.031	0.031	0.031	0.031	0.031	0.031

Table 2. Groundwater Monitoring Analytical Results for cPAHs
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Benz(a)anthracene (μg/L)	Benzo(a)pyrene (μg/L)	Benzo(b)fluoranthene (μg/L)	Benzo(k)fluoranthene (μg/L)	Chrysene (μg/L)	Dibenz(a,h)anthracene (μg/L)	Indeno(1,2,3,-cd)pyrene (μg/L)
Plant 1, continued								
AMW-05	6/16/2004	ND	ND	ND	ND	ND	ND	ND
AMW-05	6/16/2004	ND	ND	ND	ND	ND	ND	ND
AMW-05	12/6/2004	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-05	3/10/2005	ND	ND	ND	ND	ND	ND	ND
AMW-05	6/21/2005	0.0132	ND	0.0189	0.0185	0.0178	ND	0.0142
AMW-05	9/27/2005	ND	ND	ND	ND	ND	ND	ND
AMW-05	12/13/2005	ND	ND	ND	ND	ND	ND	ND
AMW-05	3/21/2006	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-05	7/6/2006	ND	ND	ND	ND	ND	ND	ND
AMW-05	9/18/2006	ND	ND	ND	ND	**0.0832 J**	ND	ND
AMW-05	12/12/2006	**0.0771J**	**NDUJ**	**0.157J**	**0.0397J**	**0.0768J**	**0.121J**	**0.129J**
AMW-05	3/21/2007	**0.0499**	**0.0534**	**0.0551**	**0.51**	**0.0562**	**0.051**	**0.0633**
AMW-05	6/6/2007	ND	ND	ND	ND	ND	ND	ND
AMW-05	9/12/2007	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-05	12/18/2007	ND	ND	ND	ND	ND	ND	ND
AMW-05	3/26/2008	0.0159	ND	ND	ND	0.0116	ND	ND
AMW-05	6/25/2008	cPAH Sampling Reduced to an Annual Event						
AMW-05	12/16/2008	ND	ND	ND	ND	ND	ND	ND
AMW-05	12/16/2009	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ	ND UJ
AMW-05	12/14/2010	0.019 J	0.018 J	0.021 J	0.020 J	0.025 J	ND UJ	ND UJ
AMW-05	12/21/2011	ND	ND	0.018	ND	ND	ND	ND
AMW-05	12/19/2012	ND	ND	ND	ND	ND	ND	ND
AMW-05	12/10/2013	**0.037**	**0.031**	**0.053**	ND	**0.051**	ND	0.030
Plant 2								
GM-19S	4/10/1997	ND	ND	ND	ND	ND	ND	ND
GM-19S	7/9/1997	ND	ND	ND	ND	ND	ND	ND
GM-19S	10/22/1997	ND	ND	ND	ND	ND	ND	ND
GM-19S	1/22/1998	ND	ND	ND	ND	ND	ND	ND
GM-19S		WELL DELETED FROM cPAH MONITORING PROGRAM						
GM-19D	4/10/1997	ND	ND	ND	ND	ND	ND	ND
GM-19D	7/9/1997	ND	ND	ND	ND	ND	ND	ND
GM-19D	10/22/1997	ND	ND	ND	ND	ND	ND	ND
GM-19D	1/22/1998	ND	ND	ND	ND	ND	ND	ND
GM-19D		WELL DELETED FROM cPAH MONITORING PROGRAM						
GM-21S	4/10/1997	ND	ND	ND	ND	ND	ND	ND
GM-21S	7/9/1997	ND	ND	ND	ND	ND	ND	ND
Cleanup Level		0.031	0.031	0.031	0.031	0.031	0.031	0.031

Table 2. Groundwater Monitoring Analytical Results for cPAHs
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Benz(a)anthracene (µg/L)	Benzo(a)pyrene (µg/L)	Benzo(b)fluoranthene (µg/L)	Benzo(k)fluoranthene (µg/L)	Chrysene (µg/L)	Dibenz(a,h)anthracene (µg/L)	Indeno(1,2,3,-cd)pyrene (µg/L)
Plant 2, continued								
GM-21S	10/23/1997	ND	ND	ND	ND	ND	ND	ND
GM-21S	1/23/1998	ND	ND	ND	ND	ND	ND	ND
GM-21S		WELL DELETED FROM cPAH MONITORING PROGRAM						
GM-21D	4/10/1997	ND	ND	ND	ND	ND	ND	ND
GM-21D	7/9/1997	0.01 J	0.01 J	0.02 J	0.02 J	0.02 UJ	ND	0.01 J
GM-21D	10/23/1997	ND	ND	ND	ND	ND	ND	ND
GM-21D	1/23/1998	ND	ND	ND	ND	ND	ND	ND
GM-21D		WELL DELETED FROM cPAH MONITORING PROGRAM						
GM-23S	4/10/1997	NS	NS	NS	NS	NS	NS	NS
GM-23S	7/9/1997	ND	ND	ND	ND	ND	ND	ND
GM-23S	10/22/1997	ND	ND	ND	ND	ND	ND	ND
GM-23S	1/23/1998	NS	NS	NS	NS	NS	NS	NS
GM-23S		WELL DELETED FROM cPAH MONITORING PROGRAM						
Cleanup Level		0.031	0.031	0.031	0.031	0.031	0.031	0.031

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

cPAHs Carcinogenic polynuclear aromatic hydrocarbons.
J Estimated value.
µg/L Micrograms per liter.
NA Not analyzed.
ND Constituent not detected above reporting limit.
R Rejected; the presence or absence of the constituent cannot be verified.
U Undetected.

Table 3. Monthly Groundwater LNAPL and Sheen Monitoring
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Free Product
Plant 1		
GM-11S	9/29/1999	**~0.29 foot**
GM-11S	10/19/1999	**~0.59 foot**
GM-11S	11/19/1999	**~0.51 foot**
GM-11S	12/28/1999	**~0.10 foot**
GM-11S	1/21/2000	**~0.01 foot**
GM-11S	2/16/2000	**~0.01 foot**
GM-11S	3/27/2000	**~0.01 foot**
GM-11S	4/14/2000	**~0.01 foot**
GM-11S	5/15/2000	**~0.34 foot**
GM-11S	6/26/2000	**~0.07 foot**
GM-11S	7/19/2000	None
GM-11S	8/15/2000	None
GM-11S	9/29/2000	**Sheen**
GM-11S	10/12/2000	None
GM-11S	11/14/2000	**~0.03 foot**
GM-11S	12/14/2000	None
GM-11S	1/11/2001	**~0.01 foot**
GM-11S	2/15/2001	None
GM-11S	3/15/2001	None
GM-11S	4/13/2001	None
GM-11S	5/16/2001	**~0.13 foot**
GM-11S	6/11/2001	None
GM-11S	7/24/2001	None
GM-11S	8/21/2001	None
GM-11S	9/6/2001	**Sheen**
GM-11S	10/19/2001	None
GM-11S	11/15/2001	**Sheen**
GM-11S	12/10/2001	**Sheen**
GM-11S	1/16/2002	**Sheen**
GM-11S	2/21/2002	**Sheen**
GM-11S	3/18/2002	**Sheen**
GM-11S	4/18/2002	**Sheen**
GM-11S	5/20/2002	**Sheen**
GM-11S	6/19/2002	**Sheen**
GM-11S	7/15/2002	**Sheen**
GM-11S	8/20/2002	**Sheen**
GM-11S	9/20/2002	**Sheen**
GM-11S	10/15/2002	**Sheen**
GM-11S	11/27/2002	**Sheen**
GM-11S	12/18/2002	**Sheen**
GM-11S	1/16/2003	**Sheen**
GM-11S	2/11/2003	**Sheen**
GM-11S	3/11/2003	**Sheen**
GM-11S	4/15/2003	**Sheen**
GM-11S	5/15/2003	**Sheen**
GM-11S	6/17/2003	**Sheen**
GM-11S	7/15/2003	**Sheen**
GM-11S	8/13/2003	**Sheen**
GM-11S	9/16/2003	**Sheen**
GM-11S	10/14/2003	**Sheen**
Cleanup Level		No Sheen

Table 3. Monthly Groundwater LNAPL and Sheen Monitoring
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Free Product
Plant 1, continued		
GM-11S	11/19/2003	**Sheen**
GM-11S	12/17/2003	**Sheen**
GM-11S	1/13/2004	**Sheen**
GM-11S	2/10/2004	**Sheen**
GM-11S	3/17/2004	**Sheen**
GM-11S	4/15/2004	**Sheen**
GM-11S	5/25/2004	**Sheen**
GM-11S	6/13/2004	**Sheen**
GM-11S	7/13/2004	**Sheen**
GM-11S	8/12/2004	**Sheen**
GM-11S	9/16/2004	**Sheen**
GM-11S	10/13/2004	**Sheen**
GM-11S	11/18/2004	**Sheen**
GM-11S	12/16/2004	**Sheen**
GM-11S	1/13/2005	**Sheen**
GM-11S	2/15/2005	**Sheen**
GM-11S	3/15/2005	**Sheen**
GM-11S	4/15/2005	**Sheen**
GM-11S	5/20/2005	**Sheen**
GM-11S	6/10/2005	**Sheen**
GM-11S	7/15/2005	**Sheen**
GM-11S	8/12/2005	**Sheen**
GM-11S	9/14/2005	**Sheen**
GM-11S	10/14/2005	**Sheen**
GM-11S	11/23/2005	**Sheen**
GM-11S	12/19/2005	**Sheen**
GM-11S	1/25/2006	**Sheen**
GM-11S	2/14/2006	**Sheen**
GM-11S	3/15/2006	**Sheen**
GM-11S	4/14/2006	**Sheen**
GM-11S	5/17/2006	**Sheen**
GM-11S	6/14/2006	**Sheen**
GM-11S	7/12/2006	**Sheen**
GM-11S	8/16/2006	**Sheen**
GM-11S	9/13/2006	**Sheen**
GM-11S	10/12/2006	**Sheen**
GM-11S	11/17/2006	**Sheen**
GM-11S	12/19/2006	**Sheen**
GM-11S	1/19/2007	**Sheen**
GM-11S	2/16/2007	**Sheen**
GM-11S	3/19/2007	**Sheen**
GM-11S	4/19/2007	**Sheen**
GM-11S	5/17/2007	**Sheen**
GM-11S	6/14/2007	**Sheen**
GM-11S	7/13/2007	**Sheen**
GM-11S	8/16/2007	**Sheen**
GM-11S	9/10/2007	**Sheen**
GM-11S	10/17/2007	**Sheen**
GM-11S	11/16/2007	**Sheen**
GM-11S	12/14/2007	**Sheen**
Cleanup Level		No Sheen

Table 3. Monthly Groundwater LNAPL and Sheen Monitoring
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Free Product
Plant 1, continued		
GM-11S	1/22/2008	**Sheen**
GM-11S	2/14/2008	**Sheen**
GM-11S	3/14/2008	**Sheen**
GM-11S	4/18/2008	**Sheen**
GM-11S	5/16/2008	**Sheen**
GM-11S	6/18/2008	**Sheen**
GM-11S	7/16/2008	**Sheen**
GM-11S	8/18/2008	**Sheen**
GM-11S	9/16/2008	**Sheen**
GM-11S	10/15/2008	**Sheen**
GM-11S	11/14/2008	**Sheen**
GM-11S	12/11/2008	**Sheen**
GM-11S	1/14/2009	**Sheen**
GM-11S	2/18/2009	**Sheen**
GM-11S	3/17/2009	**Sheen**
GM-11S	4/16/2009	None
GM-11S	5/14/2009	None
GM-11S	6/16/2009	None
GM-11S	7/22/2009	**Sheen**
GM-11S	8/18/2009	**Sheen**
GM-11S	9/14/2009	**Sheen**
GM-11S	10/20/2009	**Sheen**
GM-11S	11/18/2009	None
GM-11S	12/15/2009	None
GM-11S	1/21/2010	**Sheen**
GM-11S	2/17/2010	**Sheen**
GM-11S	3/16/2010	**Sheen**
GM-11S	4/15/2010	None
GM-11S	5/18/2010	**Sheen**
GM-11S	6/17/2010	**Sheen**
GM-11S	7/29/2010	**Sheen**
GM-11S	8/19/2010	**Sheen**
GM-11S	9/22/2010	**Sheen**
GM-11S	10/20/2010	**Sheen**
GM-11S	11/30/2010	**Sheen**
GM-11S	12/23/2010	**Sheen**
GM-11S	1/19/2011	**Sheen**
GM-11S	2/16/2011	**Sheen**
GM-11S	3/29/2011	**Sheen**
GM-11S	4/21/2011	**Sheen**
GM-11S	5/19/2011	**Sheen**
GM-11S	6/15/2011	**Sheen**
GM-11S	7/20/2011	None
GM-11S	8/17/2011	None
GM-11S	9/14/2011	None
GM-11S	10/12/2011	None
GM-11S	11/23/2011	None
GM-11S	12/14/2011	None
GM-11S	1/24/2012	None
GM-11S	2/15/2012	None
Cleanup Level		No Sheen

Table 3. Monthly Groundwater LNAPL and Sheen Monitoring
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Free Product
Plant 1, continued		
GM-11S	3/16/2012	None
GM-11S	4/18/2012	None
GM-11S	5/16/2012	None
GM-11S	6/13/2012	None
GM-11S	7/20/2012	None
GM-11S	8/15/2012	None
GM-11S	9/6/2012	None
GM-11S	10/24/2012	None
GM-11S	11/28/2012	None
GM-11S	12/18/2012	None
GM-11S	1/23/2013	**Sheen**
GM-11S	2/21/2013	**Sheen**
GM-11S	3/13/2013	None
GM-11S	4/17/2013	None
GM-11S	5/22/2013	None
GM-11S	6/12/2013	None
GM-11S	7/24/2013	**Sheen**
GM-11S	8/21/2013	None
GM-11S	9/25/2013	**Sheen**
GM-11S	10/15/2013	None
GM-11S	11/20/2013	None
GM-11S	12/18/2013	None
GM-11S	1/15/2014	None
GM-11S	2/12/2014	None
GM-11S	3/20/2014	None
GM-11S	4/16/2014	None
GM-11S	5/21/2014	None
GM-11S	6/18/2014	None
GM-11S	7/25/2014	None
GM-11S	8/13/2014	None
GM-11S	9/17/2014	None
GM-12S	4/14/2000	None
GM-12S	5/15/2000	NM
GM-12S	6/15/2000	NM
GM-12S	7/19/2000	NM
GM-12S	8/15/2000	NM
GM-12S	9/29/2000	None
GM-12S	10/12/2000	None
GM-12S	11/14/2000	None
GM-12S	12/14/2000	None
GM-12S	1/11/2001	None
GM-12S	2/15/2001	None
GM-12S	3/15/2001	None
GM-12S	4/13/2001	None
GM-12S	5/16/2001	None
GM-12S	6/11/2001	None
GM-12S	7/24/2001	None
GM-12S	8/21/2001	None
GM-12S	9/6/2001	None
GM-12S	10/19/2001	None
GM-12S	11/15/2001	None
GM-12S	12/10/2001	None
GM-12S	1/16/2002	NM
GM-12S	2/21/2002	None
GM-12S	3/18/2002	None
GM-12S	4/18/2002	None

Table 3. Monthly Groundwater LNAPL and Sheen Monitoring
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Free Product
Cleanup Level		No Sheen

Table 3. Monthly Groundwater LNAPL and Sheen Monitoring
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Free Product
Plant 1, continued		
GM-12S	5/20/2002	None
GM-12S	6/19/2002	None
GM-12S	7/15/2002	None
GM-12S	8/20/2002	None
GM-12S	9/20/2002	None
GM-12S	10/15/2002	None
GM-12S	11/27/2002	None
GM-12S	12/18/2002	None
GM-12S	1/16/2003	None
GM-12S	2/11/2003	None
GM-12S	3/11/2003	None
GM-12S	4/15/2003	None
GM-12S	5/15/2003	None
GM-12S	6/17/2003	None
GM-12S	7/15/2003	None
GM-12S	8/13/2003	None
GM-12S	9/16/2003	None
GM-12S	10/14/2003	None
GM-12S	11/19/2003	None
GM-12S	12/17/2003	None
GM-12S	1/13/2004	None
GM-12S	2/10/2004	None
GM-12S	3/17/2004	None
GM-12S	4/15/2004	None
GM-12S	5/25/2004	None
GM-12S	6/13/2004	None
GM-12S	7/13/2004	None
GM-12S	8/12/2004	None
GM-12S	9/16/2004	None
GM-12S	10/13/2004	None
GM-12S	11/18/2004	None
GM-12S	12/16/2004	None
GM-12S	1/13/2005	None
GM-12S	2/15/2005	None
GM-12S	3/15/2005	None
GM-12S	4/15/2005	None
GM-12S	5/20/2005	None
GM-12S	6/10/2005	None
GM-12S	7/15/2005	None
GM-12S	8/12/2005	None
GM-12S	9/14/2005	None
GM-12S	10/14/2005	None
GM-12S	11/23/2005	None
GM-12S	12/19/2005	None
GM-12S	1/25/2006	None
GM-12S	2/14/2006	None
GM-12S	3/15/2006	None
GM-12S	4/14/2006	None
GM-12S	5/17/2006	None
GM-12S	6/14/2006	None
GM-12S	7/12/2006	None
Cleanup Level		No Sheen

Table 3. Monthly Groundwater LNAPL and Sheen Monitoring
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Free Product
Plant 1, continued		
GM-12S	8/16/2006	None
GM-12S	9/13/2006	None
GM-12S	10/12/2006	None
GM-12S	11/17/2006	None
GM-12S	12/19/2006	None
GM-12S	1/19/2007	None
GM-12S	2/16/2007	None
GM-12S	3/19/2007	None
GM-12S	4/19/2007	None
GM-12S	5/17/2007	None
GM-12S	6/14/2007	None
GM-12S	7/13/2007	None
GM-12S	8/16/2007	None
GM-12S	9/10/2007	None
GM-12S	10/17/2007	None
GM-12S	11/16/2007	None
GM-12S	12/14/2007	None
GM-12S	1/22/2008	None
GM-12S	2/14/2008	None
GM-12S	3/14/2008	None
GM-12S	4/18/2008	None
GM-12S	5/16/2008	None
GM-12S	6/18/2008	None
GM-12S	7/16/2008	None
GM-12S	8/18/2008	None
GM-12S	9/16/2008	None
GM-12S	10/15/2008	None
GM-12S	11/14/2008	None
GM-12S	12/11/2008	None
GM-12S	1/14/2009	None
GM-12S	2/18/2009	None
GM-12S	3/17/2009	None
GM-12S	4/16/2009	None
GM-12S	5/14/2009	None
GM-12S	6/16/2009	None
GM-12S	7/22/2009	None
GM-12S	8/18/2009	None
GM-12S	9/14/2009	None
GM-12S	10/20/2009	None
GM-12S	11/18/2009	None
GM-12S	12/15/2009	None
GM-12S	1/21/2010	None
GM-12S	2/17/2010	None
GM-12S	3/16/2010	None
GM-12S	4/15/2010	None
GM-12S	5/18/2010	None
GM-12S	6/17/2010	None
GM-12S	7/29/2010	None
GM-12S	8/19/2010	None
GM-12S	9/22/2010	None
GM-12S	10/20/2010	None
Cleanup Level		No Sheen

Table 3. Monthly Groundwater LNAPL and Sheen Monitoring
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Free Product
Plant 1, continued		
GM-12S	11/30/2010	None
GM-12S	12/23/2010	None
GM-12S	1/19/2011	None
GM-12S	2/16/2011	None
GM-12S	3/29/2011	None
GM-12S	4/21/2011	None
GM-12S	5/19/2011	None
GM-12S	6/15/2011	None
GM-12S	7/20/2011	None
GM-12S	8/17/2011	None
GM-12S	9/14/2011	None
GM-12S	10/12/2011	None
GM-12S	11/23/2011	None
GM-12S	12/14/2011	None
GM-12S	1/24/2012	None
GM-12S	2/15/2012	None
GM-12S	3/16/2012	None
GM-12S	4/18/2012	None
GM-12S	5/16/2012	None
GM-12S	6/13/2012	None
GM-12S	7/20/2012	None
GM-12S	8/15/2012	None
GM-12S	9/6/2012	None
GM-12S	10/24/2012	None
GM-12S	11/28/2012	None
GM-12S	12/18/2012	None
GM-12S	1/23/2012	None
GM-12S	2/21/2013	None
GM-12S	3/13/2013	None
GM-12S	4/17/2013	None
GM-12S	5/22/2013	None
GM-12S	6/12/2013	None
GM-12S	7/24/2013	None
GM-12S	8/21/2013	None
GM-12S	9/25/2013	None
GM-12S	10/15/2013	None
GM-12S	11/20/2013	None
GM-12S	12/18/2013	None
GM-12S	1/15/2014	None
GM-12S	2/12/2014	None
GM-12S	3/20/2014	None
GM-12S	4/16/2014	None
GM-12S	5/21/2014	None
GM-12S	6/18/2014	None
GM-12S	7/25/2014	None
GM-12S	8/13/2014	None
GM-12S	9/17/2014	None
GM-13S	7/6/1998	**Yes***
GM-13S	10/20/1998	**~0.08 foot**
GM-13S	11/18/1998	**~0.08 foot**
GM-13S	12/15/1998	**~0.01 foot**
GM-13S	2/17/1999	**~0.08 foot**
GM-13S	3/15/1999	**~0.34 foot**
GM-13S	4/14/1999	**~0.20 foot**
GM-13S	5/13/1999	**~0.44 foot**
GM-13S	6/15/1999	**~0.35 foot**

Table 3. Monthly Groundwater LNAPL and Sheen Monitoring
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Free Product
GM-13S	7/15/1999	**~0.31 foot**
Cleanup Level		No Sheen

Table 3. Monthly Groundwater LNAPL and Sheen Monitoring
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Free Product
Plant 1, continued		
GM-13S	8/17/1999	**~0.19 foot**
GM-13S	9/16/1999	**~0.09 foot**
GM-13S	10/19/1999	**~0.10 foot**
GM-13S	11/19/1999	**~0.11 foot**
GM-13S	12/28/1999	**~0.12 foot**
GM-13S	1/21/2000	**~0.11 foot**
GM-13S	2/16/2000	
GM-13S	3/21/2000	**~0.11 foot**
GM-13S	4/14/2000	**~0.13 foot**
GM-13S	5/15/2000	**~0.10 foot**
GM-13S	6/16/2000	**Sheen**
GM-13S	7/19/2000	**Sheen**
GM-13S	8/15/2000	**Sheen**
GM-13S	9/29/2000	None
GM-13S	10/12/2000	**Sheen**
GM-13S	11/14/2000	**~0.01 foot**
GM-13S	12/14/2000	NM
GM-13S	1/11/2001	NM
GM-13S	2/15/2001	NM
GM-13S	3/15/2001	NM
GM-13S	4/13/2001	NM
GM-13S	5/16/2001	None
GM-13S	6/11/2001	None
GM-13S	7/24/2001	None
GM-13S	8/21/2001	None
GM-13S	9/6/2001	**Sheen**
GM-13S	10/19/2001	None
GM-13S	11/15/2001	None
GM-13S	12/10/2001	**Sheen**
GM-13S	1/16/2002	**Sheen**
GM-13S	2/21/2002	NM
GM-13S	3/18/2002	None
GM-13S	4/18/2002	None
GM-13S	5/20/2002	None
GM-13S	6/19/2002	None
GM-13S	7/15/2002	None
GM-13S	8/20/2002	None
GM-13S	9/20/2002	None
GM-13S	10/15/2002	None
GM-13S	11/27/2002	None
GM-13S	12/18/2002	None
GM-13S	1/16/2003	None
GM-13S	2/11/2003	None
GM-13S	3/11/2003	**Sheen**
GM-13S	4/15/2003	**Sheen**
GM-13S	5/15/2003	**Sheen**
GM-13S	6/17/2003	None
GM-13S	7/15/2003	None
GM-13S	8/13/2003	None
GM-13S	9/16/2003	None
GM-13S	10/14/2003	None
Cleanup Level		No Sheen

Table 3. Monthly Groundwater LNAPL and Sheen Monitoring
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Free Product
Plant 1, continued		
GM-13S	11/19/2003	None
GM-13S	12/17/2003	None
GM-13S	1/13/2004	None
GM-13S	2/10/2004	None
GM-13S	3/17/2004	None
GM-13S	4/15/2004	None
GM-13S	5/25/2004	**Sheen**
GM-13S	6/13/2004	**Sheen**
GM-13S	7/13/2004	**Sheen**
GM-13S	8/12/2004	None
GM-13S	9/16/2004	None
GM-13S	10/13/2004	None
GM-13S	11/18/2004	None
GM-13S	12/16/2004	None
GM-13S	1/13/2005	None
GM-13S	2/15/2005	None
GM-13S	3/15/2005	None
GM-13S	4/15/2005	None
GM-13S	5/20/2005	None
GM-13S	6/10/2005	None
GM-13S	7/15/2005	None
GM-13S	8/12/2005	None
GM-13S	9/14/2005	None
GM-13S	10/14/2005	None
GM-13S	11/23/2005	None
GM-13S	12/19/2005	None
GM-13S	1/25/2006	None
GM-13S	2/14/2006	None
GM-13S	3/15/2006	None
GM-13S	4/14/2006	None
GM-13S	5/17/2006	None
GM-13S	6/14/2006	None
GM-13S	7/12/2006	None
GM-13S	8/16/2006	**Sheen**
GM-13S	9/13/2006	**Sheen**
GM-13S	10/12/2006	None
GM-13S	11/17/2006	None
GM-13S	12/19/2006	None
GM-13S	1/19/2007	None
GM-13S	2/16/2007	None
GM-13S	3/19/2007	**Sheen**
GM-13S	4/19/2007	None
GM-13S	5/17/2007	None
GM-13S	6/14/2007	None
GM-13S	7/13/2007	None
GM-13S	8/16/2007	None
GM-13S	9/10/2007	None
GM-13S	10/17/2007	None
GM-13S	11/16/2007	None
GM-13S	12/14/2007	None
Cleanup Level		No Sheen

Table 3. Monthly Groundwater LNAPL and Sheen Monitoring
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Free Product
Plant 1, continued		
GM-13S	1/22/2008	None
GM-13S	2/14/2008	None
GM-13S	3/14/2008	None
GM-13S	4/18/2008	None
GM-13S	5/16/2008	None
GM-13S	6/18/2008	None
GM-13S	7/16/2008	None
GM-13S	8/18/2008	None
GM-13S	9/16/2008	None
GM-13S	10/15/2008	None
GM-13S	11/14/2008	None
GM-13S	12/11/2008	None
GM-13S	1/14/2009	None
GM-13S	2/18/2009	None
GM-13S	3/17/2009	None
GM-13S	4/16/2009	None
GM-13S	5/14/2009	None
GM-13S	6/16/2009	None
GM-13S	7/22/2009	None
GM-13S	8/18/2009	None
GM-13S	9/14/2009	None
GM-13S	10/20/2009	None
GM-13S	11/18/2009	None
GM-13S	12/15/2009	None
GM-13S	1/21/2010	None
GM-13S	2/17/2010	**Sheen**
GM-13S	3/16/2010	**Film**
GM-13S	4/15/2010	**Film**
GM-13S	5/18/2010	**Film**
GM-13S	6/17/2010	**Film**
GM-13S	7/29/2010	**Sheen**
GM-13S	8/19/2010	None
GM-13S	9/22/2010	**Film**
GM-13S	10/20/2010	None
GM-13S	11/30/2010	None
GM-13S	12/23/2010	None
GM-13S	1/19/2011	None
GM-13S	2/16/2011	None
GM-13S	3/29/2011	**Film**
GM-13S	4/21/2011	**~0.01 foot**
GM-13S	5/19/2011	**Film**
GM-13S	6/15/2011	None
GM-13S	7/20/2011	**Film**
GM-13S	8/17/2011	None
GM-13S	9/14/2011	None
GM-13S	10/12/2011	None
GM-13S	11/23/2011	None
GM-13S	12/14/2011	None
GM-13S	1/24/2012	None
GM-13S	2/15/2012	None
Cleanup Level		No Sheen

Table 3. Monthly Groundwater LNAPL and Sheen Monitoring
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Free Product
Plant 1, continued		
GM-13S	3/16/2012	None
GM-13S	4/18/2012	None
GM-13S	5/16/2012	None
GM-13S	6/13/2012	None
GM-13S	7/20/2012	**Film**
GM-13S	8/15/2012	**Film**
GM-13S	9/6/2012	**Film**
GM-13S	10/24/2012	**Film**
GM-13S	11/28/2012	**Film**
GM-13S	12/18/2012	None
GM-13S	1/23/2013	None
GM-13S	2/21/2013	None
GM-13S	3/13/2013	None
GM-13S	4/17/2013	None
GM-13S	5/22/2013	None
GM-13S	6/13/2013	None
GM-13S	7/24/2013	None
GM-13S	8/21/2013	None
GM-13S	9/25/213	None
GM-13S	10/15/2013	None
GM-13S	11/20/2013	None
GM-13S	12/18/2013	None
GM-13S	1/15/2014	None
GM-13S	2/12/2014	None
GM-13S	3/20/2014	None
GM-13S	4/16/2014	None
GM-13S	5/21/2014	None
GM-13S	6/18/2014	None
GM-13S	7/25/2014	None
GM-13S	8/13/2014	None
GM-13S	9/17/2014	None
GM-14S	4/9/1997	**Sheen**
GM-14S	7/9/1997	**Sheen**
GM-14S	10/22/1997	**Sheen**
GM-14S	1/22/1998	**Sheen**
GM-14S	3/12/1998	**Sheen**
GM-14S	7/6/1998	**Sheen**
GM-14S	10/20/1998	**Sheen**
GM-14S	12/15/1998	**Sheen**
GM-14S	3/26/1999	**Sheen**
GM-14S	6/28/1999	**Sheen**
GM-14S	9/28/1999	None
GM-14S	8/15/2000	None
GM-14S	9/29/2000	None
GM-14S	10/12/2000	None
GM-14S	11/14/2000	None
GM-14S	12/14/2000	None
GM-14S	1/11/2001	None
GM-14S	2/15/2001	None
GM-14S	3/15/2001	None
GM-14S	4/13/2001	None
GM-14S	5/16/2001	None
GM-14S	6/11/2001	None
GM-14S	7/24/2001	None
GM-14S	8/21/2001	None
GM-14S	9/6/2001	None

Table 3. Monthly Groundwater LNAPL and Sheen Monitoring
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Free Product
GM-14S	10/19/2001	None
Cleanup Level		No Sheen

Table 3. Monthly Groundwater LNAPL and Sheen Monitoring
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Free Product
Plant 1, continued		
GM-14S	11/15/2001	None
GM-14S	12/10/2001	None
GM-14S	1/16/2002	None
GM-14S	2/21/2002	None
GM-14S	3/18/2002	None
GM-14S	4/18/2002	None
GM-14S	5/20/2002	None
GM-14S	6/19/2002	None
GM-14S	7/15/2002	None
GM-14S	8/20/2002	None
GM-14S	9/20/2002	None
GM-14S	10/15/2002	None
GM-14S	11/27/2002	None
GM-14S	12/18/2002	None
GM-14S	1/16/2003	None
GM-14S	2/11/2003	None
GM-14S	3/11/2003	None
GM-14S	4/15/2003	None
GM-14S	5/15/2003	None
GM-14S	6/17/2003	None
GM-14S	7/15/2003	None
GM-14S	8/13/2003	None
GM-14S	9/16/2003	None
GM-14S	10/14/2003	None
GM-14S	11/19/2003	None
GM-14S	12/17/2003	None
GM-14S	1/13/2004	None
GM-14S	2/10/2004	None
GM-14S	3/17/2004	None
GM-14S	4/15/2004	None
GM-14S	5/25/2004	None
	Deleted from Monitoring	
Plant 2		
MW-03	1/25/1999	NM
MW-03	2/17/1999	None
MW-03	3/15/1999	None
MW-03	4/15/1999	NM
MW-03	5/13/1999	None
MW-03	6/15/1999	NM
MW-03	7/15/1999	NM
MW-03	8/17/1999	**~0.43 foot**
MW-03	9/16/1999	**~0.50 foot**
MW-03	10/19/1999	**~0.42 foot**
MW-03	11/19/1999	**~0.49 foot**
MW-03	12/28/1999	**~0.34 foot**
MW-03	1/21/2000	**~0.02 foot**
MW-03	2/16/2000	**~0.02 foot**
MW-03	3/27/2000	**~0.03 foot**
MW-03	4/14/2000	**~0.04 foot**
	Abandoned	
Cleanup Level		No Sheen

Table 3. Monthly Groundwater LNAPL and Sheen Monitoring
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	Free Product
Plant 2, continued		
MW-03R	8/21/2001	None
MW-03R	9/16/2001	NM
MW-03R	10/19/2001	NM
MW-03R	11/15/2001	NM
MW-03R	12/10/2001	NM
MW-03R	1/16/2002	NM
MW-03R	2/21/2002	NM
MW-03R	3/18/2002	None
MW-03R	4/18/2002	None
MW-03R	5/20/2002	None
MW-03R	6/19/2002	None
MW-03R	7/15/2002	None
MW-03R	8/20/2002	None
MW-03R	9/20/2002	None
MW-03R	10/15/2002	None
MW-03R	11/27/2002	None
MW-03R	12/18/2002	NM
MW-03R	1/16/2003	NM
MW-03R	2/11/2003	NM
MW-03R	3/11/2003	NM
MW-03R	3/25/2003	None
MW-03R	4/15/2003	None
MW-03R	5/15/2003	None
MW-03R	6/17/2003	None
MW-03R	7/15/2003	None
MW-03R	8/13/2003	None
MW-03R	9/16/2003	None
MW-03R	10/14/2003	None
MW-03R	11/19/2003	None
MW-03R	12/17/2003	None
MW-03R	1/13/2004	None
MW-03R	2/10/2004	None
MW-03R	3/17/2004	None
MW-03R	4/15/2004	None
MW-03R	5/25/2004	None
MW-03R	6/13/2004	None
MW-03R	7/13/2004	None
MW-03R	8/12/2004	Deleted from Monitoring
Cleanup Level		No Sheen

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

Due to maintenance of a sorbent "sock" placed in GM-13S and MW-03, these measurements do not necessarily reflect actual product thicknesses in the wells.

Active product recovery from GM-11S began in April 2000. Product thickness recorded in GM-11S after that date is not representative of static conditions.

MW-03 was destroyed during Island redevelopment activities and was replaced by MW-03R.

* Free product present, thickness not measured.

~ Approximately.

NM Not measured due to inaccessibility.

Table 4. 2014 Quarterly Performance Monitoring Groundwater Elevations
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TOC Elevation (ft msl)	Depth to Water (ft below TOC)	Groundwater Elevation (ft msl)
Plant 1				
GM-14S	3/12/2014	8.57	3.24	5.33
GM-14S	6/11/2014		4.51	4.06
GM-14S	9/10/2014		5.25	3.32
GM-15S	3/12/2014	8.92	4.23	4.69
GM-15S	6/11/2014		5.31	3.61
GM-15S	9/9/2014		5.56	3.36
GM-16S	3/12/2014	8.53	3.65	4.88
GM-16S	6/11/2014		4.82	3.71
GM-16S	9/10/2014		5.64	2.89
GM-17S	3/12/2014	9.19	3.35	5.84
GM-17S	6/11/2014		4.77	4.42
GM-17S	9/10/2014		5.81	3.38
GM-24S	3/12/2014	7.62	1.96	5.66
GM-24S	6/11/2014		3.53	4.09
GM-24S	9/10/2014		4.46	3.16
AR-03	3/12/2014	9.35	4.90	4.45
AR-03	6/10/2014		5.96	3.39
AR-03	9/9/2014		6.67	2.68
AMW-01	3/11/2014	8.88	7.28	1.60
AMW-01	6/10/2014		11.86	-2.98
AMW-01	9/9/2014		7.34	1.54
AMW-02	3/11/2014	12.14	10.14	2.00
AMW-02	6/10/2014		14.17	-2.03
AMW-02	9/9/2014		8.25	3.89
AMW-03	3/11/2014	12.07	9.98	2.09
AMW-03	6/10/2014		13.41	-1.34
AMW-03	9/9/2014		8.70	3.37
AMW-04	3/11/2014	8.00	6.55	1.45
AMW-04	6/10/2014		9.99	-1.99
AMW-04	9/9/2014		10.11	-2.11
Plant 1 Continued				
AMW-05	3/11/2014	8.14	6.68	1.46
AMW-05	6/10/2014		8.74	-0.60
AMW-05	9/9/2014		9.47	-1.33
GM-13S	3/13/2013	11.90	8.26	3.64
GM-13S	6/12/2013		8.71	3.19
GM-13S	9/25/2013		8.54	3.36
GM-12S	3/13/2013	8.32	4.70	3.62

Table 4. 2014 Quarterly Performance Monitoring Groundwater Elevations
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well	Date	TOC Elevation (ft msl)	Depth to Water (ft below TOC)	Groundwater Elevation (ft msl)
GM-12S	6/12/2013		5.00	3.32
GM-12S	9/25/2013		5.09	3.23
MW-06	3/11/2014	8.03	3.98	4.05
MW-06	6/11/2014		5.06	2.97
MW-06	9/9/2014		5.29	2.74
MW-1-T9	3/12/2014	9.07	4.76	4.31
MW-1-T9	6/11/2014		5.71	3.36
MW-1-T9	9/10/2014		6.43	2.64
MW-2-T9	3/12/2014	9.23	4.44	4.79
MW-2-T9	6/11/2014		5.33	3.90
MW-2-T9	9/10/2014		6.07	3.16
MW-3-T9	3/12/2014	8.73	4.15	4.58
MW-3-T9	6/11/2014		5.12	3.61
MW-3-T9	9/10/2014		5.79	2.94
MW-4-T9	3/12/2014	10.65	6.46	4.19
MW-4-T9	6/11/2014		7.34	3.31
MW-4-T9	9/9/2014		7.98	2.67
Plant 2				
GM-19S	3/12/2014	7.68	2.12	5.56
GM-19S	9/10/2014		4.56	3.12

ft Feet

msl Mean sea level in National Geodetic Vertical Datum of 1929 (NGVD29).

TOC Top of casing

Table 5. Waterfront Groundwater Recovery Wells Petroleum Hydrocarbon History
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well ID	Date	Gasoline mg/l	Diesel mg/l	Oil mg/l	Benzene ug/l	Toluene ug/l	Ethylbenzene ug/l	Xylenes ug/l
RW-10	Nov-03	0.625			1.2	0.892	2.42	3.07
RW-10	Aug-04	0.661	**36.2**	3.46	0.5	0.5	0.653	1.99
RW-10	Feb-05	0.473	1.21	0.75	0.5	0.5	0.5	1.41
RW-10	Nov-05	0.420	13.3	1.63	0.5	0.5	0.5	1
RW-10	Mar-06	0.066	4.14	0.75	0.5	0.5	0.5	1
RW-10	Nov-06	0.930	3.48	1.09	0.5	0.5	0.5	1
RW-10	May-07	0.073	0.255	*0.5*	0.5	0.5	0.5	1
RW-10	Nov-07	0.246	4.65	0.841	0.5	0.5	0.5	1
RW-10	Apr-08	0.235	1.91	*0.515*	0.5	0.5	0.5	1
RW-10	Nov-08	0.347	8.21	0.946	0.5	0.5	0.5	1
RW-10	Apr-09	0.448	5.95	0.804	0.5	0.5	0.5	1.36
RW-10	Nov-09	0.320	5.2	0.78	*0.5*	*1*	*1*	*2*
RW-10	Apr-10	0.460	2.3	*0.49*	*0.5*	*1*	*1*	*2*
RW-10	Nov-10	0.251	2.4	0.65	*0.5*	*1*	*1*	*3*
RW-10	Apr-11	0.6	1.5	0.68	*0.5*	*1*	*1*	*3*
RW-10	Nov-11	0.171	0.22	*0.39*	*0.5*	*1*	*1*	*3*
RW-10	Apr-12	0.366	0.51	0.46	*0.5*	*1*	*1*	*3*
RW-10	Nov-12	*0.1*	*0.11*	*0.11*	*0.5*	*0.5*	*0.5*	*1.5*
RW-10	Apr-13	0.2	0.36	*0.49*	*0.5*	*0.5*	*0.5*	*0.5*
RW-10	Nov-13	0.13	*0.25*	*0.25*	*0.5*	*0.5*	*0.5*	*1*
RW-10	Apr-14	0.16	1.6	0.73	*0.14*	*0.16*	*0.13*	0.13
RW-10	Average	0.3	4.7	0.8	0.5	0.6	0.7	1.6
RW-9	Nov-03	**13.10**			5	43.2	146	1180
RW-9	Aug-04	**1.24**	**94.9**	2.19	0.5	0.5	1.23	1.64
RW-9	Feb-05	0.907	**22.1**	<15	0.5	0.5	3.64	4.74
RW-9	Nov-05	0.568	4.31	0.708	0.5	0.5	0.968	1.45
RW-9	Mar-06	0.166	1.68	0.75	0.5	0.5	0.5	1
RW-9	Nov-06	0.359	5.98	1.17	0.5	0.5	0.647	1.09
RW-9	May-07	0.402	2.08	*0.5*	5.43	0.5	1.4	1.49
RW-9	Nov-07	0.184	**70.1**	**11.6**	0.5	*0.5*	*0.5*	*1*
RW-9	Apr-08	0.170	**18.2**	2.94	3.21	*0.5*	*0.5*	*1*
RW-9	Nov-08	0.130	**49.5**	8.21	0.5	*0.5*	*0.5*	*1*
RW-9	Apr-09	0.280	**45.1**	6.71	0.5	*0.5*	*0.5*	*1*
RW-9	Nov-09	0.670	**32**	6.8	1.5	*1*	*1*	*2*
RW-9	Apr-10	**6.0**	**110**	**24**	*0.5*	*1*	*1*	*2*
RW-9	Nov-10	0.207	2.0	0.53	*0.5*	*1*	*1*	*3*
RW-9	Apr-11	**1.12**	**276**	**45.9**	*0.5*	*1*	*1*	*3*
RW-9	Nov-11	0.289	2.3	*0.39*	*0.5*	*1*	*1*	*3*
RW-9	Apr-12	0.113	**33.2**	5.3	0.72	*1*	*1*	*3*
RW-9	Nov-12	*0.1*	8.2	8.4	0.5	*0.5*	*0.5*	*1.5*
RW-9	Apr-13	0.1	**44.0**	8.5	*0.5*	*0.5*	*0.5*	*0.5*
RW-9	Nov-13	0.062	**14.0**	2.6	*0.5*	*0.5*	*0.5*	*1*
RW-9	Apr-14	0.14	**56.0**	**16**	*0.14*	*0.16*	*0.13*	*0.12*
RW-9	Average	**1.3**	**44.6**	8.1	1.1	2.7	7.8	57.8
RW-8	Nov-03	0.367			0.5	0.5	0.787	2.23
RW-8	Aug-04	0.181	**19.8**	2.19	0.5	0.5	0.53	2.13
RW-8	Feb-05	0.218	2.58	0.75	0.5	0.5	0.564	3.04
RW-8	Nov-05	0.099	0.575	0.721	0.5	0.5	0.5	1
RW-8	Mar-06	0.050	1.44	0.75	0.5	0.5	0.5	1
RW-8	Nov-06	0.050	3.58	0.762	0.5	0.5	0.5	1
RW-8	May-07	0.068	0.273	*0.5*	0.5	0.5	0.5	1
RW-8	Nov-07	0.065	0.29	0.543	0.5	0.5	0.5	1
RW-8	Apr-08	0.067	0.279	*0.529*	0.5	0.5	0.5	1
RW-8	Nov-08	0.088	3.85	0.492	0.5	0.5	0.5	1
RW-8	Apr-09	0.091	0.255	*0.476*	0.5	0.5	0.5	1
RW-8	Nov-09	0.140	1.3	*0.47*	*0.5*	*1*	*1*	*2*
RW-8	Apr-10	0.150	1.1	*0.49*	*0.5*	*1*	*1*	*2*
RW-8	Nov-10	0.105	1.0	*0.39*	*0.5*	*1*	*1*	*3*
RW-8	Apr-11	0.0995	2.6	0.59	*0.5*	*1*	*1*	*3*
RW-8	Nov-11	0.183	1.7	*0.39*	*0.5*	*1*	*1*	*3*
RW-8	Apr-12	*0.05*	1.3	*0.39*	*0.5*	*1*	*1*	*3*
RW-8	Nov-12	0.185	4.0	3.6	*0.5*	*0.5*	*0.5*	*1.5*
RW-8	Apr-13	0.062	2.7	0.52	*0.5*	*0.5*	*0.5*	*0.5*
RW-8	Nov-13	0.1	0.82	*0.25*	*0.5*	*0.5*	*0.5*	*1*
RW-8	Apr-14	0.13	3.40	0.91	0.15	*0.16*	*0.13*	0.52
RW-8	Average	0.1	2.6	0.8	0.5	0.6	0.6	1.7
	Groundwater Cleanup Level	**1.0**	**10.0**	**10.0**	**71**			
Reporting Limits/Units		0.05 mg/l	0.25 mg/l	.750 mg/l	0.5 ug/l	0.5 ug/l	0.5 ug/l	1.0 ug/l

Table 5. Waterfront Groundwater Recovery Wells Petroleum Hydrocarbon History
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well ID	Date	Gasoline mg/l	Diesel mg/l	Oil mg/l	Benzene ug/l	Toluene ug/l	Ethylbenzene ug/l	Xylenes ug/l
RW-7	Nov-03	0.148			0.5	0.5	0.518	2.87
RW-7	Aug-04	0.050	7.6	1.2	0.5	0.5	0.5	1.09
RW-7	Feb-05	0.050	1.21	0.75	0.5	0.5	0.5	1
RW-7	Nov-05	0.050	0.35	0.728	0.5	0.5	0.5	1
RW-7	Mar-06	0.050	0.25	0.75	0.5	0.5	0.5	1
RW-7	Nov-06	0.063	3.16	1.34	0.5	0.5	0.5	1
RW-7	May-07	0.414	0.49	*0.515*	0.5	0.5	0.5	1
RW-7	Nov-07	0.187	0.25	*0.5*	0.5	0.5	0.5	1
RW-7	Apr-08	0.063	0.25	*0.5*	0.5	0.5	0.5	1
RW-7	Nov-08	0.071	0.236	*0.472*	0.5	0.5	0.5	1
RW-7	Apr-09	0.123	0.238	*0.476*	0.5	0.5	0.5	1
RW-7	Nov-09	0.075	0.69	*0.47*	*0.5*	*1*	*1*	*2*
RW-7	Apr-10	0.140	0.85	*0.49*	*0.5*	*1*	*1*	*2*
RW-7	Nov-10	0.11	0.46	*0.4*	*0.5*	*1*	*1*	*3*
RW-7	Apr-11	0.207	1.1	*0.41*	*0.5*	*1*	*1*	*3*
RW-7	Nov-11	*0.05*	0.13	*0.4*	*0.5*	*1*	*1*	*3*
RW-7	Apr-12	*0.05*	0.21	*0.42*	*0.5*	*1*	*1*	*3*
RW-7	Nov-12	*0.1*	0.32	0.37	*0.5*	*0.5*	*0.5*	*1.5*
RW-7	Apr-13	0.081	0.63	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*
RW-7	Nov-13	*0.05*	0.45	*0.24*	*0.5*	*0.5*	*0.5*	*1*
RW-7	Apr-14	0.07	2.4	0.6	0.17	*0.16*	0.17	0.23
RW-7	Average	0.1	1.1	0.6	0.5	0.6	0.6	1.5
RW-1	Nov-03	0.858	8.73	1.34	1.03	0.758	2.71	3.39
RW-1	Aug-04	**1.00**	**31.6**	2.08	0.685	0.787	2.1	4.18
RW-1	Feb-05	**1.03**	**18.9**	0.75	10.5	4.66	4.06	20.2
RW-1	Nov-05	0.547	2.19	0.708	0.5	0.5	0.5	1.67
RW-1	Mar-06	0.144	4.78	0.802	0.5	0.5	0.5	1
RW-1	Nov-06	0.173	3.28	*0.487*	0.5	0.5	0.5	1
RW-1	May-07	0.081	0.972	*0.526*	0.5	0.5	0.5	1
RW-1	Nov-07	0.056	0.596	*0.505*	0.5	0.5	0.5	1
RW-1	Apr-08	0.068	0.25	*0.5*	0.5	0.5	0.5	1
RW-1	Nov-08	0.050	0.274	*0.472*	0.5	0.5	0.5	1
RW-1	Apr-09	0.074	0.332	*0.481*	0.5	0.5	0.5	1
RW-1	Nov-09	0.073	0.44	*0.47*	*0.5*	*1*	*1*	*2*
RW-1	Apr-10	0.071	0.31	*0.49*	*0.5*	*1*	*1*	*2*
RW-1	Nov-10	0.143	0.32	*0.39*	*0.5*	*1*	*1*	*3*
RW-1	Apr-11	0.0991	0.95	*0.39*	*0.5*	*1*	*1*	*3*
RW-1	Nov-11	0.14	6.9	1.6	*0.5*	*1*	*1*	*3*
RW-1	Apr-12	0.131	0.86	*0.4*	0.53	*1*	*1*	*3*
RW-1	Nov-12	*0.1*	0.23	0.35	*0.5*	*0.5*	*0.5*	*1.5*
RW-1	Apr-13	0.15	0.47	*0.5*	*0.5*	*0.5*	*0.5*	*0.5*
RW-1	Nov-13	0.12	0.4	*0.25*	*0.5*	*0.5*	*0.5*	*1*
RW-1	Apr-14	0.17	0.9	0.34	0.3	*0.16*	0.35	0.44
RW-1	Average	0.3	4.0	0.7	1.0	0.9	1.0	2.7
RW-6	Nov-03	**1.81**			**569**	23.1	10	116
RW-6	Aug-04	0.067	0.25	0.75	0.5	0.5	0.5	1
RW-6	Feb-05	0.101	0.25	0.75	0.5	0.5	0.788	1.3
RW-6	Nov-05	**8.19**	**115**	***14.7***	7.62	2.56	53.6	524
RW-6	Mar-06	**31.80**	**560**	**300**	12.7	9.15	96.7	568
RW-6	Nov-06	**1.14**	**26.8**	*1.05*	0.591	0.5	0.636	10
RW-6	May-07	**1.02**	**38.9**	*5.05*	34	1.44	16.6	15.2
RW-6	Nov-07	0.05	1.9	*5.32*	0.5	0.5	0.5	1
RW-6	Apr-08	0.33	5.56	0.542	10.2	1.22	9.56	6.9
RW-6	Nov-08	0.05	0.734	*0.472*	0.5	0.5	0.5	1
RW-6	Apr-09	0.175	1.14	*0.476*	6.93	0.5	3.08	3.32
RW-6	Nov-09	*0.050*	0.73	*0.47*	*0.5*	*1*	*1*	*2*
RW-6	Apr-10	**1.10**	3.2	*0.49*	53	2	9.4	6.7
RW-6	Nov-10	0.266	2.5	*0.39*	*0.5*	*1*	*1*	*3*
RW-6	Apr-11	0.595	*0.37*	*0.41*	15.1	*1*	9.5	6.7
RW-6	Nov-11	*0.05*	0.21	*0.38*	*0.5*	*1*	*1*	*3*
RW-6	Apr-12	*0.05*	0.98	*0.4*	1.1	*1*	*1*	*3*
RW-6	Nov-12	*0.1*	*0.11*	*0.11*	*0.5*	*0.5*	*0.5*	*1.5*
RW-6	Apr-13	0.18	1.1	*0.49*	0.82	*0.5*	*0.5*	0.55
RW-6	Nov-13	0.052	0.29	*0.25*	*0.5*	*0.5*	*0.5*	*1*
RW-6	Apr-14	0.19	1.4	0.36	2.1	0.34	1.3	0.64
RW-6	Average	**2.3**	**38.1**	**16.6**	34.2	2.3	10.4	60.8
	Groundwater Cleanup Level	**1.0**	**10.0**	**10.0**	**71**			
Reporting Limits/Units		0.05 mg/l	0.25 mg/l	.750 mg/l	0.5 ug/l	0.5 ug/l	0.5 ug/l	1.0 ug/l

Table 5. Waterfront Groundwater Recovery Wells Petroleum Hydrocarbon History
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well ID	Date	Gasoline mg/l	Diesel mg/l	Oil mg/l	Benzene ug/l	Toluene ug/l	Ethylbenzene ug/l	Xylenes ug/l
RW-5	Nov-03	**2.10**	4.13	0.75	5.21	0.657	83.5	186
RW-5	Aug-04	**7.60**	**14.5**	1.55	1.93	1.67	324	630
RW-5	Feb-05	**3.18**	**17.4**	***15***	**37.8**	40	38.5	287
RW-5	Nov-05	**19.60**	**1240**	***361***	**43.2**	42	66.2	879
RW-5	Mar-06	**1.79**	**13.3**	7.5	1.06	24.2	8.03	129
RW-5	Nov-06	0.741	8	1.67	0.5	0.5	0.732	4.23
RW-5	May-07	**2.920**	**13.9**	2.01	22.1	0.705	16.7	60.1
RW-5	Nov-07	1.430	2.16	0.639	1.08	0.5	1.87	2.07
RW-5	Apr-08	0.240	7.71	2.17	5.64	0.5	1.19	1.48
RW-5	Nov-08	**1.520**	0.916	*0.472*	6.32	0.5	2.85	3.55
RW-5	Apr-09	0.873	**11.7**	2.45	**93.3**	2.42	8.74	16.5
RW-5	Nov-09	0.066	0.4	*0.47*	*0.5*	*1*	*1*	*2*
RW-5	Apr-10	0.570	1.4	*0.49*	7.3	*1*	15	29
RW-5	Nov-10	0.785	0.9	*0.39*	30.5	*1*	2	5.3
RW-5	Apr-11	0.801	1.3	*0.41*	10.3	*1*	3.5	7
RW-5	Nov-11	0.18	1.2	*0.39*	9.2	*1*	5.6	3.9
RW-5	Apr-12	0.746	0.35	*0.41*	14.1	*1*	6.8	26
RW-5	Nov-12	*0.1*	0.38	0.41	1.6	*0.5*	*0.5*	*1.5*
RW-5	Apr-13	0.18	**26**	2.2	0.57	*0.5*	*0.5*	*0.5*
RW-5	Nov-13	0.22	*0.25*	*0.25*	0.83	*0.5*	*0.5*	*1*
RW-5	Apr-14	0.46	2.8	0.79	5.2	0.55	1.9	4.1
RW-5	Average	**2.2**	**65.2**	**19.1**	14.2	5.8	28.1	108.5
RW-4	Nov-03	**4.89**			36.1	44.3	337	281
RW-4	Aug-04	**182.0**	**681**	***150***	**617**	7740	2750	15,200
RW-4	Feb-05	**49.4**	**2,610**	***765***	**347**	2830	834	7,210
RW-4	Nov-05	**77.5**	**3,650**	***1820***	**341**	6940	1100	8,010
RW-4	Mar-06	**26.1**	**440**	**150**	30.2	654	346	3,340
RW-4	Nov-06	**7.23**	**139**	*5.26*	65.2	157	47	1,090
RW-4	May-07	0.82	8.08	*0.543*	3.97	0.547	3.89	77.5
RW-4	Nov-07	**1.29**	0.553	*0.543*	1.97	0.536	3.5	106
RW-4	Apr-08	0.07	2.91	*0.532*	0.5	0.5	0.5	4.57
RW-4	Nov-08	0.73	6.43	*0.472*	6.86	0.5	3.6	28.2
RW-4	Apr-09	0.565	7.93	*0.481*	8.17	0.5	1.43	18.3
RW-4	Nov-09	**5.5**	**25**	1.2	22	1.9	30	310
RW-4	Apr-10	**4.2**	**10**	*0.49*	46	1.6	24	155
RW-4	Nov-10	**2.61**	**20**	0.86	39.9	*1.0*	15	47.9
RW-4	Apr-11	**5.73**	**29.5**	1.2	67.9	1.2	44.8	158
RW-4	Nov-11	**4.51**	**56.2**	1.4	48.5	*1.0*	43.6	98.3
RW-4	Apr-12	**6.24**	**38.1**	1.4	56.8	*1.2*	45.3	106
RW-4	Nov-12	0.771	**10.7**	9.2	7.5	*0.5*	3.9	10.1
RW-4	Apr-13	**1.1**	7.1	*0.5*	16	*0.5*	5.4	2.32
RW-4	Nov-13	0.77	0.63	*0.25*	12	*0.5*	6.2	12
RW-4	Apr-14	**3.7**	**50**	2.7	14	0.49	14	22
RW-4	Average	**18.4**	**389.7**	**145.6**	**85.2**	875.1	269.5	1728.0
RW-2	Nov-03	**2.07**			**820**	369	34.5	124
RW-2	Aug-04	**7.03**	46	1.41	**2,270**	382	354	1,180
RW-2	Feb-05	**4.65**	1.02	0.75	**1,690**	450	296	752
RW-2	Nov-05	**2.82**	0.76	0.708	**1,540**	299	159	353
RW-2	Mar-06	**2.39**	6.84	3.75	**1,120**	112	138	224
RW-2	Nov-06	**13.10**	**14.3**	1.05	**1,830**	516	410	1,810
RW-2	May-07	**8.25**	6.35	*0.505*	**254**	33.1	237	1,150
RW-2	Nov-07	**3.55**	3.32	*0.538*	**895**	5	79.4	172
RW-2	Apr-08	**2.06**	**10.0**	*0.515*	**245**	5	58	190
RW-2	Nov-08	**1.42**	1.1	*0.481*	**360**	4.04	17.6	40
RW-2	Apr-09	0.497	0.864	*0.476*	49	1.78	9.49	22
RW-2	Nov-09	**2.4**	2.6	*0.48*	**400**	23	150	410
RW-2	Apr-10	**1.5**	1.0	*0.49*	**200**	1.5	66	98
RW-2	Nov-10	0.36	8.1	*0.6*	34.9	*1.0*	7.7	23.3
RW-2	Apr-11	**1.0**	1.5	*0.39*	**146**	1.3	27.8	51.7
RW-2	Nov-11	0.96	0.69	*0.39*	**363**	4.7	36.5	63.8
RW-2	Apr-12	0.57	**13.9**	*0.74*	**139**	*1.0*	13.7	17.4
RW-2	Nov-12	0.71	1.0	*0.91*	**196**	1.2	11.2	8.3
RW-2	Apr-13	0.47	3.0	*0.49*	**230**	2.0	20	6.6
RW-2	Nov-13	0.40	4.6	*0.25*	**80**	2.9	6.2	5.5
RW-2	Apr-14	**2.20**	7.2	0.53	**290**	100	84	79
RW-2	Average	**2.8**	6.7	0.8	**626.3**	110.3	105.5	322.9
	Groundwater Cleanup Level	**1.0**	**10.0**	**10.0**	**71**			
Reporting Limits/Units		0.05 mg/l	0.25 mg/l	.750 mg/l	0.5 ug/l	0.5 ug/l	0.5 ug/l	1.0 ug/l

Table 5. Waterfront Groundwater Recovery Wells Petroleum Hydrocarbon History
BP West Coast Products, Terminal 21T, Harbor Island, Seattle, Washington

Well ID	Date	Gasoline mg/l	Diesel mg/l	Oil mg/l	Benzene ug/l	Toluene ug/l	Ethylbenzene ug/l	Xylenes ug/l
GM-11S	Nov-03	**2.28**			**614**	38.3	67.2	141
GM-11S	Aug-04	**2.06**	**57**	3.93	**506**	2.17	49.3	84.1
GM-11S	Feb-05	**2.42**	**25.1**	<15	55.6	0.848	25.5	17.3
GM-11S	Nov-05	**2.15**	**37.4**	<7.14	**124**	3.66	13.7	5.34
GM-11S	Mar-06	**1.41**	**17.8**	*7.5*	**218**	2.5	24.5	5
GM-11S	Nov-06	0.131	**10.8**	*1.05*	13.5	0.5	2.86	1.59
GM-11S	May-07	**1.68**	1.1	*0.556*	**175**	2.5	81.2	35.1
GM-11S	Nov-07	**2.20**	2.34	*0.505*	56.2	4.16	48.4	34.3
GM-11S	Apr-08	**1.93**	0.319	*0.532*	65.7	1.76	185	132
GM-11S	Nov-08	**1.66**	1.23	*0.472*	**95.3**	1.76	44.5	14.8
GM-11S	Apr-09	**1.26**	0.942	*0.481*	5.34	0.898	19.1	11.1
GM-11S	Aug-09	**1.90**	1.2	*0.48*	71	2.4	37	6.3
GM-11S	Nov-09	**1.50**	3.6	*0.48*	36	1.1	48	24
GM-11S	Apr-10	**3.00**	5	0.5	46	1.6	93	156
GM-11S	Nov-10	**1.39**	1.8	*0.48*	42	1.9	64.9	37.1
GM-11S	Apr-11	**1.42**	0.52	*0.4*	18.4	*1*	26.5	20.1
GM-11S	Nov-11	**2.28**	0.47	*0.38*	30.9	1.7	22.9	10.3
GM-11S	Apr-12	**2.24**	1.1	*0.38*	33	1.7	59.2	40.4
GM-11S	Nov-12	0.671	0.83	0.62	11.4	0.86	44.6	27.9
GM-11S	Apr-13	0.5	0.35	*0.49*	20	0.52	23	9.1
GM-11S	Nov-13	0.33	0.47	0.58	4.1	0.6	10	1
GM-11S	Apr-14	**1.2**	3.9	1.4	10	0.82	23	2.7
GM-11S	Average	**1.6**	8.3	1.1	**102.3**	3.3	46.1	37.1
	Groundwater Cleanup Level	**1.0**	**10.0**	**10.0**	**71**			
Reporting Limits/Units		0.05 mg/l	0.25 mg/l	.750 mg/l	0.5 ug/l	0.5 ug/l	0.5 ug/l	1.0 ug/l

Detection limits for many of the Oil analyses were raised due to sample dilution for diesel analyses.
These samples are listed with a "<" notation.
Values highlighted in bold exceed the cleanup level

Table 6. Waterfront Groundwater System Petroleum Hydrocarbon Recovery Rates
BP West Coast Products Terminal 21T, Harbor Island, Seattle, Washington

GROUNDWATER SYSTEM EFFICIENCIES

SAMPLE DATE	UNITS	Influent Benzene	Effluent Benzene	% Reduction	Influent Diesel	Effluent Diesel	% Reduction	Influent Ethylbenzene	Effluent Ethylbenzene	% Reduction
2002 Averages	µg/L	225.3	14.3	91%	7,315	7,020	4%	55.2	6.2	75%
2003 Averages	µg/L	137.7	19.5	76%	4,945	4,648	-1%	44.5	12.9	69%
2004 Averages	µg/L	93.5	3.2	82%	10,285	9,342	-6%	76.8	4.7	79%
2005 Averages	µg/L	76.7	14.5	84%	4,162	5,987	-9%	170.8	45.4	81%
2006 Averages	µg/L	38.9	1.2	89%	11,263	2,174	42%	42.1	0.9	90%
2007 Averages	µg/L	8.8	1.5	60%	1,223	906	18%	6.6	0.8	56%
2008 Averages	µg/L	10.0	1.1	70%	540	468	6%	5.5	0.7	39%
2009 Averages	µg/L	5.2	1.0	48%	369	561	8%	4.1	1.6	31%
2010 Averages	µg/L	3.9	0.7	76%		2,193	*NA*	6.8	1.7	78%
2011 Averages	µg/L	3.2	0.5	80%		1,714	*NA*	2.4	1.0	53%
2012 Averages	µg/L	3.6	1.3	48%		2,787	*NA*	1.9	1.2	37%
2013 Averages	µg/L	1.0	0.5	45%		1,333	*NA*	1.1	0.5	49%
1/14/2014	µg/L	12	*0.15*	99%		780	*NA*	1.9	*0.15*	92%
2/11/2014	µg/L	0.33	*0.15*	55%		1,600	*NA*	0.33	*0.15*	55%
3/20/2014	µg/L	1.4	*1.1*	21%		1,600	*NA*	*0.89*	*0.89*	NA
4/16/2014	µg/L	2.2	0.24	89%		2,400	*NA*	0.66	*0.13*	80%
5/21/2014	µg/L	0.24	*0.14*	42%		820	*NA*	0.27	*0.13*	52%
6/19/2014	µg/L	0.43	0.16	63%		510	*NA*	*0.13*	*0.13*	NA
7/24/2014	µg/L	*0.7*	*0.14*	80%		1,000	*NA*	*0.65*	*0.1*	80%
8/13/2014	µg/L	1	*0.70*	30%		2,700	*NA*	1.5	0.79	47%
9/17/2014	µg/L	0.28	*0.14*	50%		2,400	*NA*	0.15	*0.13*	12%
SURFACE WATER CLEANUP LEVELS		71 µg/L			10,000 µg/L			NA		
KCDNR DISCHARGE LIMITS			70 µg/L			100,000 µg/L			1,700 µg/L	
2014 Averages		2.1 µg/L	.32 µg/L	59%	NA	1,534 µg/L	NA	.72 µg/L	.29 µg/L	60%

SAMPLE DATE	UNITS	Influent Gasoline	Effluent Gasoline	% Reduction	Influent Oil	Effluent Oil	% Reduction	Influent Toluene	Effluent Toluene	% Reduction	Influent Xylenes	Effluent Xylenes	% Reduction
2002 Averages	µg/L	1,770	336	82%	831	804	5%	17.0	2.5	88%	88.8	9.9	87%
2003 Averages	µg/L	1,854	678	62%	760	763	0%	42.7	5.4	61%	154.1	50.3	68%
2004 Averages	µg/L	4,383	840	59%	762	1,026	-8%	116.6	2.2	82%	356.6	23.0	75%
2005 Averages	µg/L	10,090	3,229	70%	864	750	15%	566.9	121.0	84%	1,327.7	367.9	78%
2006 Averages	µg/L	4,944	202	94%	665	666	0%	55.6	0.8	77%	485.1	5.2	96%
2007 Averages	µg/L	407	115	63%	598	598	0%	1.0	0.5	21%	19.8	1.9	50%
2008 Averages	µg/L	279	76	61%	505	504	0%	0.7	0.5	40%	10.6	1.6	65%
2009 Averages	µg/L	407	182	46%	497	489	2%	0.8	0.7	44%	15.2	7.4	33%
2010 Averages	µg/L	915	336	*65%*		*410*	*NA*	*0.9*	*0.9*	*NA*	26	6.7	69%
2011 Averages	µg/L	439	89	*69%*		*492*	*NA*	*1.0*	*1.0*	*NA*	7	3.0	29%
2012 Averages	µg/L	362	144	*61%*		*636*	*NA*	*1.0*	*1.0*	*NA*	6	3.4	48%
2013 Averages	µg/L	356	124	*57%*		*433*	*NA*	*0.5*	*0.5*	*NA*	2	1.0	78%
1/14/2014	µg/L	440	22	*95%*		160	*NA*	2.0	*0.15*	*93%*	3.5	*0.45*	87%
2/11/2014	µg/L	800	150	*81%*		230	*NA*	*0.15*	*0.15*	*NA*	1.5	*0.45*	70%
3/20/2014	µg/L	530	19	96%		280	*NA*	*0.89*	*0.89*	*NA*	*0.82*	*0.82*	*NA*
4/16/2014	µg/L	1,400	470	66%		260	*NA*	0.58	*0.16*	*72%*	1.8	0.19	89%
5/21/2014	µg/L	360	52	*86%*		230	*NA*	0.44	*0.16*	*64%*	3.6	*0.12*	97%
6/19/2014	µg/L	290	180	*38%*		65	*NA*	*0.16*	*0.16*	*NA*	0.33	*0.12*	64%
7/24/2014	µg/L	240	24	*90%*		180	*NA*	*0.2*	*0.2*	*NA*	*0.6*	0.31	48%
8/13/2014	µg/L	1,500	310	*79%*		360	*NA*	*0.8*	*0.8*	*NA*	4.7	2.6	45%
9/17/2014	µg/L	150	*10*	*93%*		340	*NA*	*0.16*	*0.16*		0.35	*0.12*	66%
SURFACE WATER CLEANUP LEVELS		1,000 µg/L			10,000 µg/L			NA			NA		
KCDNR DISCHARGE LIMITS			NA			100,000 µg/L			1,400 µg/L			NA	
2014 Averages		634 µg/L	137 µg/L	1 µg/L	NA	234 µg/L	NA	.59 µg/L	.31 µg/L	NA	1.9 µg/L	.58 µg/L	79%

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	0.04	8.62	18.84	4.26	0.01	0.05	0.19	**4.66**
2011 Totals and Averages	355	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**
1/14/2014	36	1.24	64,520	0.0036	0.26	0.61	0.12	0.0008	0.0008	0.0017	**0.14**
2/11/2014	28	1.23	49,470	0.0025	0.26	0.49	0.08	0.0004	0.0005	0.0010	**0.12**
3/19/2014	36	1.75	90,820	0.0007	0.50	1.21	0.19	0.0004	0.0005	0.0009	**0.28**
4/16/2014	26	1.33	49,920	0.0007	0.40	0.83	0.11	0.0003	0.0003	0.0005	**0.20**
5/21/2014	35	1.37	69,150	0.0007	0.51	0.93	0.14	0.0003	0.0003	0.0016	**0.23**
6/19/2014	29	1.57	65,510	0.0002	0.18	0.36	0.08	0.0002	0.0001	0.0011	**0.09**
7/24/2014	5	2.53	18,220	0.0001	0.04	0.11	0.02	0.0000	0.0001	0.0001	**0.03**
8/13/2014	20	1.52	43,850	0.0003	0.32	0.68	0.10	0.0002	0.0004	0.0010	**0.16**
9/17/2014	35	1.53	77,300	0.0004	0.53	1.64	0.23	0.0003	0.0005	0.0016	**0.35**
2014 Totals and Averages	250	1.56	528,760	0.01	2.99	6.88	1.07	0.00	0.00	0.01	**1.61**
		TOTALS:	**27,044,244 gal**	**13.30**	**924.79**	**1538.54**	**155.47**	**34.79**	**14.71**	**101.19**	
	Maximum permitted GPM:	**27.8**	**Gallons Gas, Diesel, & Oil Recovered:**		**150.37**	**220.42**	**20.38**	**TOTAL GALLONS RECOVERED:**			**390.11**

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)	2,619 lbs
Total Gallons Dissolved Gas, Diesel, and Oil Recovered in Groundwater (2002-Present)*	**390 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)	**14,530 gal**
Total Gallons Recovered by Interim Recovery Systems (1992-2002)	**15,223 gal**
Total Gallons of Petroleum Removed (1992-Present)	**29,754 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.
If the influent concentrations are below the laboratories method detection limit, the percent reduction is calculated using the method detection 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 1.583×10^{-7}
1.583×10^{-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 7. Inland SVE System Petroleum Hydrocarbon Recovery Rates
BP West Coast Products Terminal 21T, Seattle, Washington

Date	Total Hours of Operation	Hours Operated Over Period	Total HSVE Flow Rate from wells (SCFM)	Influent Gasoline Range Organics (GRO) (mg/m^3)	GRO Recovered Over Period (lbs)	Cumulative GRO recovery (lbs)	GRO avg lbs/day over period	Influent Benzene (mg/m^3)	Benzene Recovered Over Period (lbs)	Cumulative Benzene Recovery (lbs)	Avg % CO_2 - Atmospheric concentration (0.04%)	Pounds GRO Destruction From Enhanced Biodegradation Over Period (lbs)	Cumulative GRO Destruction From Enhanced Biodegradation (gal)
2008 Averages & Totals	2,690	2,677	175	4,400	6,072	6,928	58.8	8.78	7.0	7.8	0.38	2,989	486
2009 Averages & Totals	11,245	8,555	258	59.0	551	7,479	1.55	*0.11*	1.1	8.9	0.23	11,748	2,396
2010 Averages & Totals	19,872	8,628	257	9.1	71	7,550	0.20	*0.36*	2.2	11.1	0.18	9,233	3,898
2011 Averages & Totals	23,503	3,583	247	25.5	117	7,667	0.78	*0.56*	1.9	13.0	0.18	2,748	4,344
2012 Averages & Totals	31,631	8,128	246	12.6	87	7,754	0.26	*0.54*	4.1	17.1	0.00	66	4,355
2013 Averages & Totals	37,638	6,007	257	26.6	158	7,912	0.63	0.07	0.2	17.3	0.00	0.00	4,355
1/15/2014	38,308	671	235	12.0	4.8	7,917	0.17	0.99	*0.30*	17.59	0.00	0.00	4,355
2/12/2014	38,979	671	267	2.3	4.5	7,922	0.16	*0.017*	*0.32*	17.91	0.00	0.00	4,355
3/20/2014	39,620	641	260	1.8	1.3	7,923	0.05	*0.017*	*0.01*	17.92	0.00	0.00	4,355
4/16/2014	40,263	643	263	1.5	1.0	7,924	0.04	0.017	*0.01*	17.9	0.00	0.00	4,355
5/21/2014	41,101	838	249	1.9	1.4	7,925	0.04	*0.017*	*0.01*	17.9	0.00	0.00	4,355
6/18/2014	41,771	670	251	1.9	1.2	7,927	0.04	*0.017*	*0.01*	18.0	0.00	0.00	4,355
7/25/2014	42,657	886	267.6	0.8	1.2	7,928	0.03	0.00	*0.01*	18.0	0.00	0.00	4,355
8/13/2014	43,113	456	252.8	NR	1.9	7,930	0.10	0.03	*0.01*	18.0	0.00	0.00	4,355
9/17/2014	43,953	840	241.8	7.9	3.4	7,933	0.10	0.09	*0.05*	18.0	0.00	0.00	4,355

Total Combined Recovery lbs (Bio+GRO): 34,716 **Total lbs of Gasoline (GRO): 7,933** **Total lbs Benzene: 18.02** **Total lbs from Biodegradation: 26,783**

Total Combined Recovery gal (Bio+GRO): 5,645 **Total gal of Gasoline (GRO): 1,290** **Total gal of Benzene: 2.46** **Total gal from Biodegradation: 4,355**

Notes:

Samples are collected from the SVE influent vapor stream (air) for all analyses.

Samples are analyzed for concentrations of gasoline range organics (GRO) and benzene, toluene, ethylbenzene, & xylenes (BTEX) at an accredited lab.

Samples analysis methodologies utilized include TO-3 or NWTPH-Gx for GRO and TO-15, TO-3, or 8021b for BTEX.

Pounds of gasoline are converted to gallons by assuming that 6.15 lbs equals 1.0 gallons.

Pounds of benzene are converted to gallons by assuming that 7.33 lbs equals 1.0 gallons.

Total pounds of recovered gasoline starts at 839 pounds, as this was the amount recovered during pilot testing.

Total pounds of recovered benzene starts at 0.80 pounds, as this was the amount recovered during pilot testing.

Benzene and Gasoline recovery are biased high, as recoveries are calculated assuming analytes are present at associated detection limits. This provides a protective estimate of analyte concentrations below detection limits.

Analytes were not detected from analyses for all values listed in *italic*. The associated detection limits for the analyses are the value listed in *italic*.

The SVE system was shutdown from December 2010 through June 2011 and November 2012 through April 2013 due to high groundwater elevations that submerged horizontal SVE screens. The SVE system was restarted once the groundwater elevation had fallen to a save level for system operation.

Due to a laboratory oversight, benzene concentrations could not be quantified for the April 17, 2013 air sample. The May 17, 2013 air sample was analyzed for benzene using EPA Method TO-15, which generated data to a much lower detection limit than historically reported. No benzene was detected in this sample.

August 2014 GRO concentrations were not utilized to calculate GRO recovery. Laboratory analyses for GRO were biased high by the presence of non-target analytes, identified as siloxane compounds not typically found in gasoline and is not present at the site. This data was excluded to avoid artificially elevating gasoline capture.

Enhanced Biodegradation Calculations:

C = Average Influent CO_2 concentration (%)

Q = Influent Flow Rate (SCFM)

Mc = Molecular wt. of Carbon Dioxide = 44

CO_2 recovery (lbs/hr) = C x Q x Mc x 5.277 x 10-4

5.277 x 10-4 is a constant and is derived as follows:

1/100% x 60min/1hr x 1 lb Mole/379 cu.ft. x 1/3

Note: SVE TPH as CO_2 recovery rates were calculated by assuming that for every 3 lbs of CO_2 detected, 1 lb of TPH is metabolized, and that all CO_2 present in vapor stream above background atmospheric concentrations (0.04%) is attributable to microbial degradation of hydrocarbons in soil.

Definitions:

Avg - average
Bio - biodegradation of petroleum hydrocarbons
CO_2 - carbon dioxide
gal - gallons
GRO - gasoline range organics (gasoline range petroleum hydrocarbons)
hr - hour
HSVE - horizontal soil vapor extraction
lbs - pounds
mg/m^3 - milligrams per cubic meter
NA - not available (see reasons above)
NR - not reported
SCFM - standard cubic feet per minute
SVE - soil vapor extraction
TPH - total petroleum hydrocarbons

Appendix A.

Consent Decree & Restrictive Covenant

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IN THE SUPERIOR COURT OF THE STATE OF WASHINGTON IN AND FOR KING COUNTY

STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY, Plaintiff, v. ARCO PRODUCTS COMPANY, A DIVISION OF ATLANTIC RICHFIELD COMPANY (ARCO), Respondents	NO. 00-2-05714-8SEA **ORDER ENTERING CONSENT DECREE**

Having reviewed the Consent Decree signed by the parties to this matter, the Joint Motion for Entry of the Consent Decree, the Declarations of Nnamdi Madakor and Thomas C. Morrill, and the file herein, it is hereby

ORDERED AND ADJUDGED that the Consent Decree in this matter is Entered and that the Court shall retain jurisdiction over the Consent Decree to enforce its terms.

DATED this _____day of MAR 24 2000, 2000.

Stephen M. Gaddis

~~JUDGE~~/COMMISSIONER
King County

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Presented by:

CHRISTINE O. GREGOIRE
Attorney General

Thomas C Morrill

THOMAS C. MORRILL, WSBA #18388
Assistant Attorney General

Attorneys for Plaintiff
State of Washington
Department of Ecology

DATED: Feb 22, 2000

GRAHAM AND DUNN

Frederick O. Frederickson

FREDERICK O. FREDERICKSON, WSBA #1856
Attorney for Defendant
ARCO Products Company, a division of
Atlantic Richfield Company (ARCO)

DATED: February 18, 2000

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IN THE SUPERIOR COURT OF THE STATE OF WASHINGTON
IN AND FOR KING COUNTY

STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY, Plaintiff, v. ARCO PRODUCTS COMPANY, A DIVISION OF ATLANTIC RICHFIELD COMPANY (ARCO), Respondents.	NO. 00-2-05714-8SEA JOINT MOTION FOR ENTRY OF THE CONSENT DECREE AND MEMORANDUM IN SUPPORT OF MOTION

I. INTRODUCTION

Plaintiff Washington State Department of Ecology ("Ecology") and Defendant, ARCO (jointly "The Parties") bring this motion seeking entry of the attached Consent Decree. This motion is based upon the pleadings filed in this matter, including the Declarations of Nnamdi Madakor and Thomas C. Morrill.

II. RELIEF REQUESTED

The Parties request that the Court approve and enter the attached Consent Decree which requires certain remedial actions at the ARCO Harbor Island Site in Seattle, King County, Washington. The Parties also request that the Court retain jurisdiction over this action until the work required by the Consent Decree is completed and the Parties request a dismissal of this action.

III. AUTHORITY

RCW 70.105D.030 authorizes Ecology to issue such orders as may be necessary to effectuate the purposes of chapter 70.105D RCW and to enter into consent decrees through

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judicial proceedings. In addition, RCW 70.105D.040(4) authorizes the Attorney General to agree to a settlement with a potentially liable person and to request that the settlement be entered as a consent decree in the superior court of the county where a violation is alleged to have occurred.

IV. CONCLUSION

The Parties believe it is appropriate for the Court to exercise its judicial discretion and approve the attached Consent Decree, and hereby request that the Court enter the attached Order.

DATED this 22nd day of February, 2000.

CHRISTINE O. GREGOIRE
Attorney General

Thomas C Morrill

THOMAS C. MORRILL, WSBA #18388
Assistant Attorney General
Attorneys for Plaintiff
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IN THE SUPERIOR COURT OF THE STATE OF WASHINGTON
IN AND FOR KING COUNTY

STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY, Plaintiff, v. ARCO PRODUCTS COMPANY, A DIVISION OF ATLANTIC RICHFIELD COMPANY (ARCO) Respondents.	NO. 00-2-05714-8SEA COMPLAINT

Plaintiff, State of Washington, Department of Ecology ("Ecology"), alleges as follows:

I. DESCRIPTION OF ACTION

1. This action is brought on behalf of the Washington State Department of Ecology, to enter a settlement agreement in the form of a Consent Decree ("Consent Decree") for the performance of remedial actions at a facility where there have been releases and/or threatened releases of hazardous substances.

2. The "Property", or "Site", that is the subject of this action is referred to as ARCO Harbor Island Terminal-Plant I and Plant 2, is located at 1652 Southwest Lander Street and at the southwest quadrant of the intersection of southwest Florida Street and Eleventh Avenue southwest, in Seattle, Washington. The Site is more particularly described in Exhibit A of the Consent Decree that is being submitted to settle this action.

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II. JURISDICTION

3. This Court has jurisdiction under RCW 70.105D.050(5)(b), the Model Toxics Control Act ("MTCA"), over the subject matter and over the parties. Venue is properly laid in King County, the location of the Property at issue.

4. Authority is conferred upon the Washington State Attorney General by RCW 70.105.D.040(4) to agree to a settlement with any potentially liable person if, after public notice and hearing, Ecology finds the proposed settlement would lead to a more expeditious cleanup of hazardous substances in compliance with cleanup standards under RCW 70.105D.030(2)(e). Under RCW 70.105D.040(4)(b), such a settlement must be entered as a Consent Decree issued by a court of competent jurisdiction.

5. Ecology has determined that a release or threatened release of a hazardous substance has occurred at the Site.

6. Ecology has given notice to ARCO Products Company, a division of Atlantic Richfield Company (ARCO), herein after referred to as ("ARCO"), as provided in RCW 70.105D.020(16), of Ecology's determination that they are potentially liable persons for the Property and that there has been a release and/or threatened release of hazardous substances at the Property.

III. PARTIES

7. Plaintiff Ecology is an agency of the State of Washington responsible for overseeing remedial action at sites contaminated with hazardous substances under RCW 70.105D.

8. Defendants refers to ARCO.

IV. FACTUAL ALLEGATIONS

9. ARCO presently owns the following property known as ARCO Harbor Island Terminal-Plant 1 and Plant 2 located at 1652 Southwest Lander Street and at the southwest quadrant of the intersection of Southwest Florida Street and Eleventh Avenue Southwest,

ATTORNEY GENERAL OF WASHINGTON
Ecology Division
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respectively, Seattle, Washington, 98124 (collectively referred to as the "Site" and more particularly described in Exhibit A of the Consent Decree that is being submitted to settle this action). The ARCO Harbor Island Terminal, an operating facility, consists of two separate bulk storage plants (Plant No. 1 and Plant No. 2). Plant No. 1 consists of approximately 20 above-ground storage tanks and houses the main terminal facility which includes a large warehouse, office building, pump room, truck wash, motor transport garage, boiler house, vapor recovery unit building, loading dock and several smaller buildings and sheds. The products previously stored in Plant No. 1 include "black oil" (Bunker "C") and light black oil diesel, unleaded and leaded gasolines, stove oil, heating oil, kerosene, "flash gas", aviation fuel, klenzene (paint thinner), and gasoline additives. Plant No. 2 contains approximately 6 above-ground storage tanks in which No. 2 diesel fuels are presently stored. Plant No. 2 also houses a foam house and a salt tower.

10. Free-phase hydrocarbons are present at the Site situated at the top of the water table beneath portions of Plant 1, including under the warehouse next to the West Waterway of the Duwamish River; and

11. Residual hydrocarbons are present in the soil at the Site beneath portions of Plant 1 and Plant 2.

12. Dissolved petroleum hydrocarbons and CPAHs exceeding the Surface Water Quality Standards are present in the groundwater at the Site beneath Plants 1 and 2.

13. There has been a release of hazardous substances at the Site.

14. Ecology and Defendant have entered into a settlement agreement under the MTCA for remedial actions at the Site.

V. CAUSES OF ACTION

15. Plaintiff realleges paragraphs 1 through 14, above.

16. Ecology further alleges that the Defendants are responsible for performing remedial actions at the facility pursuant to RCW 70.105D and Chapter 173-340 WAC.

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17. Ecology and the Defendants have entered into a Consent Decree requiring remedial actions at the facility, and Ecology will move for entry of that Consent Decree as a basis for settling this action.

VI. PRAYER FOR RELIEF

WHEREAS Ecology and ARCO have voluntarily entered into a proposed Consent Decree, Ecology hereby requests that the Court, pursuant to RCW 70.105D.040, approve and order the entry of the proposed Consent Decree. Ecology further requests that the Court retain jurisdiction to enforce the terms of the Consent Decree.

Respectfully submitted this 22nd day of February, 2000.

CHRISTINE O. GREGOIRE
Attorney General

Thomas C Morrill

THOMAS C. MORRILL, WSBA #18388
Assistant Attorney General
Attorneys for Plaintiff

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IN THE SUPERIOR COURT OF THE STATE OF WASHINGTON
IN AND FOR KING COUNTY

STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY, Plaintiff, v. ARCO PRODUCTS COMPANY, A DIVISION OF ATLANTIC RICHFIELD COMPANY (ARCO), Respondents.	NO. 00-2-05714-8SEA DECLARATION OF NNAMDI MADAKOR

I, NNAMDI MADAKOR, declare as follows:

1. I am over twenty-one years of age and am competent to testify herein. The facts set forth in this Declaration are from my personal knowledge.

2. I am employed as a Site Project Manager at the Washington State Department of Ecology. I am the site manager and am knowledgeable on matters relating to the Site in Seattle, Washington referred to as the ARCO Harbor Island Site.

3. On behalf of Ecology, I took part in the negotiations that led to the Consent Decree that is being presented to the Court.

4. The Consent Decree was the subject of public notice and public comment as required by RCW 70.105D.040(4)(a). Ecology also conducted a public hearing as required by WAC 173-340-600(9)(d).

5. Ecology received comments during the first public comment period on the substance of the Consent Decree. Ecology considered the comments and made substantive changes

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IN THE SUPERIOR COURT OF THE STATE OF WASHINGTON
IN AND FOR KING COUNTY

00-2-05714-8SEA

STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY, Plaintiff, v. ARCO PRODUCTS COMPANY, A DIVISION OF ATLANTIC RICHFIELD COMPANY (ARCO), Respondents.	NO. **DECLARATION OF THOMAS C. MORRILL**

I, THOMAS C. MORRILL, declare as follows:

1. I am over twenty-one years of age and am competent to testify herein. The facts set forth in this Declaration are from my personal knowledge.

2. I am an Assistant Attorney General assigned to represent the Washington State Department of Ecology and the Attorney General's Office on legal matters relating to the site in Seattle, Washington referred to as the ARCO Harbor Island Site.

3. On behalf of Ecology and the Attorney General's Office, I took part in the negotiations that led to the Consent Decree that is being presented to the Court.

4. The Consent Decree was the subject of public notice and public comment as required by RCW 70.105D.040(4)(a). Ecology also conducted a public hearing as required by WAC 173-340-600(9)(d).

5. Ecology received comments during the first public comment period on the substance of the Consent Decree. Ecology considered the comments and made substantive changes

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IN THE SUPERIOR COURT OF THE STATE OF WASHINGTON
IN AND FOR KING COUNTY

STATE OF WASHINGTON, DEPARTMENT OF ECOLOGY, Plaintiff, v. ARCO PRODUCTS COMPANY, A DIVISION OF ATLANTIC RICHFIELD COMPANY (ARCO), Respondents.	NO. 00-2-05714-8SEA **SUMMONS**

To: ARCO PRODUCTS COMPANY, A DIVISION OF ATLANTIC RICHFIELD COMPANY (ARCO);

And To: The Clerk of the above-entitled Court:

A lawsuit has been started against you in the above-entitled Court by the State of Washington, Department of Ecology, Plaintiff. Plaintiff's claim is stated in the written Complaint, a copy of which is served upon you with this Summons.

The parties have agreed to resolve this matter by entry of a consent decree. Accordingly, this Summons shall not require the filing of an answer.

Respectfully submitted this 11 day of February, 2000.

CHRISTINE O. GREGOIRE
Attorney General

Thomas C Morrill

THOMAS C. MORRILL, WSBA #18388
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DEPARTMENT OF ADMINISTRATION

IN THE SUPERIOR COURT OF THE STATE OF WASHINGTON
KING COUNTY

STATE OF WASHINGTON DEPARTMENT OF ECOLOGY, Plaintiff, v. ARCO PRODUCTS COMPANY, A DIVISION OF ATLANTIC RICHFIELD COMPANY (ARCO) Defendants.	No. 00-2-05714-8SEA **CONSENT DECREE**

TABLE OF CONTENTS

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I. INTRODUCTION

A. In entering into this Consent Decree (Decree), the mutual objective of the Washington State Department of Ecology (Ecology), and ARCO Products Company, a division of Atlantic Richfield Company (ARCO or Defendant) is to provide for remedial action at a facility where there has been a release or threatened release of hazardous substances. This Decree requires the Defendant to undertake the following remedial action(s):

(1) Implement the Cleanup Action Plan (CAP)

(2) Provide for Public Participation

(3) Provide Remedial Design (RD)

(4) Implement the Groundwater Compliance Monitoring that includes:

(A) Protection Monitoring

(B) Performance Monitoring

(C) Confirmational Monitoring

Ecology has determined that these actions are necessary to protect public health and the environment.

B. The Complaint in this action is being filed simultaneously with this Decree. An answer has not been filed, and there has not been a trial on any issue of fact or law in this case. However, the parties wish to resolve the issues raised by Ecology's complaint. In addition, the parties agree that settlement of these matters without litigation is reasonable and in the public interest and that entry of this Decree is the most appropriate means of resolving these matters.

C. In signing this Decree, Defendant agrees to its entry and subject to Paragraph E below agrees to be bound by its terms.

D. By entering into this Decree, the parties do not intend to discharge nonsettling parties from any liability they may have with respect to matters alleged in the complaint. The parties retain the right to seek reimbursement, in whole or in part, from any liable persons for sums expended under this Decree.

ATTORNEY GENERAL OF WASHINGTON
ECOLOGY DIVISION
P.O. BOX 40117
Olympia, WA 98504-0117
Fax: (360) 438-7743 340-9599

E. This Decree is not an admission of and shall not be construed as proof of liability or responsibility for any releases of hazardous substances or cost for remedial action nor an admission of any facts; provided, however, that the Defendant shall not challenge the jurisdiction of Ecology in any proceeding to enforce this Decree.

F. The Court is fully advised of the reasons for entry of this Decree, and good cause having been shown: IT IS HEREBY ORDERED, ADJUDGED, AND DECREED AS FOLLOWS:

II. JURISDICTION

A. This Court has jurisdiction over the subject matter and over the parties pursuant to Chapter 70.105D RCW, the Model Toxics Control Act (MTCA), and venue is proper in King County.

B. Authority is conferred upon the Washington State Attorney General by RCW 70.105D.040(4)(a) to agree to a settlement with any potentially liable person if, after public notice, Ecology finds the proposed settlement would lead to a more expeditious cleanup of hazardous substances. RCW 70.105D.040(4)(b) requires that such a settlement be entered as a consent decree issued by a court of competent jurisdiction.

C. Ecology has determined that a release or threatened release of hazardous substances has occurred at the Site which is the subject of this Decree.

D. Ecology has given notice to Defendant, as set forth in RCW 70.105D.020(15), of Ecology's determination that the Defendant is a potentially liable person for the Site and that there has been a release or threatened release of hazardous substances at the Site.

E. The actions to be taken pursuant to this Decree are necessary to protect public health, welfare, and the environment.

F. Defendant has agreed to undertake the actions specified in this Decree and consents to the entry of this Decree under the MTCA.

III. PARTIES BOUND

This Decree shall apply to and be binding upon the signatories to this Decree (parties), their

ATTORNEY GENERAL OF WASHINGTON
ECOLOGY DIVISION
P.O. BOX 40117
Olympia, WA 98504-0117
Fax: (360) 438-7743 340-9599

successors and assigns and shall supersede the prior Agreed Order entered into by the parties. The undersigned representative of each party hereby certifies that he or she is fully authorized to enter into this Decree and to execute and legally bind such party to comply with the Decree. Defendant agrees to undertake all actions required by the terms and conditions of this Decree and not to contest state jurisdiction regarding this Decree. No change in ownership or corporate status shall alter the responsibility of the Defendant under this Decree. Defendant shall provide a copy of this Decree to all agents, contractors and subcontractors retained to perform work required by this Decree and shall ensure that the contract for such work will be in compliance with this Decree.

IV. DEFINITIONS

Except as specified herein, all definitions in WAC 173-340-200 apply to the terms in this Decree.

A. Site: The Site, owned by ARCO Products Company, a division of Atlantic Richfield Company (ARCO) is known as ARCO Harbor Island Terminal-Plant 1 and Plant 2 located at 1652 Southwest Lander Street and at the southwest quadrant of the intersection of Southwest Florida Street and Eleventh Avenue Southwest, respectively, Seattle, Washington, 98124 (collectively referred to as the "Site") on Harbor Island. The Site is part of the Tank Farm Operable Unit One (OU1) for the Harbor Island Superfund Site. The Site is more particularly described in Exhibit A to this Decree, which is a detailed site diagram.

B. Parties: Refers to the Washington State Department of Ecology and ARCO.

C. Defendant: Refers to ARCO Products Company, a division of Atlantic Richfield Company (ARCO).

D. Consent Decree or Decree: Refers to this Consent Decree and each of the exhibits to the Decree. All exhibits are by this reference incorporated herein, and are integral and enforceable parts of this Consent Decree. The terms "Consent Decree" or "Decree" shall include all Exhibits to the Consent Decree.

ATTORNEY GENERAL OF WASHINGTON
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P.O. BOX 40117
Olympia, WA 98504-0117
Fax: (360) 438-7743 340-9599

V. STATEMENT OF FACTS

Ecology makes the following finding of facts without any express or implied admissions by Defendant.

A. ARCO presently owns the following property known as ARCO Harbor Island Terminal--Plant 1 and Plant 2 located at 1652 Southwest Lander Street and at the southwest quadrant of the intersection of Southwest Florida Street and Eleventh Avenue Southwest, respectively, Seattle, Washington, 98124 (collectively referred to as the "Site"). The ARCO Harbor Island Terminal, an operating facility, consists of two separate bulk storage plants (Plant 1 and Plant 2). Plant 1 consists of approximately 20 above-ground storage tanks and houses the main terminal facility which includes a large warehouse, office building, pump room, truck wash, motor transport garage, boiler house, vapor recovery unit, building, loading dock and several smaller buildings and sheds. The products previously stored in Plant 1 include "black oil" (Bunker "C") and light black oil diesel, unleaded and leaded gasoline, stove oil, heating oil, kerosene, "flash gas", aviation fuel, klenzene (paint thinner), and gasoline additives. Plant 2 contains approximately 6 aboveground storage tanks in which No. 2 diesel fuels are presently stored. Plant 2 also houses a foam house and a salt tower.

B. Ecology files contain the following reports: Subsurface Environmental Assessment ARCO Harbor Island Terminal, Seattle, Washington. Engineering Enterprises, Inc., October 5, 1987 (EEI Report) and Remedial Investigations, ARCO Harbor Island Terminal 21T, Seattle, Washington. Geraghty & Miller, Inc., April 22, 1994 (RI Report). Based on the EEI and RI Reports, Ecology finds as follows:

1. Free-phase hydrocarbons are confirmed to be present at the Site situated at the top of the water table beneath portions of Plant 1, including under the warehouse next to the West Waterway of the Duwamish River; and

2. Residual hydrocarbons are confirmed to be present in the soil at the Site beneath portions of Plant 1, and Plant 2.

ATTORNEY GENERAL OF WASHINGTON
ECOLOGY DIVISION
P.O. BOX 40117
Olympia, WA 98504-0117
Fax: (360) 438-7743 340-9599

3. Dissolved petroleum hydrocarbons and cPAHs exceeding the Surface Water Quality Standards are confirmed to be present in the groundwater at the Site beneath Plants 1 and 2.

C. Ecology files contain the following report: Feasibility Study Report; Conceptual Site Model and Selection of The Preferred Remedial Alternative, ARCO Harbor Island Terminal 21T, Seattle, Washington. Geraghty & Miller, Inc., December 6, 1996 (FS Report). Based on the FS Report, Ecology finds as follows:

1. ARCO identified a preferred remedy after evaluating other alternative remedies to address the hazardous substances located on site. Ecology concurs that the remedy preferred by ARCO is appropriate. The preferred remedy is to:

   a. Expand the product extraction under the warehouse to include dissolved petroleum hydrocarbons, implement vapor extraction, implement air sparging

   b. Excavate accessible TPH hot spots in Plant 1, using the action levels of 10,000 mg/kg.

   c. Excavate accessible TPH hot spots in Plant 2, using the action levels of 20,000 mg/kg.

   d. Implement compliance groundwater monitoring program and if necessary, contingency plans.

   e. Implement institutional controls.

   f. The Compliance Groundwater Monitoring Program will include bioassay/sediment sampling at the West Waterway of the Duwamish River to further evaluate risks to the marine organism, if any, and to evaluate if additional remedial actions will be necessary.

D. In August, 1995, the United States District Court for Western District of Washington (Civil Action No. 95-01495-Z) entered a Consent Decree ("Federal Consent Decree") in U.S. v. The Port of Seattle et al. relating to claims under the Comprehensive Environmental Response, Compensation and Liability Act ("CERCLA") 42 U.S.C. § 9601 et seq. involving the Harbor Island

ATTORNEY GENERAL OF WASHINGTON
ECOLOGY DIVISION
P.O. BOX 40117
Olympia, WA 98504-0117
Fax: (360) 438-7743 340-9599

Superfund Site. Article I, paragraph 8 of the Federal Consent Decree identifies operable units within the Harbor Island Superfund Site and recites that the Petroleum Tank Farm Operable Unit is under the management of the Department of Ecology. The Environmental Protection Agency and Ecology have entered into Memorandums of Understanding dated February 5, 1991 and March 3, 1994 setting forth the duties and responsibilities of each Agency with regard to site management and enforcement activities at the Harbor Island Superfund Site.

E. Ecology and Defendant agree (a) that they have entered into a settlement agreement under the MTCA and in particular RCW 70.105D.040(e), (ii) that all terms and conditions of the settlement agreement are set forth in this Consent Decree, and (c) pursuant to Section 4, Chapter 406, Laws of 1997 (Senate Bill 7900) (hereinafter Senate Bill 7900) this Consent Decree is not based on circumstances unique to Defendant. Ecology and Defendant intend that this settlement agreement shall be enforced to the maximum extent permitted under the MTCA.

VI. WORK TO BE PERFORMED

This Decree contains a program designed to protect public health, welfare and the environment from the known release, or threatened release, of hazardous substances at, on, or from the Site. ARCO agrees to take the following remedial actions and that all work be conducted in accordance with chapter 173-340 WAC, unless otherwise specifically provided herein. These actions are more specifically described in the Cleanup Action Plan attached as Exhibit B.

A. Task 1:Implement the Cleanup Action Plan (CAP):

1. Expand the product extraction system under the warehouse and include extraction of dissolved petroleum hydrocarbons along the shoreline

2. Implement soil vapor extraction

3. Implement air sparging above and below the watertable along the shoreline and under the warehouse (to address in-accessible TPH hot spots in soils)

4. Excavate accessible TPH hot spots in Plant 1, using the action levels of 10,000 mg/kg. The accessible area in Plant 1 that will require excavation is in the southeast of the site

ATTORNEY GENERAL OF WASHINGTON
ECOLOGY DIVISION
P.O. BOX 40117
Olympia, WA 98504-0117
Fax: (360) 438-7743 340-9599

between the above storage Tank No. 1, 8, 9, and 13. The accessible TPH hot spots are in the vicinity of soil borings B-17, B-20, B-21, B-23, TS-25, TS-26, TS-27, TS-36, TS-37, TS-39, TS-40, TS-40, TS-41 and TS-42. It is Ecology's expectation that the accessible TPH soil hot spots will be excavated without undermining the integrity of the above storage tanks next to the hot spot. Excavate accessible TPH hot spots in Plant 2, using the action levels of 20,000 mg/kg. There are two accessible TPH hot spot areas in Plant 2 that will require excavation. The first TPH hot spot is located in the northeast corner of the site at soil boring TS-1. The second TPH hot spot is located south and southeast of the site between the above storage Tank No. 59001 and 20001 and are in the vicinity of soil borings B-36, B-37, TS-12, TS-14, TS-15, TS-17, TS-19, TS-31, TS-32, TS-34 and TS-35. It is Ecology's expectation that these accessible TPH soil hot spots will be excavated without undermining the integrity of the above storage tanks next to the hot spots.

5. Implement compliance groundwater monitoring program

6. As part of the compliance groundwater monitoring program, implement sediment/bioassay sampling as necessary to further evaluate risks to the marine organism, if any, and to evaluate if additional remedial actions will be necessary.

7. Implement institutional controls, Restrictive Covenant and Contingency Plans, if necessary.

B. Task 2: Provide for Public Participation

C. Task 3: Provide Remedial Design (or Engineering Report)

D. Task 4: Implement the Compliance Groundwater Monitoring Program that includes:

1. Protection Monitoring
2. Performance Monitoring
3. Confirmational Monitoring

E. Task 5: Implement Schedule as outlined in Exhibit E (Attached)

F. Defendant agrees not to perform any remedial actions on Site that are inconsistent with the remedial actions required under this Consent Decree.

ATTORNEY GENERAL OF WASHINGTON
ECOLOGY DIVISION
P.O. BOX 40117
Olympia, WA 98504-0117
Fax: (360) 438-7743 340-9599

VII. DESIGNATED PROJECT COORDINATORS

The project coordinator for Ecology is:

Nnamdi Madakor, Senior Hydrogeologist
Washington State Department of Ecology
Northwest Regional Office
3190 160th Avenue SE
Bellevue, WA 98008-5452
(425) 649-7112

The project coordinator for Defendant is:

Ralph Moran, Senior Environmental Engineer
ARCO Products Company
4 Centerpoint Drive
La Palma, CA 90623-1066
(714) 670-5126

Each project coordinator shall be responsible for overseeing the implementation of this Decree. The Ecology project coordinator will be Ecology's designated representative at the Site. To the maximum extent possible, communications between Ecology and the Defendant and all documents, including reports, approvals, and other correspondence concerning the activities performed pursuant to the terms and conditions of this Decree, shall be directed through the project coordinators. The project coordinators may designate, in writing, working level staff contacts for all or portions of the implementation of the remedial work required by this Decree. The project coordinators may agree to minor modifications to the work to be performed without formal amendments to this Decree. Minor modifications will be documented in writing by Ecology.

Each party may change its respective project coordinator. Written notification shall be given to the other parties at least ten (10) calendar days prior to the change.

VIII. PERFORMANCE

All work performed pursuant to this Decree shall be under the direction and supervision, as necessary, of a professional engineer or hydrogeologist, or equivalent, with experience and expertise in hazardous waste site investigation and cleanup. Any construction work must be under the

ATTORNEY GENERAL OF WASHINGTON
ECOLOGY DIVISION
P.O. BOX 40117
Olympia, WA 98504-0117
Fax: (360) 438-7743 340-9599

supervision of a professional engineer. Defendant shall notify Ecology in writing as to the identity of such engineer(s) or hydrogeologist(s), or others and of any contractors and subcontractors to be used in carrying out the terms of this Decree, in advance of their involvement at the Site.

IX. ACCESS

Ecology or any Ecology authorized representatives shall have the authority to enter and freely move about all property at the Site at all reasonable times for the purposes of, inter alia: inspecting records, operation logs, and contracts related to the work being performed pursuant to this Decree; reviewing Defendant's progress in carrying out the terms of this Decree; conducting such tests or collecting such samples as Ecology may deem necessary; using a camera, sound recording, or other documentary type equipment to record work done pursuant to this Decree; and verifying the data submitted to Ecology by the Defendant. Without limitation on Ecology's rights under this section, Ecology will provide ARCO advance notice of its entry onto the Site when appropriate. All parties with access to the Site pursuant to this paragraph shall comply with Site access and operating procedures, Exhibit C. Ecology shall make the results of all sampling, laboratory reports, videos and other test results generated by it or on its behalf available to Defendant.

X. SAMPLING, DATA REPORTING, AND AVAILABILITY

With respect to the implementation of this Decree, Defendant shall make the results of all sampling, laboratory reports, and/or test results generated by it, or on its behalf available to Ecology and shall submit these results in accordance with Section XI of this Decree.

In accordance with WAC 173-340-840(5), groundwater sampling data shall be submitted according to the requirements that will be established in the Groundwater Compliance Monitoring Program. Each party shall allow split or replicate samples to be taken by the other and shall provide 5 working days notice before conducting any sampling activities.

XI. PROGRESS REPORTS

Defendant shall submit to Ecology written progress reports, which describe the actions taken to implement the requirements of this Decree. The progress report shall be prepared no more frequently than set forth in the following schedule:

ATTORNEY GENERAL OF WASHINGTON
ECOLOGY DIVISION
P.O. BOX 40117
Olympia, WA 98504-0117
Fax: (360) 438-7743 340-9599

- Quarterly during remedial design activities
- Monthly during construction phase activities
- Monthly for the first quarter after remedial system startup

The frequency of progress reports to be submitted following the first quarter after remedial system startup shall be established in the Groundwater Compliance Monitoring Program. Progress reports shall include the following:

A. A list of on-site activities that have taken place during the reporting period;

B. Detailed description of any deviations from required tasks not otherwise documented in project plans or amendment requests;

C. Description of all deviations from the schedule (VI. Work To Be Performed) during the current reporting period and any planned deviations in the upcoming reporting period;

D. For any deviations in schedule, a plan for recovering lost time and maintaining compliance with the schedule;

E. All raw data (including laboratory analysis) received by the Defendant during the past month and an identification of the source of the sample;

F. A list of deliverables for the upcoming month if different from the schedule; and

All progress reports shall be submitted by the fifteenth day of the reporting period in which they are due after the effective date of this Decree. Unless otherwise specified, progress reports and any other documents submitted pursuant to this Decree shall be sent to Ecology's project coordinator.

XII. RETENTION OF RECORDS

Defendant shall preserve, during the pendency of this Decree and for ten (10) years from the date this Decree is no longer in effect as provided in Section XXV, all records, reports, documents, and underlying data in its possession relevant to the implementation of this Decree and shall insert in contracts with project contractors and subcontractors a similar record retention requirement. Upon request of Ecology, Defendant shall make all non-archived, non-privileged records available to Ecology and allow access for review. All archived non-privileged records shall be made available to Ecology within a reasonable period of time.

ATTORNEY GENERAL OF WASHINGTON
ECOLOGY DIVISION
P.O. BOX 40117
Olympia, WA 98504-0117
Fax: (360) 438-7743 340-9599

XIII. TRANSFER OF INTEREST IN PROPERTY

Prior to any voluntary or involuntary conveyance or relinquishment of title, easement, leasehold, or other interest in any portion of the Site, Defendant shall provide for continued operation and maintenance of any containment system, treatment system, and monitoring system installed or implemented pursuant to this Decree.

Prior to transfer of any legal or equitable interest in all or any portion of the Site, and during the effective period of this Decree, Defendant shall serve a copy of this Decree upon any prospective purchaser, lessee, transferee, assignee, or other successor in interest of the property; and, at least thirty (30) days prior to any transfer, Defendant shall notify Ecology of said contemplated transfer.

XIV. RESOLUTION OF DISPUTES

A. In the event a dispute arises as to an approval, disapproval, payment obligation, proposed modification or other decision or action by Ecology's project coordinator, the parties shall utilize the dispute resolution procedure set forth below.

(1) Upon receipt of the Ecology project coordinator's decision, the Defendant has fourteen (14) days within which to notify Ecology's project coordinator of its objection to the decision.

(2) The parties' project coordinators shall then confer in an effort to resolve the dispute. If the project coordinators cannot resolve the dispute within fourteen (14) days, Ecology's project coordinator shall issue a written decision.

(3) Defendant may then request Ecology management review of the decision. This request shall be submitted in writing to the Toxics Cleanup Program Manager within seven (7) days of receipt of Ecology's project coordinator's decision.

(4) Ecology's Program Manager shall conduct a review of the dispute and shall issue a written decision regarding the dispute within thirty (30) days of the Defendant's request for review. The Program Manager's decision shall be Ecology's final decision on the disputed matter.

B. If Ecology's final written decision is unacceptable to Defendant, the parties may, by

ATTORNEY GENERAL OF WASHINGTON
ECOLOGY DIVISION
P.O. BOX 40117
Olympia, WA 98504-0117
Fax: (360) 438-7743 340-9599

mutual agreement, submit the dispute to a neutral mediator. No more than thirty (30) days after the conclusion of any mediation, Ecology shall issue a written statement either reaffirming its original decision or setting forth a new decision. Defendant has the right to submit the dispute to the Court for resolution within thirty (30) days after any of the following: (i) Defendant receives written notice that Ecology does not agree to submit the dispute to mediation,; (ii) After mediation, Defendant receives a written statement from Ecology that is unacceptable to Defendant; or (iii) Ecology fails to issue the final decision described earlier in this paragraph. The parties agree that one judge should retain jurisdiction over this case and shall, as necessary, resolve any dispute arising under this Decree.

C. For disputes that arise under the following sections of the Decree, the Court shall review the action or decision of Ecology under an arbitrary and capricious standard of review: work to be performed (Section VI), designated project coordinators (Section VII), performance (Section VIII), access (Section IX), sampling, data reporting and availability (Section X), progress reports (Section XI), retention of records (Section XII), amendment of Consent Decree (Section XV), extension of schedule (Section XVI), endangerment (Section XVII), compliance with applicable laws (Section XX), implementation of remedial action (Section XXII), five year review (Section XXIII), public participation (Section XXIV), duration of decree (Section XXV), and land use restrictions (Section XXIX).

D. The parties agree to only utilize the dispute resolution process in good faith and agree to expedite, to the extent possible, the dispute resolution process whenever it is used. Where either party utilizes the dispute resolution process in bad faith or for purposes of delay, the other party may seek sanctions.

Implementation of these dispute resolution procedures shall not provide a basis for delay of any activities required in this Decree, unless Ecology agrees in writing to a schedule extension or the Court so orders.

XV. AMENDMENT OF CONSENT DECREE

Except for an extension granted pursuant to Section XVI below or technical revisions to Section VI or Exhibit B affecting the nature or scope of remedial work, this Decree may only be

ATTORNEY GENERAL OF WASHINGTON
ECOLOGY DIVISION
P.O. BOX 40117
Olympia, WA 98504-0117
Fax: (360) 438-7743 340-9599

amended by a written stipulation among the parties to this Decree that is entered by the Court or by order of the Court. Such amendment shall become effective upon entry by the Court. Agreement to amend shall not be unreasonably withheld by any party to the Decree.

Defendant shall submit any request for an amendment to Ecology for approval. Ecology shall indicate its approval or disapproval in a timely manner after the request for amendment is received. If the amendment to the Decree is substantial, Ecology will provide public notice and opportunity for comment. Reasons for the disapproval shall be stated in writing. If Ecology does not agree to any proposed amendment, the disagreement may be addressed through the dispute resolution procedures described in Section XIV of this Decree. Technical revisions to Section VI or Exhibit B, affecting the nature or scope of remedial work, may be made by mutual written agreement of the parties without approval of the court.

XVI. EXTENSION OF SCHEDULE

A. An extension of schedule shall be granted only when a request for an extension is submitted in a timely fashion, generally at least 15 days prior to expiration of the deadline for which the extension is requested, and good cause exists for granting the extension. All extensions shall be requested in writing. The request shall specify the reason(s) the extension is needed.

An extension shall only be granted for such period of time as Ecology determines is reasonable under the circumstances. A requested extension shall not be effective until approved by Ecology or the Court. Ecology shall act upon any written request for extension in a timely fashion. It shall not be necessary to formally amend this Decree pursuant to Section XV when a schedule extension is granted.

B. The burden shall be on the Defendant to demonstrate to the reasonable satisfaction of Ecology that the request for such extension has been submitted in a timely fashion and that good cause exists for granting the extension. Good cause includes, but is not limited to, the following.

(1) Circumstances beyond the reasonable control and despite the due diligence of Defendant including delays caused by unrelated third parties or Ecology, such as (but not limited to) delays by Ecology in reviewing, approving, or modifying documents submitted by Defendant; or

ATTORNEY GENERAL OF WASHINGTON
ECOLOGY DIVISION
P.O. BOX 40117
Olympia, WA 98504-0117
Fax: (360) 438-7743 340-9599

(2) Acts of God, including fire, flood, blizzard, extreme temperatures, storm, or other unavoidable casualty; or

(3) Endangerment as described in Section XVII, or

(4) Other circumstances deemed by Ecology to be exceptional, extraordinary, or otherwise necessary to protect the environment or public interest.

However, neither increased costs of performance of the terms of the Decree nor changed economic circumstances shall be considered circumstances beyond the reasonable control of Defendant.

C. Ecology may extend the schedule for a period not to exceed ninety (90) days, except where an extension is needed as a result of:

(1) Delays in the issuance of a necessary permit which was applied for in a timely manner; or

(2) Other circumstances deemed exceptional or extraordinary by Ecology; or

(3) Endangerment as described in Section XVII.

Ecology shall give Defendant written notification in a timely fashion of any extensions granted pursuant to this Decree. Ecology shall not unreasonably withhold approval of requested extensions.

XVII. ENDANGERMENT

In the event Ecology determines that activities implementing or in compliance with this Decree, or any other circumstances or activities, are creating or have the potential to create a danger to the health or welfare of the people on the Site or in the surrounding area or to the environment, Ecology may order Defendant to stop further implementation of this Decree for such period of time as needed to abate the danger or may petition the Court for an order as appropriate. During any stoppage of work under this section, the obligations of Defendant with respect to the work under this Decree which is ordered to be stopped shall be suspended and the time periods for performance of that work, as well as the time period for any other work dependent upon the work which is stopped, shall be extended, pursuant to Section XVI of this Decree, for such period of time as Ecology determines is reasonable under the circumstances.

ATTORNEY GENERAL OF WASHINGTON
ECOLOGY DIVISION
P.O. BOX 40117
Olympia, WA 98504-0117
Fax: (360) 438-7743 340-9599

In the event Defendant determines that activities undertaken in furtherance of this Decree or any other circumstances or activities are creating an endangerment to the people on the Site or in the surrounding area or to the environment, Defendant may stop implementation of this Decree for such period of time necessary for Ecology to evaluate the situation and determine whether Defendant should proceed with implementation of the Decree or whether the work stoppage should be continued until the danger is abated. Defendant shall notify Ecology's project coordinator as soon as possible, but no later than twenty-four (24) hours after such stoppage of work, and thereafter provide Ecology with documentation of the basis for the work stoppage. If Ecology disagrees with the Defendant's determination, it may order Defendant to resume implementation of this Decree. If Ecology concurs with the work stoppage, the Defendant's obligations shall be suspended and the time period for performance of that work, as well as the time period for any other work dependent upon the work which was stopped, shall be extended, pursuant to Section XVI of this Decree, for such period of time as Ecology determines is reasonable under the circumstances. Any disagreements arising under this clause shall be resolved through the dispute resolution procedures in Section XIV.

XVIII. COVENANT NOT TO SUE

A. In consideration of ARCO's compliance with the terms and conditions of this Decree, Ecology agrees that compliance with this Decree shall stand in lieu of any and all administrative, legal, and equitable remedies and enforcement actions available to Ecology against ARCO for the release or threatened release of hazardous substances covered by the terms of this Decree.

B. This covenant is strictly limited in its application to the Site specifically described in Exhibit A and to those hazardous substances that Ecology knows to be located at the Site as of the date of entry of this Decree. This covenant is not applicable to any other hazardous substance or area and Ecology retains all of its authority relative to such substances and areas.

C. In the following circumstances Ecology may exercise it full legal authority to address releases of hazardous substances at the Site notwithstanding the Covenant Not to Sue set forth above:

(1) If ARCO fails to comply with the terms and conditions of this Decree, including all exhibits, and, after written notice of noncompliance, fails to comply; or

ATTORNEY GENERAL OF WASHINGTON
ECOLOGY DIVISION
P.O. BOX 40117
Olympia, WA 98504-0117
Fax: (360) 438-7743 340-9599

(2) If factors not known at the time of entry of this Decree, including factors listed in WAC 173-340-420(2), are discovered and Ecology determines, in light of these factors, that further remedial action is necessary at the Site to protect human health or the environment; or

(3) If Ecology determines that conditions at the Site cause an endangerment to human health or the environment, and that actions beyond those required under this Decree are necessary.

(4) Subject to compliance with the contingency plan, if monitoring at the site establishes that contingency plan must be implemented, and further monitoring establishes that the remedy set forth in the contingency plan is insufficient to meet cleanup standards.

D. The Covenant Not to Sue set forth above shall have no applicability whatsoever to

(1) Criminal liability;

(2) Any Liability for damages to natural resources;

(3) Any Ecology action against potentially liable persons not a party to this Decree.

XIX. INDEMNIFICATION

Defendant agrees to indemnify and save and hold the State of Washington, its employees, and agents harmless from any and all claims or causes of action for death or injuries to persons or for loss or damage to property arising from or on account of acts or omissions of Defendant, its officers, employees, agents, or contractors in entering into and implementing this Decree. However, the Defendant shall not indemnify the State of Washington nor save nor hold its employees and agents harmless from any claims or causes of action arising out of the intentional misconduct or negligent acts or omissions of the State of Washington, or the employees or agents of the State, in implementing the activities pursuant to this Decree.

XX. COMPLIANCE WITH APPLICABLE LAWS

A. All actions carried out by Defendant pursuant to this Decree shall be done in accordance with all applicable federal, state, and local requirements, including requirements to obtain necessary permits, except as provided in paragraph B. of this section.

ATTORNEY GENERAL OF WASHINGTON
ECOLOGY DIVISION
P.O. BOX 40117
Olympia, WA 98504-0117
Fax: (360) 438-7743 340-9599

B. Pursuant to RCW 70.105D.090 (1), the substantive requirements of chapters 70.94, 70.95, 70.105, 75.20, 90.48, and 90.58 RCW and of any laws requiring or authorizing local government permits or approvals for the remedial action under this Decree that are known to be applicable at the time of entry of the Decree have been included in Exhibit B, the Cleanup Action Plan, and are binding and enforceable requirements of the Decree. Defendant has a continuing obligation to determine whether additional permits or approvals addressed in RCW 70.105D.090(l) would otherwise be required for the remedial action under this Decree. In the event either Defendant or Ecology determines that additional permits or approvals addressed in RCW 70.105D.090(l) would otherwise be required for the remedial action under this Decree, it shall promptly notify the other party of this determination. Ecology shall determine whether Ecology or Defendant shall be responsible to contact the appropriate state and/or local agencies. If Ecology so requires, Defendant shall promptly consult with the appropriate state and/or local agencies and provide Ecology with written documentation from those agencies of the substantive requirements those agencies believe are applicable to the remedial action. Ecology shall make the final determination on the additional substantive requirements that must be met by Defendant and on how Defendant must meet those requirements. Ecology shall inform Defendant in writing of these requirements. Once established by Ecology, the additional requirements shall be enforceable requirements of this Decree. Defendant shall not begin or continue the remedial action potentially subject to the additional requirements until Ecology makes its final determination.

Ecology shall ensure that notice and opportunity for comment is provided to the public and appropriate agencies prior to establishing the substantive requirements under this section. C. Pursuant to RCW 70.105D.090(2), in the event Ecology determines that the exemption from complying with the procedural requirements of the laws referenced in RCW 70.105D.090(l) would result in the loss of approval from a federal agency which is necessary for the State to administer any federal law, the exemption shall not apply and the Defendant shall comply with both the procedural and substantive requirements of the laws referenced in RCW 70.105D.090(l), including any requirements to obtain permits.

ATTORNEY GENERAL OF WASHINGTON
ECOLOGY DIVISION
P.O. BOX 40117
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D. In implementing this Decree for purposes such as sampling, it is contemplated that the Defendant may remove limited quantities of soil, groundwater, and other materials (collectively, "Materials") from real property within or adjacent to the Site. Any removal shall be done in compliance with all applicable laws as required by this Section XX. It is agreed that any disposition of the Material by the Defendant, including documents generated pursuant to such disposition shall not be deemed to be an admission by such party of liability for purposes of the Model Toxics Control Act.

XXI. REMEDIAL AND INVESTIGATIVE COSTS

A. The Defendant agrees to pay costs incurred by Ecology pursuant to this Decree which have not been previously paid. These costs shall include work performed by Ecology or its contractors for, or on, the Site under Ch. 70.105D RCW both prior to and subsequent to the issuance of this Decree for investigations, remedial actions, and Decree preparation, negotiations, oversight and administration. Ecology costs shall include costs of direct activities and support costs of direct activities as defined in WAC 173-340-550(2). The Defendant agrees to pay the required amount within ninety (90) days of receiving from Ecology an itemized statement of costs that includes a summary of costs incurred, an identification of involved staff, and the amount of time spent by involved staff members on the project. A general statement of work performed will be provided upon request and Defendant has submitted such a request to Ecology. Itemized statements shall be prepared quarterly. Failure to pay Ecology's costs within ninety (90) days of receipt of the itemized statement will result in interest charges at the rate of twelve percent per annum. Defendant reserves the right to review and approve any charges prior to payment. Any dispute regarding remedial and investigation costs for the Site shall be subject to dispute resolution pursuant to Section XIV. Defendant reserves the right to pay the undisputed portion of an invoice and not pay the disputed portion.

XXII. IMPLEMENTATION OF REMEDIAL ACTION

If Ecology determines that Defendant has failed without good cause to implement the remedial action, Ecology may, after notice to Defendant, perform any or all portions of the remedial

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action that remain incomplete. If Ecology performs all or portions of the remedial action because of the Defendant's failure to comply with its obligations under this Decree, Defendant shall reimburse Ecology for the costs of doing such work in accordance with Section XXI, provided that Defendant is not obligated under this section to reimburse Ecology for costs incurred for work inconsistent with or beyond the scope of this Decree.

XXIII. FIVE YEAR REVIEW

As remedial action, including groundwater monitoring, continues at the Site, the parties agree to review the progress of remedial action at the Site, and to review the data accumulated as a result of site monitoring as often as is necessary and appropriate under the circumstances or as agreed upon in the Compliance Groundwater Monitoring Program for the ARCO Site. The parties agree to meet to discuss the Site status every five years upon request from Ecology, or at Defendant's request. Ecology reserves the right to require further remedial action at the Site under appropriate circumstances. This provision shall remain in effect for the duration of the Decree.

XXIV. PUBLIC PARTICIPATION

Ecology shall maintain the responsibility for public participation at the Site. However, Defendant shall cooperate with Ecology and, if agreed to by Ecology, shall:

A. Prepare drafts of public notices and fact sheets at important stages of the remedial action, such as the submission of engineering design reports. Ecology will finalize (including editing if necessary) and after receiving and considering comments from the Defendant distribute such fact sheets and prepare and distribute public notices of Ecology's presentations and meetings;

B. Notify Ecology's project coordinator prior to the preparation of all press releases and fact sheets, and before major meetings with the interested public and local governments. Likewise, Ecology shall notify and consult with Defendant prior to the issuance of all press releases and fact sheets, and before major meetings with the interested public and local governments;

C. Participate in public presentations on the progress of the remedial action at the Site. Participation may be through attendance at public meetings to assist in answering questions, or as a presenter;

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D. Provide Ecology with copies of documents to be placed in information repositories to be located at the Seattle Public Library, Downtown Branch, Magazines, Newspapers and Government Publications Dept. 1000 4th Ave. Seattle, Washington 98104 and Ecology's Northwest Regional Office at 3190 160th Avenue SE, Bellevue, Washington 98008-5452. At a minimum, copies of all public notices, fact sheets, and press releases; all quality assured ground water, surface water, soil sediment, and air monitoring data; remedial actions plans, supplemental remedial planning documents, and all other similar documents relating to performance of the remedial action required by this Decree shall be promptly placed in these repositories.

XXV. DURATION OF DECREE

A. This Decree shall remain in effect and the remedial program described in the Decree shall be maintained and continued until the Defendant has received written notification from Ecology that the requirements of this Decree have been satisfactorily completed. Ecology shall issue such notification within sixty (60) days after the requirements of this Decree have been satisfactorily completed. Thereafter the parties within thirty (30) days shall jointly request that the Court vacate this Consent Decree.

B. Upon completion of each action specified in the Final CAP, Ecology shall issue a Certificate of Completion within sixty (60) days after such action has been completed.

XXVI. CLAIMS AGAINST THE STATE

Defendant hereby agrees that it will not seek to recover any costs incurred in implementing the remedial action required by this Decree from the State of Washington or any of its agencies; and further, that the Defendant will make no claim against the State Toxics Control Account or any Local Toxics Control Account for any costs incurred in implementing this Decree. Except as provided above, however, Defendant expressly reserves its right to seek to recover any costs incurred in implementing this Decree from any other potentially liable person.

XXVII. EFFECTIVE DATE

This Decree is effective upon the date it is entered by the Court.

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XXVIII. PUBLIC NOTICE AND WITHDRAWAL OF CONSENT

This Decree has been the subject of public notice and comment under RCW 70.105D.040(4)(a). As a result of this process, Ecology has found that this Decree will lead to a more expeditious cleanup of hazardous substances at the Site.

If the Court withholds or withdraws its consent to this Decree, it shall be null and void at the option of any party and the accompanying Complaint shall be dismissed without costs and without prejudice. In such an event, no party shall be bound by the requirements of this Decree.

XXIX. LAND USE RESTRICTIONS

ARCO agrees that the restrictive covenant, attached hereto as Exhibit D and by this reference incorporated herein, shall be recorded with the office of the King County Recorder within 10 days of the entry of this Decree and shall restrict future uses of the Site. With Ecology's prior written approval, and after completion of the remedial action required by this Decree, ARCO, or its successor(s), may record an instrument that provides that the restrictive covenant provided in Exhibit D shall no longer limit uses of the Site or be of any further force or effect. Prior to any approval, Ecology will seek public comment.

XXX CONTRIBUTION PROTECTION

A. By signing this Decree, the parties intend that Defendant will obtain the protection against claims for contribution to the fullest extent provided by any applicable law for matters addressed in this Decree and as is provided by MTCA, RCW 70.105D.040(d) (4).

XXXI. RESERVATION OF RIGHTS

By agreeing to this Decree, Defendant and Ecology agree to abide by its terms. The execution and performance of the Decree is not, however, an admission by Defendant of any fact or liability for any purpose other than as a foundation for the entry of this Decree. Defendant's performance under the Decree is undertaken without waiver of or prejudice to any claims or defenses whatsoever that ay be asserted in the event of further administrative proceedings or litigation not associated with, or related to, this Decree.

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Jim Pendowski

1/12/00

Jim Pendowski
Program Manager
Toxics Cleanup Program

Date

H. C. Winsor

December 1, 1999

H. C. Winsor
ARCO Products Company
Manager of Western Environmental Projects

Date

Thomas C Morrill

February 22, 2000

Tom Morrill WSBA#
Assistant Attorney General

Date

GRAHAM & DUNN

By: Frederick O. Frederickson

November 29, 1999

Frederick O. Frederickson
WSBA# 1856
Attorneys for ARCO

Date

DATED this________________day of____________________, 199_.

____
JUDGE

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______________ County Superior Court

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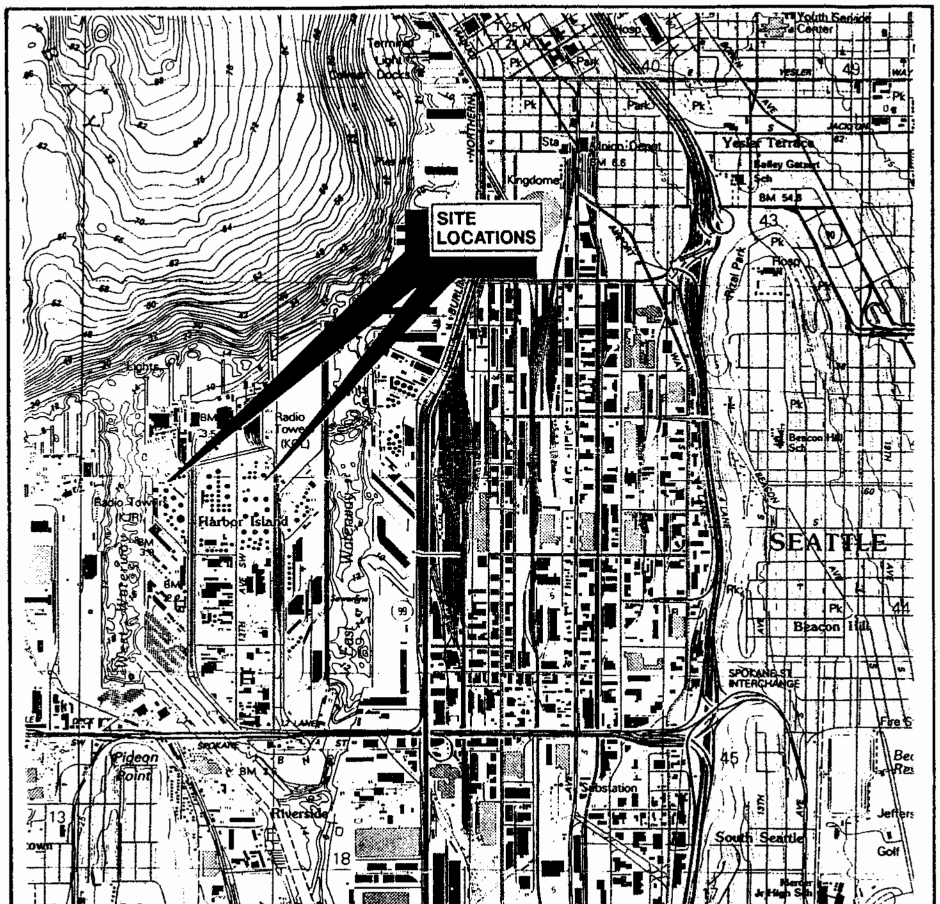
EXHIBIT A

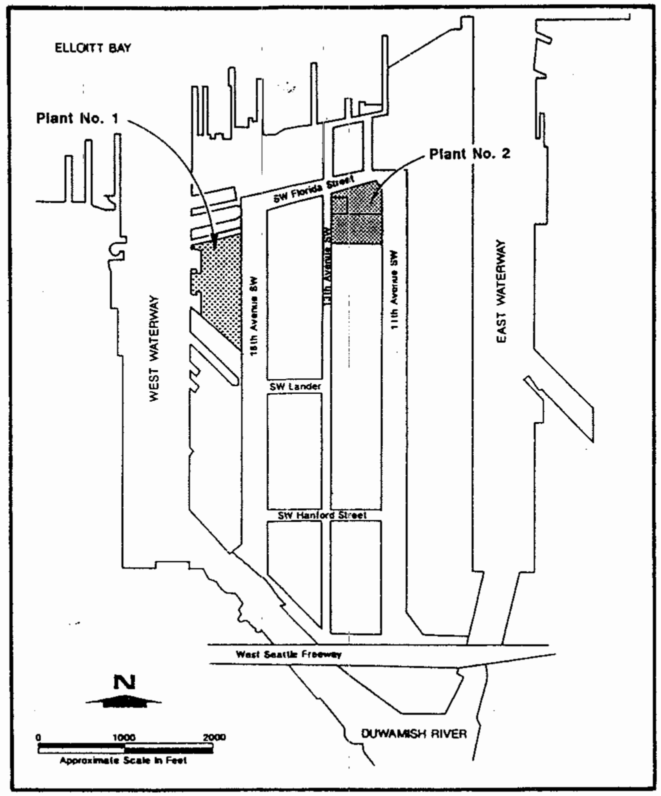
SITE DIAGRAM

163135

DRAFTER: SAC | APPROVED: LER | CHECKED: | DRAWING: | FILE NO.: | PRJCT NO.: WA0314.001 | DWG DATE: OCT 1995



SOURCE: USGS 7.5 x 15 Minute Topographic Map, SEATTLE SOUTH, WASHINGTON Quadrangle, Dated 1983.



0 .5 1 MILE

0 2000 4000 6000 FEET

N

QUADRANGLE LOCATION

GERAGHTY & MILLER, INC.
Environmental Services

SITE LOCATION MAP

ARCO Harbor Island Terminal 21T

1652 SW Lander Street

Seattle, Washington

FIGURE

1

EXHIBIT B
CLEANUP ACTION PLAN (CAP)

ARCO TERMINAL 21T

HARBOR ISLAND SITE - SEATTLE, WASHINGTON

ISSUED BY

WASHINGTON STATE DEPARTMENT OF ECOLOGY

NORTHWEST REGIONAL OFFICE, BELLEVUE

NOVEMBER 19, 1999

TABLE OF CONTENTS

EXHIBIT B
CLEANUP ACTION PLAN (CAP)

ARCO TERMINAL 21T
SEATTLE, WASHINGTON

November 19, 1999

1.0 INTRODUCTION

This Cleanup Action Plan (CAP) is provided to describe the proposed remediation at the ARCO Products Company (ARCO) Harbor Island Terminal 21T Plants 1 and 2 (Terminal 21T) in Seattle, Washington. It has been prepared to satisfy the requirements of the Model Toxics Control Act (MTCA) Agreed Order No. DE 92 TC-N-158, cooperatively entered into between ARCO and the Washington State Department of Ecology (Ecology).

The purposes of this CAP are to: 1) describe the site, including a summary of its history and extent of contamination; 2) identify the site-specific cleanup standards, 3) summarize the remedial cleanup action alternatives presented in the Focused Feasibility Studies (FFS); 4) identify and describe selected remedial action alternative for the site; and 5) discuss the implementation schedule. Detailed information regarding site history, characterization, and the evaluation of alternative cleanup actions is contained in the final RI and final FFS reports by Geraghty & Miller 1994, 1997.

The remedial actions selected for the site are to occur under the legal framework of a consent decree between ARCO and Ecology.

2.0 SUMMARY OF SITE CONDITIONS AND INTERIM REMEDIATION SYSTEM

This section provides a summary of site conditions, including the nature and extent of impacts and a description of the interim remediation system. In addition, the exposure pathways identified for the site are briefly described.

2.1 SITE CONDITIONS

The ARCO Harbor Island Terminal 21T consists of Plant 1 which is adjacent to the West Waterway of the Duwamish River, and Plant 2 which is located inland of the waterfront in the north-central part of Harbor Island (Figure 1). Groundwater flows in a radial pattern outward from the center of Harbor Island and enters the marine surface water at the Island's edge. The site is zoned industrial and meets the industrial criteria established under WAC 173-340-745. In addition, the site will likely remain an industrial facility in the foreseeable future because of the site zoning, and, perhaps more importantly, because of the substantial industrial improvements to Harbor Island (e.g., construction of cargo handling facilities and construction of major petroleum distribution pipelines for the Island). Ecology and EPA has determined that there is no current or planned future use of groundwater beneath Harbor Island for drinking water purposes but to protect the adjacent surface water and its ecosystem.

2.1.1 Nature and Extent

The following section summarizes the nature and extent of contamination at the site based on the results of the RI. A general discussion of the contaminants detected at the site is presented first. A summary of the free-phase product (product) plume beneath the warehouse next to the shoreline is presented next since this is the primary area of concern at the site. A summary of other localized areas of hydrocarbon-related impacts located inland from the warehouse area in Plants 1 and 2 is then presented as the secondary areas of concern at the site. This section is followed by a summary of minor impacts by metals in soil and groundwater at the site, and the results of surface water and marine sediment sampling.

The results of the site characterization activities conducted during the RI indicate that contaminants present in groundwater and soil at the site are primarily highly-weathered total petroleum hydrocarbons as diesel (TPH-D) with lesser amounts of weathered gasoline (TPH-G) and heavier oil (TPH-O), carcinogenic aromatic polynuclear hydrocarbons (cPAHs), and a few inorganic metals (copper and lead). The weathered TPH is most likely the result of historic spills at the site and there is no evidence of either recent or on-going releases. The inorganic metals are present at low concentrations at a few locations in groundwater and shallow soils, and are most likely due primarily to historic lead smelter activities. Other secondary sources including historical burial of tank bottom sludge, and shipbuilding activities conducted elsewhere on Harbor Island.

The results of the RI show that the primary area of impact at the site is the product plume located beneath the warehouse adjacent to the Duwamish River in Plant 1. The floating product is trapped behind the subsurface warehouse foundation and Island bulkhead that form a partial barrier to groundwater flow to the river. These structures act as a "hanging wall" which allows groundwater and possibly some dissolved petroleum hydrocarbons to flow beneath the foundation while trapping the floating product. The water table elevations fluctuate seasonally due to rainfall, and in response to tidal influence from the Duwamish River; however, the water table elevation does not drop below the base of the subsurface barriers.

Although the warehouse foundation and Island bulkhead retard the transport of floating product to the Duwamish River, a sheen occasionally appears on the Duwamish River and may be due to areas of discontinuity in the hanging wall (e.g., small cracks in the warehouse foundation or island bulkhead). The sheen is contained using sorbing booms except for the dissolved part of the petroleum hydrocarbons. In addition, an interim product recovery system has been in operation under the warehouse since 1992 (Figure 2). This system has been effective in removing product and reducing the frequency and extent of hydrocarbon sheen in the Duwamish River based on field observations since the system began operating.

Due to the dampening effect of the warehouse foundation and Island bulkhead on the shallow groundwater, water table fluctuations in response to tidal influence are only 1 to 2 feet near the Duwamish River. Seasonal fluctuations in water table elevations due to rainfall are similarly only 1 to 2 feet. The resulting “smear” zone of product in soil beneath the product plume is less than 4 feet thick. The extent of the smear zone was confirmed during the RI soil sampling activities. Elevated TPH concentrations in soil were detected below the water table but it is limited within the zone of tidal fluctuation and does not extend below the seasonal low-lower tide water table elevation.

The results of the RI also indicate that localized areas of soil with elevated concentrations of TPH are present within the tank farms of Plants 1 and 2 inland of the waterfront and warehouse area. These soils have been undergoing intrinsic bioremediation/natural attenuation and appear to be in equilibrium with groundwater at the site (i.e., the soils are not causing an increase in hydrocarbon concentrations in groundwater). Concentrations of TPH-G and TPH-D have been detected in groundwater above cleanup levels within or in close proximity to areas where the historical spills occurred. Groundwater monitoring results indicated no exceedance of the cleanup level for TPH-O. Benzene and cPAHs have also been detected within the groundwater plumes above cleanup levels. Concentrations of benzene exceeded the cleanup level in approximately 15 percent of the groundwater samples collected for five quarters of monitoring during the RI (the second, third, and fourth quarters of 1993 and the first and fourth quarters of 1996); concentrations of cPAHs exceeded the cleanup level in approximately 1 to 10 percent of the samples collected, depending on the cPAH analyzed.

The results of five quarters of monitoring data collected during the RI indicate that the dissolved-phase hydrocarbon plumes located in the tanks farms of Plant 1 and Plant 2 are stabilizing overall in extent and concentration due to on-going intrinsic bioremediation/natural attenuation.

Dissolved copper was the only metal detected in groundwater in Plant 1 and Plant 2 above cleanup levels during the five quarters of monitoring for the RI. Concentrations of dissolved copper exceeded the cleanup level in approximately 7 percent of the samples collected. Dissolved copper was also detected across much of the northern portion of Harbor Island during the USEPA RI, indicating elevated background concentrations. Copper was not detected in soils above the cleanup level. This inorganic metal is associated with marine paints used at shipbuilding and repair facilities adjacent to Plant 1 (Tetra Tech 1988).

Minor occurrences of lead and arsenic were identified in surface soil in Plant 1 above the cleanup levels. Lead concentrations above the cleanup level were detected in approximately 1 percent of the soil samples collected during the RI (only two surface samples) and arsenic concentrations above the cleanup level were detected in less than 1 percent of the soil samples collected (only one surface sample). Dissolved concentrations of lead and arsenic were not detected in groundwater above cleanup levels. Potential sources of arsenic include open-air shipbuilding and repair activities. The occurrence of lead is most likely associated with stack emissions from the former lead smelter.

The results of surface water sampling conducted during the RI detected petroleum hydrocarbon sheen on the surface water next to the site and some exceedances of surface water standards for cPAHs; however, the cPAH detection cannot be distinguished from other potential non-ARCO sources (e.g., nearby Harbor Island storm sewer out-falls, other up-river sources).

Based on the results of marine sediment sampling conducted at the site, exceedances did not meet the Sediment Standards Criteria to require active remediation. .

2.1.2 Exposure Pathways

The following pathways were evaluated at the site as part of the FFS (Geraghty & Miller 1997):

- Product to Groundwater, Surface Water and Air
- Soil to Groundwater
- Inland Soil to Groundwater to Surface Water
- Soil Particulate to Air
- Soil Direct Contact
- Groundwater to Marine Sediments

These exposure pathways for a cross section of the site are shown on Figure 3. (The location of the cross section is shown on Figure 4.) As described in the following sections, the primary exposure pathways of concern identified for the site are associated with the product plume in the warehouse area (Section 2.1.2.1). Offsite migration of dissolved petroleum hydrocarbons is a secondary concern of the site.

2.1.2.1 Product to Groundwater, Surface Water and Air

The three potential transport pathways associated with product plume beneath the warehouse include (1) migration of vapors beneath the warehouse and offices, (2) occasional product migration into the Duwamish River through discontinuities in the subsurface barriers, and (3) partitioning of hydrocarbons from the product or adjacent soil to the groundwater, and then subsequent transport in dissolved phase to the surface water through groundwater discharges.
These pathways associated with the product plume in the warehouse area are the primary pathways of concern at the site because they pose a direct threat to the surface water and its ecosystem at the shoreline. The selected cleanup action will interrupt these pathways by continuing the use of the existing bulkhead and remedial actions which will focus on removal of the product, dissolved petroleum hydrocarbons, and vapors as discussed in Section 4. These actions will be effective in meeting cleanup levels in groundwater at the point of compliance, providing protection to day workers at the warehouse from fumes and vapors, and preventing migration of product sheen and dissolved petroleum hydrocarbon plumes into the surface water adjacent to the ARCO site.

2.1.2.2 Soil to Groundwater Pathway

The results of five quarters of groundwater monitoring data and groundwater modeling conducted during the RI and FFS indicate that the soil to groundwater pathway for the inland sources appears to be complete and are stabilizing. The last recorded spill to inland soils took place over nine years ago. Groundwater monitoring data indicate that the dissolved plumes associated with these sources are stabilizing and appear to have reached equilibrium with the soils and that dissolved concentrations are generally decreasing. The soil to groundwater pathway inland of the ARCO site (portions of Plant 1 and in Plant 2 tank farms) does not pose a threat to the surface water at the shorelines based on the results of the fate and transport modeling and groundwater monitoring for the site. Therefore, offsite migration to adjacent properties is considered a secondary concern. Accessible TPH contaminated soil hot spots not located beneath the warehouse will be excavated to ensure that the dissolved petroleum hydrocarbon in groundwater emanating from these inland sources does not migrate off property boundaries, and to enhance timely restoration of the impacted areas through natural bioremediation. Monitoring wells will be located along the property boundaries as part of the Groundwater Compliance Monitoring Program to provide early warning of any pending off property migration. A detailed contingency plan is outlined in the compliance groundwater monitoring program for the site as a ‘backup’ remediation technology in case the preferred corrective option proves ineffective.

The soil to groundwater pathway was not considered in the fate and transport modeling for the areas located at the shoreline, under the warehouse, and the area next to the loading rack. Ecology recognizes the limited access to soils beneath the warehouse foundation. Therefore, the remedial alternatives selected for the inaccessible TPH contamination beneath the warehouse have been designed to treat the soils in-place and to take advantage of the hanging wall conditions along the waterfront that restrict the flow of product to the Duwamish River.

The selected remedy for groundwater at the warehouse area along the shoreline combines several remedial elements to meet the remedial action objectives of removing petroleum vapors, product and the dissolved petroleum hydrocarbons including residual hydrocarbons in soil hot spots beneath the warehouse. These elements include the following technologies: extraction monitoring wells with dual pump functions to remove product from the water table and the dissolved petroleum hydrocarbons from the subsurface, treatment of the extracted groundwater prior to discharge, soil vapor extraction, air sparging below the water table, and monitoring/institutional controls. These technologies will enhance and expedite the natural biodegradation of the TPH under the warehouse. Final configuration of this technology is based on a pilot test study completed in this area and will be implemented under the legal framework of the consent decree.

2.1.2.3 Inland Soil to Groundwater to Surface Water Pathway

The results of groundwater numerical and analytical modeling conducted during the FFS indicate that the dissolved-phase hydrocarbon plumes originating at some locations inland of the waterfront within the tank farm in Plant 1 will not reach the Duwamish River at concentrations above surface water cleanup levels but may exceed cleanup levels at property boundaries. The modeling results have been verified by the five quarters of groundwater monitoring data.

Accessible TPH soil hot spots at the inland locations of Plant 1 shall be excavated using the action levels of 10,000 mg/kg set by U.S. EPA ROD for the rest of the Island.

Accessible TPH soil hot spots at the inland locations of Plant 2, located at the middle of the island shall be excavated using action levels of 20,000 mg/kg. This is the EPA (A Guide to Corrective Action, EPA, May 1995) recommended lower threshold criteria to enable natural attenuation to successfully reduce total petroleum hydrocarbons concentrations to acceptable levels within a reasonable restoration time period (5 years).

The technologies proposed for the accessible inland TPH contaminated soil hot spots and the associated dissolved petroleum hydrocarbon in the groundwater will include soil excavation and on/off site treatment and disposal. This technology will improve groundwater quality at the site, enhance timely restoration of the impacted areas and expedite natural biodegradation of the residual TPH left in place.

2.1.2.4 Soil Particulate to Air Pathway

This pathway is not of concern with respect to TPH, since impacted soils are located within the subsurface (generally 1 to 2 feet below ground surface) for the areas of the tank farm covered with gravel. Other portions of the site are paved with asphalt. The above ground storage tanks and the tank farm walls also offer some protection from the wind. In addition, the hydrocarbons in soils at the site are very weathered, degraded, and mostly comprised of diesel and oil, not the volatile and more toxic compounds present in gasoline.

The remedy for surface soils inorganic constituents selected in the EPA ROD for Harbor Island requires 3 inches of asphalt cap at areas of the Island that exceeded 32.6 mg/kg arsenic, and 1000 mg/kg lead. EPA conducted surface soil investigations for the island including the ARCO site. Ecology and EPA agreed not to duplicate investigation efforts on the Island through a memorandum of agreement (MOA) except where data gaps exist. The results of the EPA RI surface soil investigations indicate that areas of the ARCO site covered with gravel are of limited concern because surface soil exceedances occurred in only two location points and will not require active remediation.

2.1.2.5 Soil Direct Contact Pathway

MTCA regulates points of compliance for human exposure through the direct contact pathway from approximately 0 to 15 feet below ground surface. However, petroleum hot spot excavation for the ARCO site, as outlined in this CAP, will occur from approximately 0 to 5 feet below ground surface, the maximum vertical extent of subsurface soil impact. This will remove the majority of the hot spot soil mass and will eliminate the direct contact pathway as a concern for the accessible impacted areas of the site. Certain inaccessible areas will be treated by the use of vapor extraction and air sparging technologies. Additional protection will be provided for both the accessible and inaccessible impacted areas through restrictive and deed covenants on the property and institutional controls.

2.1.2.6 Groundwater to Marine Sediments

This pathway is not a concern at this time since the results of the Supplemental RI marine sediment sampling conducted in the Duwamish River adjacent to the site did not indicate that impacts due to ARCO operations exceeded the Marine Sediment Cleanup Standards to require active remediation. However, due to the on-going discharges to the bay of petroleum hydrocarbon sheen next to the ARCO site, compliance standards will require evaluation of the sediment, biota, and the surface water next to the site as part of the attached Groundwater Compliance Monitoring and Contingency Program, Exhibit F, of the Consent Decree. This is to ensure that the preferred remedy for the site will provide continued protection to the bay as proposed in this CAP.

2.2 INTERIM REMEDIATION SYSTEM

An interim remediation system has been in operation at the site to remove floating product and associated hydrocarbon vapors from beneath the warehouse area. The interim remediation system consists of a combination of product recovery and soil vapor extraction (SVE) systems. The interim remedial system has been effective in recovering product from beneath the warehouse and reducing the frequency and extent of hydrocarbon sheen in the Duwamish River adjacent to the site. Over 11,700 gallons of product have been collected by the interim system to date. Each of the two elements of the interim system is further described below.

The product recovery system consists of two recovery wells, one located inside the warehouse (RW-1) and one located near the loading rack area (RW-4). Groundwater is pumped from these wells to enhance hydraulic capture of product. The extracted groundwater is treated using an airstripper, then discharged to the sanitary sewer system. Product is collected from these wells via two total fluids pneumatic pumps, and transferred to Tank 20 located in Plant 1 (Figure 2). The recovered product is disposed of/recycled by the terminal. Most of the product recovered to date has been from Recovery Well RW-1. The product thickness in RW-1 has been reduced from approximately 1 foot to approximately 0.01 foot since the system began operating.

The SVE element of the interim system extracts vapors from the vadose zone at five SVE wells located along the west Island bulkhead (wells SVE-1, SVE-2, SVE-3R, SVE-4, and SVE-5). The extracted vapors have been discharged through an exhaust stack to the atmosphere in compliance with the system Puget Sound Air Pollution Control Agency (PSAPCA) permit. During field tests of the SVE system, the radius of influence at each of the SVE wells was estimated to range from 43 to 100 feet (Geraghty & Miller 1994).

The air sparging element of the interim system has been installed, but has not been operated to date. The air sparging system will operate in conjunction with the SVE system. The air sparging system utilizes a compressor to deliver air into the subsurface below the water table to remove volatile hydrocarbons present from the groundwater, and to introduce oxygen to enhance in-situ biodegradation. Oil-free compressed air will be delivered below the groundwater level via Air Sparging Wells AS-1 and AS-2. These wells are located near the southern end of the warehouse where TPH concentrations of 16,000 milligrams per kilogram (mg/kg) were detected during the supplemental RI activities in the zone of tidal fluctuation below the water table. Hydrocarbon vapors will then be extracted from the overlying vadose zone via SVE Well SVE-5. The pilot test of the system was completed in January 1999. The results of this pilot test will support the design of the selected cleanup action discussed in Section 4.0. Construction details of this system will be outlined in a Remedial Design Report and will be implemented under the legal framework of the Consent Decree.

3.0 SUMMARY OF CLEANUP STANDARDS

The Model Toxics Control Act (MTCA) cleanup regulations provide that a cleanup action must comply with cleanup levels for selected hazardous substances, points of compliance (POCs), and applicable or relevant and appropriate state and federal laws (ARARs) (WAC 173-340-710). The final indicator hazardous substances identified for the site, the associated cleanup levels, and ARARs are briefly summarized in the following sections. POCs will be established within the product plume area and at the downgradient edge of the site or property boundary. POCs will be further defined during development of the compliance monitoring program as discussed in Section 4.3.

3.1 INDICATOR HAZARDOUS SUBSTANCES

Indicator hazardous substances (IHSs) were identified for the ARCO Terminal 21T site as part of the FFS using the criteria outlined in Washington Administrative Code (WAC) 173-340-708(2). The final list of IHSs for groundwater and soil are a subset of the contaminants detected at the site. The final soil IHSs are TPH-G, TPH-D, TPH-O, and free phase product. The final groundwater IHSs are dissolved copper, TPH-G, TPH-D, TPH-O, cPAHs, benzene, and free-phase product.

3.2 CLEANUP LEVELS

Groundwater and soil cleanup levels for the final IHSs were developed based on the industrial zoning of the site and the determination by Ecology that there is no current or planned future use of the groundwater for drinking water purposes. The remedial objectives for groundwater at the site are based on the protection of the adjacent surface waters and its ecosystems and to prevent dissolved petroleum hydrocarbons in the groundwater from migrating off site and impacting adjacent properties.

The subsurface soil action level for TPH at the primary areas of concern (Plant 1) of the site is set to meet the remedial objective of protecting surface water at the property boundaries and shorelines and is:

Total TPH	10,000 mg/kg

This TPH cleanup is also protective for other chemical constituents in petroleum product (i.e., BTEX).

The subsurface soil action level for TPH at the secondary areas of concern (Plant 2) of the site is set to meet the remedial objective of protecting surface water at the property boundaries by improving general groundwater conditions at the source, enhancing timely restoration of the impacted area through natural biodegradation, and is:

Total TPH	20,000 mg/kg

Groundwater cleanup levels were determined by Ecology to be surface water standards that are protective of aquatic organisms in the Duwamish River. These surface water standards are the adopted ambient water quality criteria (WAC 173-201A and Section 304 of the federal Clean Water Act). The category of ambient water quality standards selected as relevant and appropriate for the site are the chronic criteria for protection of aquatic organisms (WAC 173-201A-040). Surface water standards are not established for TPH; therefore, the groundwater cleanup levels for TPH-G, TPH-D, and TPH-O were selected as protective cleanup goals at this time. The following are the cleanup levels for the site groundwater:

Product	No Sheen
Benzene	0.071 mg/L
cPAHs	0.000031 mg/L
Copper	0.0029 mg/L
TPH-G	1.0 mg/L
TPH-D	10 mg/L
TPH-O	10 mg/L

Copper is attributable to off-site sources and is found throughout the groundwater beneath Harbor Island.

3.3 ARARS

The selected cleanup action will comply with federal, state and local ARARs. Applicable requirements are federal and state laws or regulations that legally apply to a hazardous substance, cleanup action, location, or other circumstance at the site. Relevant and appropriate requirements are those federal and state regulations that do not legally apply, but address situations sufficiently similar that they may warrant application to the cleanup action. Potential ARARs pertinent to remediation alternatives include substantive requirements of Chapters 70.94, 70.95, 70.105, 75.20, 90.48, and 90.58 RCW. Others are identified and defined in the FFS (Geraghty & Miller 1997) and they include the Model Toxics Control Act (WAC 173-340), the Washington State Dangerous Waste Regulations (WAC 173-303), Washington State Water Quality Standards for

Surface Water (WAC 173-201A), and laws requiring or authorizing local government permits or approvals for the remedial action implementation.

4.0 SUMMARY OF SELECTED CLEANUP ACTION

Site-specific cleanup action alternatives were developed and analyzed for groundwater and soil in the FFS (Volume II: Evaluation of Remedial Alternatives, Geraghty & Miller 1997), to ensure the protection of human health and the environment at the site.

Based on this initial screening and evaluation of supplemental data collected during the FFS, the following four alternatives were selected for further evaluation:

GW-1: Institutional Controls and Intrinsic Bioremediation/Natural Attenuation of Free-Phase Product (Product)

- Use Restrictions on Groundwater
- Intrinsic Bioremediation/Natural Attenuation of Product

S-1: Institutional Controls and Degradation of Organic Contaminants by Intrinsic Bioremediation/Natural Attenuation

- Deed Restrictions
- Degradation by Intrinsic Bioremediation/Natural Attenuation

GW-2: Pump and Treat for Product Plume Containment

- Use Restrictions on Groundwater
- Installation of Extraction Wells for Product Recovery
- Groundwater Treatment by Air Stripping and Optional Carbon Adsorption
- Effluent Discharge to POTW

S-2: Limited Excavation, Off-Site Treatment and Disposal, Limited In Situ Treatment, Gravel Cover

- Excavation of Accessible TPH Hot Spot Soils
- Off-Site Treatment - Low Temperature Thermal Desorption (LTTD) and/or Stabilization as Required
- Off-Site Disposal
- In-Situ Treatment of Inaccessible Soils - Biological and Vapor Extraction
- Gravel Cap

GW-3: Product Recovery (Skimming)

- Use Restrictions on Groundwater

- Installation of Recovery Wells within the Product Plume (without Groundwater Extraction)
- Disposal of Recovered Product

S-3: Limited Excavation, On Site Treatment and Disposal, Limited In Situ Treatment, Gravel Cover

- Excavation of Accessible TPH Hot Spot Soils
- On-Site Treatment - LTTD and/or Stabilization as Required
- On-Site Disposal of Treated Soil into Excavation
- In-Situ Treatment of Inaccessible Soils - Biological and Vapor Extraction
- Gravel Cover

GW-4: Pump and Treat for Product Plume and Dissolved Petroleum Hydrocarbon Containment, and Air Sparging and Vapor Extraction for Accelerated Mass Removal

- Use Restrictions on Groundwater
- Installation of Extraction Wells with Dual Functions for Product Recovery and Dissolved Petroleum Hydrocarbons
- Treatment by Air Stripping and Optional Carbon Adsorption
- Groundwater Treatment before Effluent Discharge to POTW
- Installation of Sparging and Vapor Extraction Wells to Accelerate Mass Removal

S-4: In-Situ Treatment and Gravel Capping

- In-Situ Treatment of Soils - Biological and Vapor Extraction
- Maintain Existing Warehouse Foundation Cap
- Restriction and Deed Restriction

4.1 Proposed Cleanup Alternatives

The proposed cleanup action for the site was selected based on a comparison of each cleanup action alternative with the following detailed MTCA evaluation criteria (WAC 173-340-360(2) and (3)), consideration of the MTCA remedy selection requirements and cleanup costs:

- Protection of Human Health and the Environment
- Compliance with Cleanup Standards
- Use of Permanent Solutions to the Maximum Extent Practicable
- Compliance with ARARs
- Provision for Compliance Monitoring
- Provision for Reasonable Restoration Time Frame

The following sections present a conceptual description of each element of the proposed cleanup action selected for the site. Detail descriptions with engineering drawings, specifications and justification will be presented in the Remedial Design phase for the site.

THE SELECTED REMEDIAL ALTERNATIVE (GW- 4, S-1, and S-2)

Remedial Alternative GW-4, one of the proposed alternatives in this CAP includes pump and treat for product plume and dissolved petroleum hydrocarbon recovery, air sparging and vapor extraction for accelerated mass removal of residual hydrocarbons in soil beneath the warehouse, maintaining the foundation cap for the warehouse, groundwater compliance monitoring, deed restrictions, institutional controls, and natural attenuation. The major features of this proposed cleanup alternative are presented on Figures 5 and 6. Given the limited access to the contaminated areas of primary concern beneath the warehouse building foundations of the ARCO site, this proposed cleanup action provides the most aggressive means of removing product, dissolved petroleum hydrocarbons, and residual TPH in the soil below the water table present in the warehouse area adjacent to the Duwamish River in comparison with the other cleanup actions evaluated.

A conceptual description of each element of this alternative and how it will be implemented at the site is presented below. Detailed descriptions with engineering drawings and justifications will be presented in the Remedial Design phase for the site:

Active Product Recovery. The focus of the remedial alternative includes the area beneath the warehouse and the areas immediately south, northeast, and north of the warehouse where free product is currently or has historically been detected in the subsurface. The estimated volume of the free product under the warehouse is approximately 14,000 gallons including 11,700 gallons recovered to date. As discussed in Section 2.1.2.1, hydrocarbon impact in the warehouse area along the waterfront provides the primary complete pathway for the IHSs to reach the Duwamish River (i.e., product migration and residual hydrocarbon migration from soil to groundwater and potentially to surface water). The cleanup action developed for groundwater at the ARCO Terminal is focused on removing product and the dissolved petroleum hydrocarbons from beneath the warehouse area along the waterfront and containing inland dissolved petroleum hydrocarbons within property boundaries. The cleanup action also includes remedial elements for mitigating residual hydrocarbons in soil from above and below the water table, which are associated with the product plume. The product plume and associated residual hydrocarbons in soil are potential on-going sources to the groundwater in this area and ultimately to the Duwamish River.

Pilot testing, as described below, was completed in January 1999. It provided additional information to evaluate the effectiveness and applicability of these elements for achieving the remedial objectives of removing free product and the dissolved petroleum hydrocarbons from the warehouse area along the waterfront. The results of the pilot testing will then be used to support the final design and configuration of the selected remedy (e.g., the final combination of remedial elements, number of wells, well spacing, etc.). The proposed conceptual remedy configuration that incorporates these technologies is depicted on Figures 5 and 6. A final remedy configuration will be presented in the Remedial Design for the site with complete engineering drawings, specifications, and justifications. The proposed expanded system has been conceptually designed to take advantage of the hanging wall conditions along the waterfront (comprised of the existing warehouse foundation and Island bulkhead) that restrict the flow of product to the Duwamish River (Figure 3).

A pilot test was conducted by installing a pumping well near the truck loading rack to determine if expansion of the current interim product recovery system is necessary to achieve the remedial objectives for product removal and dissolved petroleum hydrocarbon recovery. The data collected from the pilot test will then be used to support the design of the final groundwater treatment system in the Remedial Design phase.

Groundwater Treatment. Groundwater extraction will be used as part of the product skimming system to depress the water table and accelerate product movement toward the extraction wells (Figure 5). During this active product recovery, petroleum hydrocarbons dissolved in groundwater are usually recovered. The recovered groundwater will continue to be treated by air stripping to meet discharge limits prior to disposal.

Air Sparging & Natural Biodegradation of Residual TPH in the Subsurface Soil at the Shoreline. Pilot testing was conducted to determine the effectiveness of using air sparging technology for removing product from soil above and below the water table along the waterfront beneath the warehouse area. The air sparging pilot test was implemented immediately south of the warehouse to affect soils containing product in the zone of tidal fluctuation. The injection of air below the water level and into hydrocarbon-impacted soils accelerates the mobilization and recovery of the residual hydrocarbons. Results of a focused treatability studies conducted during the FFS shows the area beneath the warehouse to be deficient of oxygen necessary to support effective natural biodegradation of the petroleum hydrocarbons trapped along the shoreline. Therefore, the injection of air will elevate the oxygen levels (in this instance dissolved oxygen) and will improve conditions for aerobic hydrocarbon degradation within the saturated zone. Additionally, the air sparging reduces dissolved-phase hydrocarbon concentrations as the volatile constituents are stripped from the groundwater and captured by the SVE system described below. The pilot test results will be used to support the final design of a full-scale system for the warehouse area to meet the remedial objectives outlined in this CAP.

Soil Vapor Extraction (SVE) and Natural Biodegradation. The proposed cleanup action has been designed to continue operation of a soil vapor extraction (SVE) system installed as part of the interim remediation system to remove volatile hydrocarbons from the vadose zone beneath the warehouse next to the shoreline. Operation of the SVE system will continue to extract the volatile fraction of hydrocarbons present in the warehouse area (ensuring that the soil vapor to air pathway in the area of the product plume is interrupted). The SVE system will also maintain elevated oxygen concentrations within the vadose zone. Operation of the SVE and other technology based applications and systems in this CAP will be discontinued through performance, cleanup and technology standards evaluations as part of the Compliance Monitoring Program developed for the site. Details of the criteria and frequency for such evaluations for discontinuing the SVE and other technology based applications and systems for the site is developed as part of the attached compliance monitoring program, Exhibit F, for the ARCO site.

Product Monitoring. Throughout the site, including the inland areas, free product shall be removed from the water table to the extent practicable whenever present. Selected wells will be evaluated in the compliance groundwater monitoring program to monitor for product thickness as part of the performance standard evaluation. The containment booms located in the Duwamish River adjacent to the site provide protection to contain petroleum hydrocarbons as a result of the sheen that reached the Duwamish River. The containment booms will be maintained as part of the compliance and performance monitoring program (Exhibit F).

Remedial Alternative S-1 is the second preferred alternative in this CAP to address the warehouse and inland inaccessible TPH soil hot spots. Institutional controls and degradation of organic contaminants by intrinsic bioremediation/natural attenuation, has been selected for inaccessible soils beneath the warehouse area and inland of the warehouse area for Plant 1 and for Plant 2 to ensure protection of the human health and the environment. This remedy is expected to be accelerated following implementation of the warehouse preferred remedy discussed above and the removal of the accessible TPH hot spot soils in Plants 1 and 2 as discussed below. A deed restriction will also be implemented to prevent inappropriate future use of the site.

Remedial Alternative S-2, is the third preferred alternative in this CAP, and addresses the inland accessible TPH soil hot spots. Remedial Alternative S-2 includes excavation of accessible TPH contaminated soil hot spots at the inland portions of Plant 1 and Plant 2. This will ensure that the primary and secondary concerns identified in this CAP are met.

Locations of Accessible Soil for Excavation and Approximate Volumes. The accessible TPH hot spot in Plant 1 will be excavated using the TPH action level of 10,000 mg/kg. The TPH hot spot in Plant 1 is located southeast of the site between the aboveground storage tanks 1, 8, 9, and 13 and are in the vicinity of soil borings B-17, B-20, B-21, B-23, TS-25, TS-26, TS-27, TS-36, TS-37, TS-39, TS-40, TS-40, TS-41 and TS-42. The total volume of this TPH hot spot is approximately 1100 cubic yards. The area is generally depicted in Figure 7. It is Ecology's expectation that this accessible TPH soil hot spot will be excavated without undermining the integrity of the aboveground storage tanks next to the hot spots.

There are two accessible TPH hot spot areas in Plant 2 that will require excavation using the TPH action level of 20,000 mg/kg. The first TPH hot spot is located in the northeast corner of the site at soil boring TS-1. The total volume of this TPH hot spot is approximately 5 cubic yards. The second TPH hot spot is located south and southeast of the site between the above storage tanks no. 59001 and 20001 and are in the vicinity of soil borings B-36, B-37, TS-12, TS-14, TS-15, TS-17, TS-19, TS-31, TS-32, TS-34 and TS-35. The area is generally depicted in Figure 8. The total volume of this TPH hot spot is approximately 600 cubic yards. It is Ecology's expectation that these accessible TPH soil hot spots will be excavated without undermining the integrity of the aboveground storage tanks next to the hot spot.

The excavated TPH soil hot spots in Plants 1 and 2 will be treated on/off site and disposed on/off site. Excavation of the accessible TPH soil hot spots will improve general groundwater conditions at the source, enhance restoration time for the impacted areas, and enhance bioremediation of the residual TPH contaminated soil left in place. In addition, the groundwater monitoring program will be implemented to monitor the ongoing intrinsic degradation/natural attenuation of the residual TPH in soils as part of the selected cleanup action. A deed restriction will also be implemented to prevent inappropriate future use of the site. The total estimated costs for the selected remedies for soils and groundwater including costs to date is approximately $7.8 million.

4.2 Contingency Plans.

A contingency plan is a cleanup technology that serves as a "backup" remediation technology in the event that the Preferred Option fails or proves ineffective in a timely manner (5 years). The contingency plan and implementation criteria is included in the Compliance Monitoring Plan (Exhibit F of the Consent Decree) and summarized below.

Inland Groundwater Contingency Plan for Property Boundary Shall Include:

- Use migration control technology
- Enhance the chances of bioremediation by added nutrients as appropriate

Shoreline Contingency Plan Shall Include:

- Expand hydraulic control to ensure removal of free product from the water table
- Sediment and bioassay sampling as determined necessary through the groundwater compliance monitoring program

This contingency plan is outlined in detail in the Groundwater Monitoring Program, Exhibit F, of the Consent Decree.

4.3 Other Controls

Access Restrictions. The site is an active operating facility and has restricted access (fences, signs, work permit requirements) as part of standard operations. These restrictions are in place 24 hours/day and 7 days/week. The Access and Operating Procedures for the ARCO site is contained in Exhibit C of the Consent Decree.

Deed Restrictions. Institutional controls are measures undertaken to limit or prohibit activities that may interfere with the integrity of a cleanup action or result in exposure to hazardous substances at the site. Such measures are required to assure continued protection of human health and the environment when a cleanup action results in residual concentrations of IHS that exceed MTCA Methods A or B cleanup levels and where conditional points of compliance are established.

The site is currently an "industrial" site and is anticipated to be zoned and used as an industrial site in the foreseeable future. The proposed cleanup action for the site includes the implementation and maintenance of institutional controls to prevent future human exposure to the constituents present in the soil (including vapors) and groundwater beneath the Terminal. ARCO will add a restrictive covenant to the property to restrict the property use to industrial purposes or interfering with remedial actions implemented in this CAP. A copy of the Restrictive Covenant for the ARCO site is contained in Exhibit D of the Consent Decree.

Work Construction. Schedule to begin work under this proposed CAP and other construction activities for the Remedial Design are contained in Exhibit E of the Consent Decree. Work construction at the ARCO site will be conducted under a Safety and Health Plan prepared under WAC 173-340-810.

4.4 Groundwater Compliance Monitoring.

The attached groundwater compliance monitoring plan, Exhibit F, is consistent with WAC 173-340-410, and includes protection monitoring, performance monitoring, and confirmational monitoring. The three types of compliance monitoring to be conducted include the following:

- **Protection Monitoring** to confirm that human health and the environment are adequately protected during construction and the operation and maintenance period of the cleanup action.
- **Performance Monitoring** to confirm that the cleanup action has attained cleanup standards and other performance standards.
- **Confirmational Monitoring** to confirm the long-term effectiveness of the cleanup action once cleanup actions and other performance standards have been attained.

Points of Compliance: Soil. The determination of adequate soil treatment will be based on the remedial actions ability to comply with the groundwater cleanup standards for the site, to meet performance standards designed to minimize human health or environmental exposure to soils above cleanup levels, and to provide practicable treatment of contaminated soils. Performance standards designed to minimize human and environmental exposure to soils above the cleanup levels set for the site shall include: 1) Performance monitoring as outlined in the Groundwater Monitoring Program for the site and 2) a covenant on the property which limits the site to industrial use only and prohibits any activity which may interfere with the protectiveness of the remedial action.

Groundwater. The achievement of cleanup levels in groundwater shall be measured at points of compliance located within the product plume area and at the downgradient edge of the site. These points of compliance and performance shall consist of a network of monitoring wells located in the product plume area and on the downgradient property boundary. The exact location of these wells are identified in the attached Groundwater Compliance Monitoring Program, Exhibit F of the Consent Decree .

Product Monitoring. Throughout the site, including the inland areas, free product shall be removed from the water table to the extent practicable whenever present. Product occurrence or, if appropriate, product thickness, will be monitored at the inland and shoreline locations of the site as outlined in the groundwater monitoring program. Use of source identification and removal shall be used as needed to ensure that dissolved petroleum hydrocarbons associated with the free product do not adversely impact off site properties. The duration of the product monitoring will be based on the performance and cleanup standards outlined in the attached Groundwater Compliance Monitoring Plan, Exhibit F, for the site.

5.0 JUSTIFICATION FOR THE SELECTED CLEANUP ACTION

The cleanup action, as proposed, is designed to accomplish the following requirements: protect human health and the environment, comply with cleanup standards per WAC 173-340-700, comply with applicable state and federal laws per WAC 173-340-710, provide compliance monitoring per WAC 173-340-410, use permanent solutions to the maximum extent practicable per WAC 173-340-360 (2), (3), (4), (5), (7), and (8), provide a reasonable time restoration per WAC 173-340-360 (6), and consider public concerns per WAC 173-340-600. The following sections discusses how the proposed cleanup action will meet these requirements.

Protection of Human Health and the Environment

Active product recovery at the shoreline will prevent free-phase migration of contamination into the Bay. Active groundwater treatment will capture and prevent the spread of dissolved petroleum hydrocarbons from migration into the Bay and expedite groundwater quality restoration. The air sparging technology will reduce dissolved-phase hydrocarbon concentrations below the water table as the volatile constituents are stripped from the groundwater and captured by the soil vapor extraction (SVE) system. The SVE system installed as part of the interim remediation system will continue to remove volatile hydrocarbons from the vadose zone beneath the warehouse next to the shoreline. Operation of the SVE system will continue to extract the available volatile fraction of hydrocarbons present in the warehouse area (ensuring that the soil vapor to air pathway in the area of the product plume is interrupted). The SVE system will also maintain elevated oxygen concentrations within the vadose zone and this will improve the general conditions for natural attenuation at the warehouse. Excavation of accessible inland petroleum hydrocarbon contaminated soil hot spots will improve general groundwater conditions at the source, enhance restoration time frame, and expedite natural biodegradation of the residual TPH contaminated soils left behind. Contingency plans coupled with monitoring wells by the shoreline and the property boundaries will provide additional protection by providing a means for a ‘backup’ remediation technology in case the Preferred Corrective Option proves ineffective.

Comply with Cleanup Standards per WAC 173-340 through 760

The overall goal of cleaning up groundwater for the protection of surface water quality and containing contaminated groundwater within property limits will be met. The goal of soil cleanup standards and action levels for petroleum hydrocarbons is to protect the beneficial use of groundwater (surface water quality and associated ecosystem) and to contain residual contamination within property boundaries. The selected remedy that includes air sparging to strip volatile petroleum hydrocarbons trapped in the residual soil from below the water table and active vapor extraction to capture the vapor phase interrupting the groundwater to soil to air pathways, and active product and dissolved petroleum hydrocarbons recovery from the smear zone and below, will result in substantive compliance with the soil cleanup standards by reducing concentrations of contaminants in soils to levels that will support and maintain the attainment of groundwater quality standards under the warehouse. Excavation of accessible inland TPH soil hot spots will help improve the general groundwater quality at the TPH soil hot spots that act as sources of ongoing groundwater contamination, enhance groundwater quality restoration time frame, and expedite natural bioremediation of the residuals TPH left behind.

Use of Permanent Solutions to the Maximum Extent Practicable per WAC 173-340-360 (4), (5), (7), and (8).

Excavation of accessible TPH soil hot spots and treatment, product recovery, groundwater treatment, and petroleum vapor recovery are permanent treatment technologies that will effectively improve groundwater quality permanently and in a timely restoration time frame.

Compliance with Applicable State and Federal Laws per WAC 173-340-710.

The preferred alternative meets all state and federal laws. All activities carried out to implement the preferred alternative will meet any laws requiring or authorizing local government permits or approval for the remedial action on the site.

Provide Compliance Monitoring per WAC 173-340-410

The preferred alternative provides for long-term monitoring to ensure that groundwater continues to meet cleanup standards after remedial actions have been completed. During the remedial actions, performance monitoring will be conducted to confirm that cleanup actions have attained cleanup standards and treatment goals. After remedial actions, performance monitoring will be conducted to ensure and confirm that cleanup actions have attained cleanup standards and performance standards. Protection monitoring will be used to ensure that human health and the environment are being adequately protected during construction and operation of the cleanup actions. The specifics and details of these monitoring activities, locations, number and type of analytes, frequency, duration, and contingency plans are described in the attached Compliance Groundwater Monitoring Plan, Exhibit F, developed for the site. Schedule for this activity is contained in Exhibit E of the Consent Decree.

Provide for a Reasonable Restoration Time Frame per WAC 173-340-360 (6).

Natural attenuation with active excavation of accessible TPH soil hot spots (e.g., source control) will provide for a reasonable restoration time frame of 5 years for the site groundwater that is protective of the surface water and its ecosystem (primary concern) and protect adjacent properties (secondary concern).

In view of subsurface TPH soil hot spots that generate dissolved petroleum hydrocarbons in the groundwater above cleanup standards, Ecology believes that natural attenuation alone will not be sufficient to provide a reasonable restoration time frame for the site.

The projected 5-year restoration time frame is reasonable, and will allow for a meaningful statistical evaluation of compliance monitoring data and constitutes that time after the active

Preferred Options have been implemented. For the shoreline (beneath the warehouse), restoration time begins after free product is removed from the water table. The time projected for the free product removal under the warehouse is 18 months after installation and startup of the preferred option at the shoreline. If Contingency implementation for the shoreline is needed as a result of the groundwater compliance monitoring or other performance standards, restoration time begins immediately after contingency implementation activity.

Where contingency plan implementation is not necessary, restoration time for the site is 5 years and the restoration clock begins 30 days after implementation of the Preferred Corrective Option for the site. This is the time required to reduce residual TPH in the subsurface to reasonable levels and groundwater quality below state standards and to collect meaningful statistical data to evaluate groundwater compliance data.

Other specific time lines are outlined in Exhibit E, Schedule of Deliverables, and are detailed in the attached Compliance Groundwater Monitoring Program, Exhibit F, for the ARCO Site.

Consider Public Concerns per WAC 173-340-600

The public is given the opportunity to comment on this Final CAP during a 30-day public comment period. This review will include the following additional documents: Consent Decree, Restrictive Covenants, Project Schedule, and Groundwater Compliance and Contingency Program. The Remedial Design (RD) will be subject to a separate pubic comment period in the future. Ecology will consider all comments received. At the end of the comment period, Ecology will prepare a responsiveness summary listing each comment received and Ecology's response to the comment.

6.0 IMPLEMENTATION SCHEDULE

Exhibit E of the Consent Decree contains an outline of the schedule for the cleanup activities. The Consent Decree will become effective once signed by the Court. As outlined in the schedule, specifics on detailed analysis may be needed to complete the remedial design. Ecology has review and approval authority for these documents and the public has an opportunity to participate in each milestone through the 30-day public comment period.

7.0 REFERENCES

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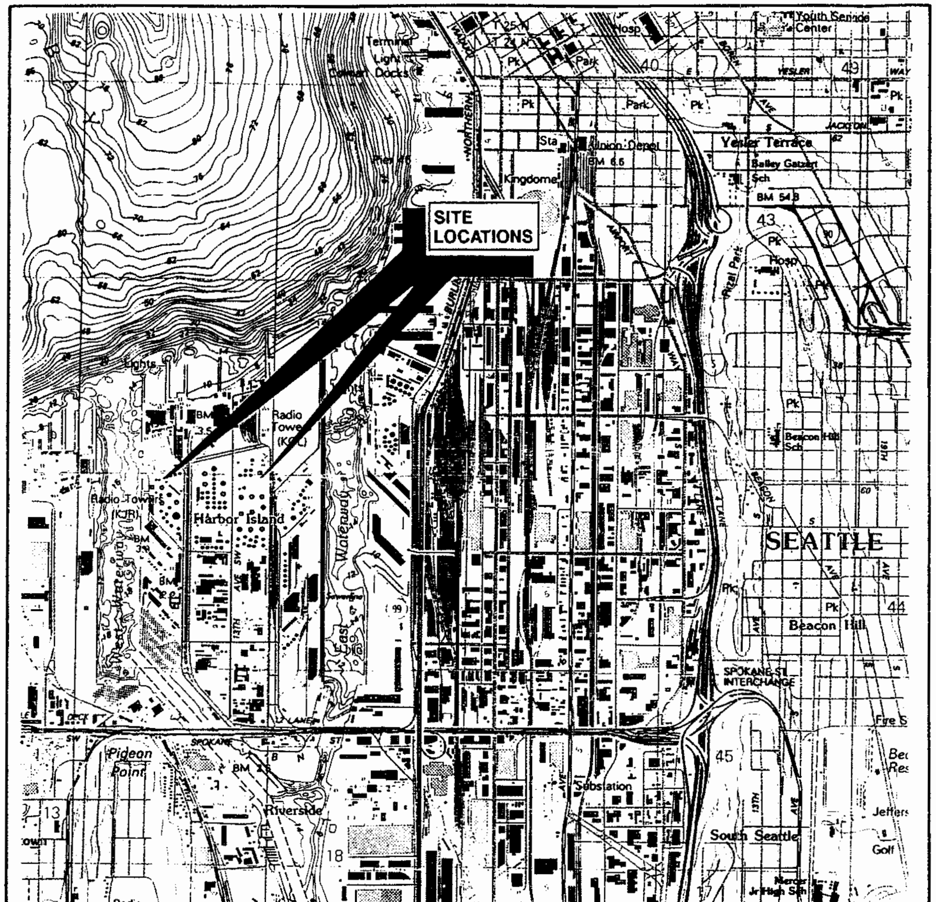
FIGURES



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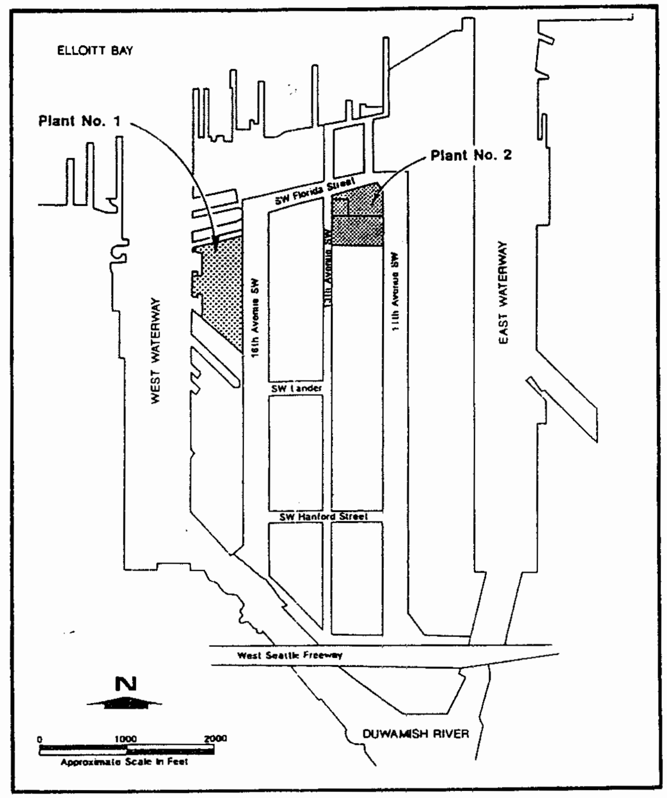
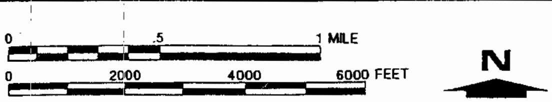




QUADRANGLE LOCATION

GERAGHTY & MILLER, INC.
Environmental Services

SITE LOCATION MAP

ARCO Harbor Island Terminal 21T

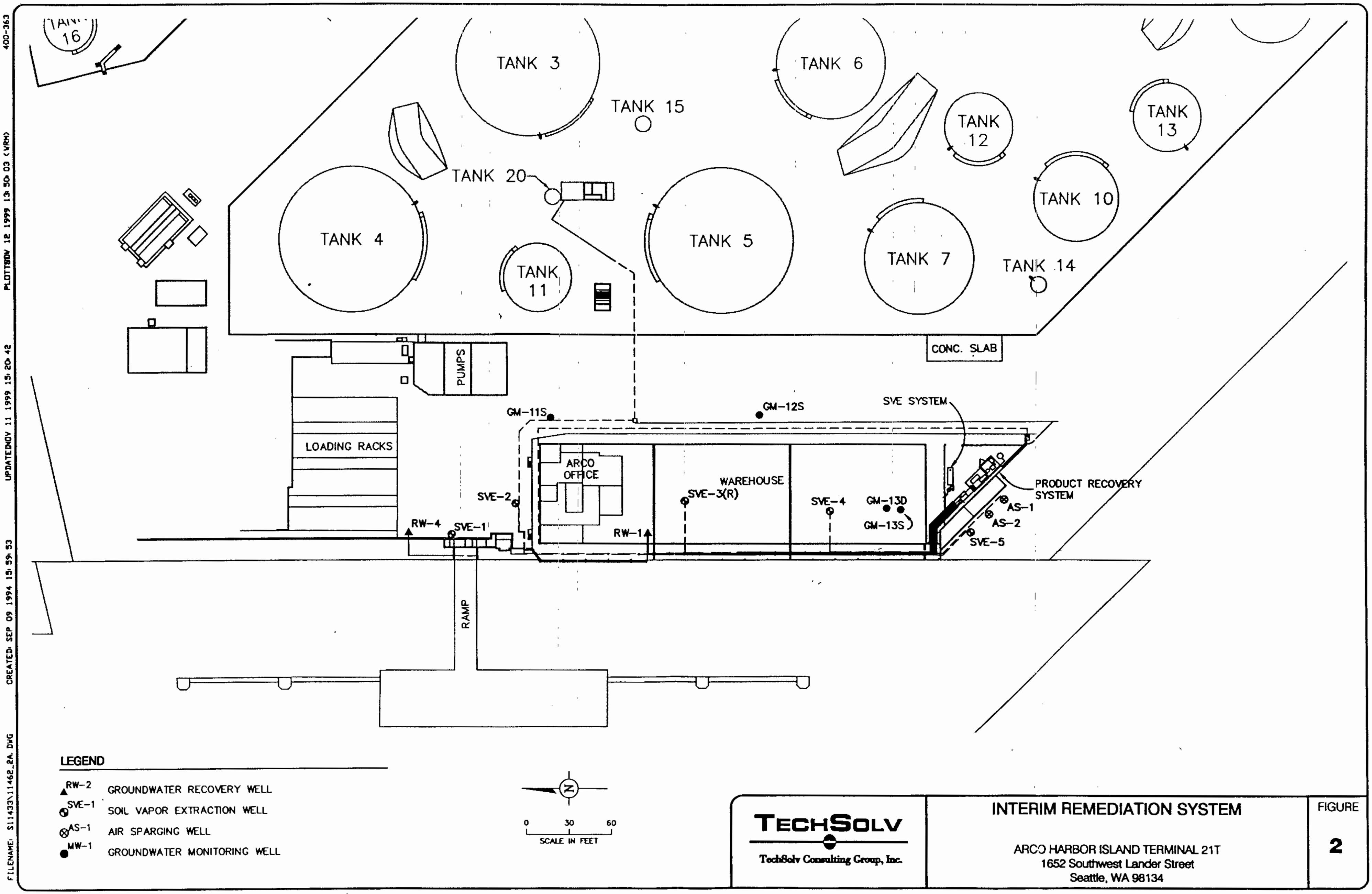
1652 SW Lander Street

Seattle, Washington

FIGURE

1

DWG DATE: OCT 1995 | PRJCT NO.: WA0314.001 | FILE NO.: | DRAWING: | CHECKED: | APPROVED: LER | DRAFTER: SAC



TANK 16
TANK 3
TANK 6
TANK 15
TANK 12
TANK 13
TANK 20
TANK 10
TANK 4
TANK 5
TANK 7
TANK 14
TANK 11
CONC. SLAB
PUMPS
LOADING RACKS
GM-11S
GM-12S
SVE SYSTEM
ARCO OFFICE
WAREHOUSE
SVE-2
SVE-3(R)
SVE-4
GM-13D
GM-13S
PRODUCT RECOVERY SYSTEM
AS-1
AS-2
SVE-5
RW-4
SVE-1
RW-1
RAMP
LEGEND
RW-2 GROUNDWATER RECOVERY WELL
SVE-1 SOIL VAPOR EXTRACTION WELL
AS-1 AIR SPARGING WELL
MW-1 GROUNDWATER MONITORING WELL
N
0 30 60
SCALE IN FEET
TECHSOLV
TechSolv Consulting Group, Inc.
INTERIM REMEDIATION SYSTEM
ARCO HARBOR ISLAND TERMINAL 21T
1652 Southwest Lander Street
Seattle, WA 98134
FIGURE
2
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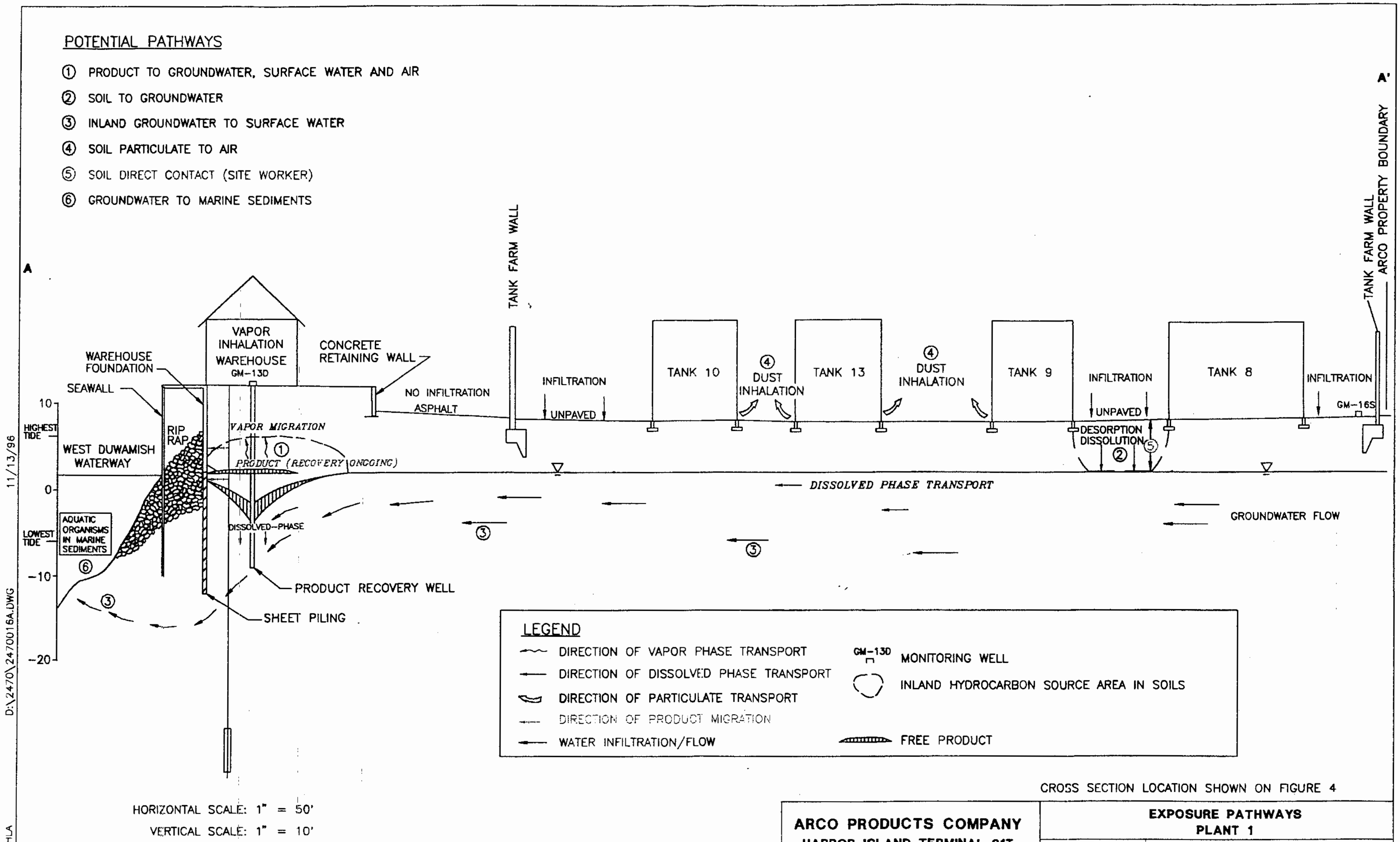
PLOTTED:NOV 12 1999 13:50:03 (VRH)
400-363

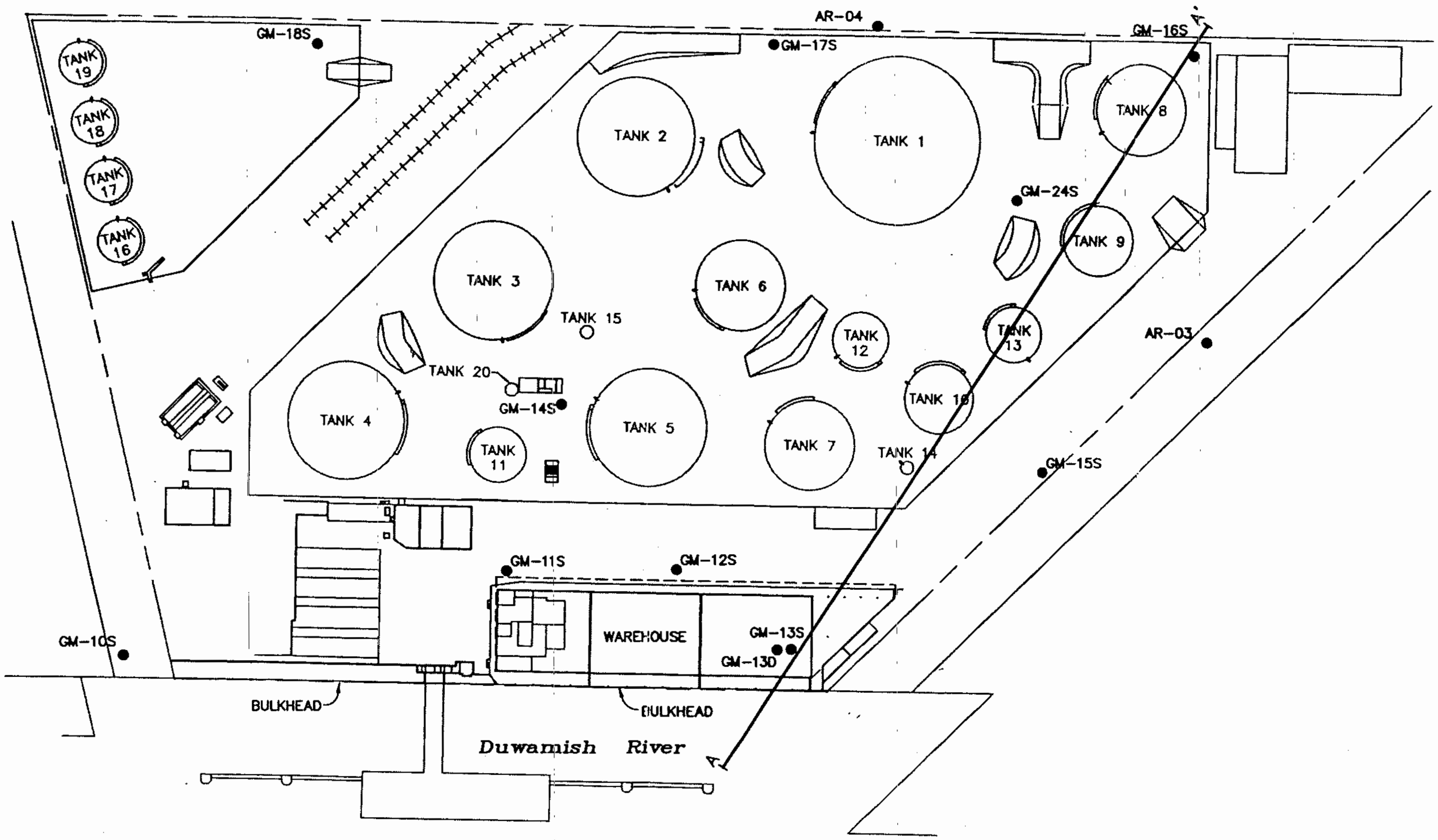


SOURCE: MODIFIED FROM THE REMEDIAL INVESTIGATION (GERAGHTY & MILLER, INC. 1994)

ARCO PRODUCTS COMPANY
HARBOR ISLAND TERMINAL 21T

EXPOSURE PATHWAYS
PLANT 1

FIGURE 3



NOTE: DATA FROM RI (FIGURE J-9)

LEGEND

●	MONITORING WELL
GM-17S	MONITORING WELL NUMBER
A —— A'	CROSS SECTION LOCATION

N

0 50 100
SCALE IN FEET

TECHSOLV
TechSolv Consulting Group, Inc.

CROSS SECTION LOCATION

ARCO HARBOR ISLAND TERMINAL 21T
1652 Southwest Lander Street
Seattle, WA 98134

FIGURE 4

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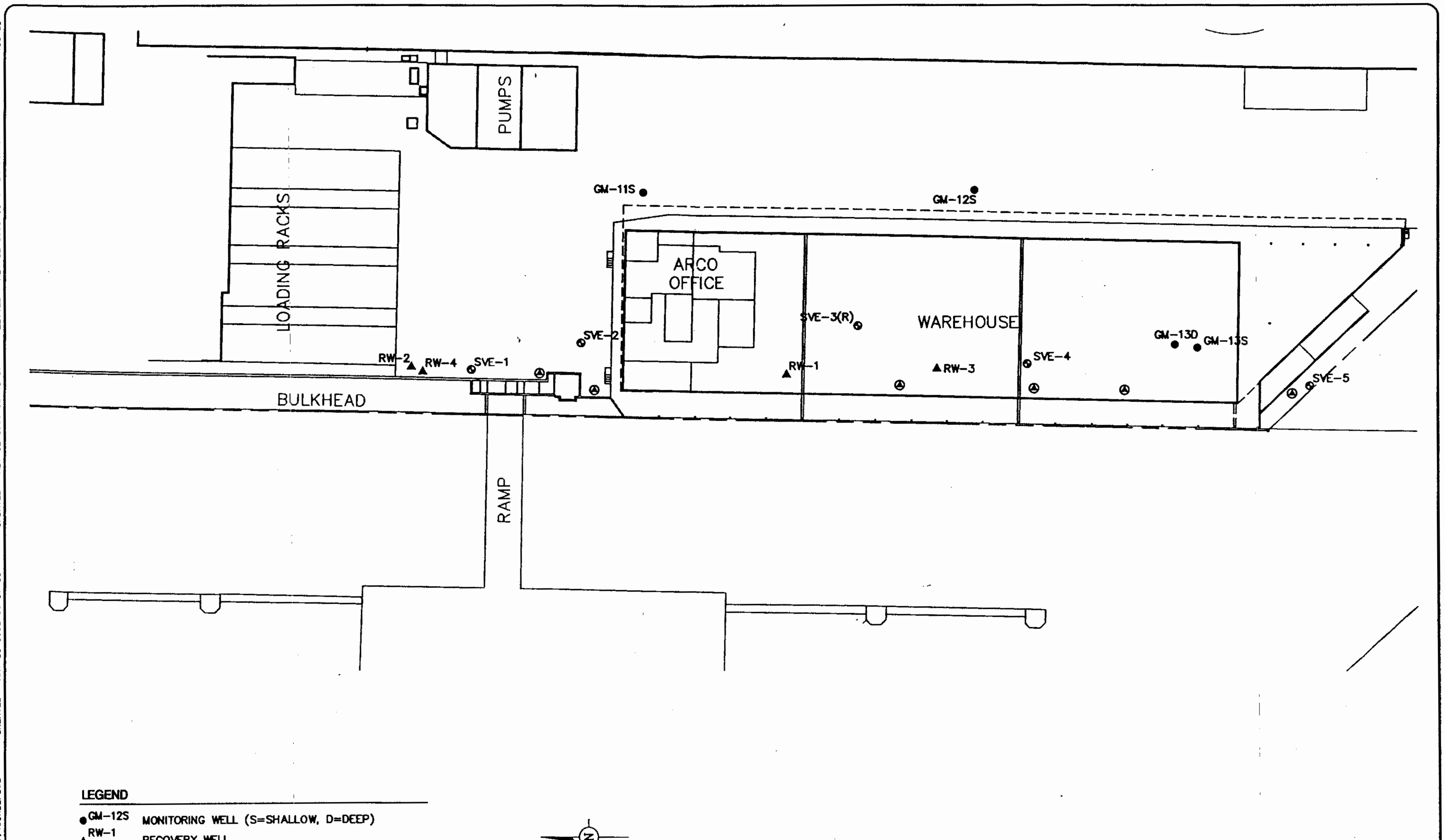
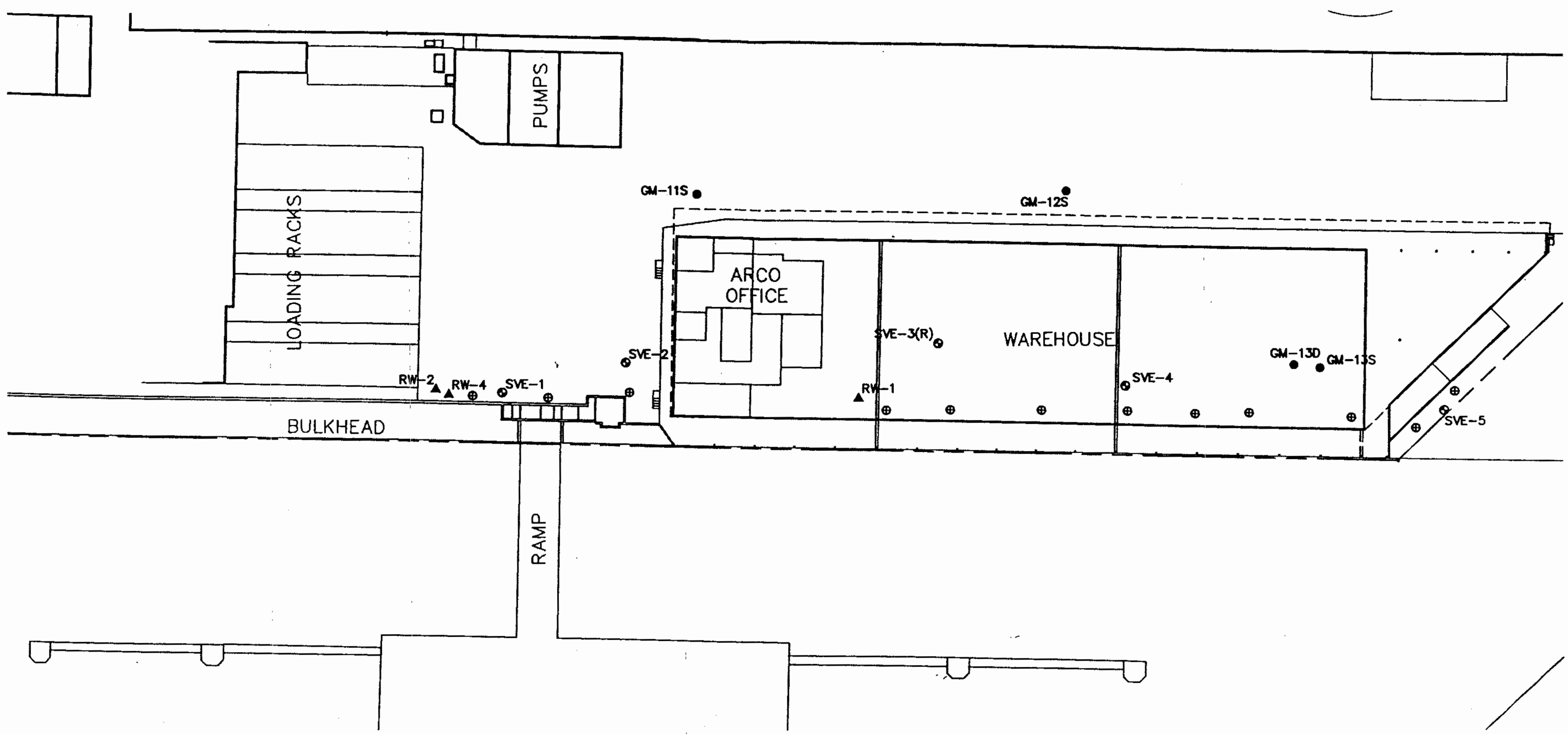


TECHSOLV
TechSolv Consulting Group, Inc.

PRELIMINARY MULTI-WELL CONFIGURATION FOR GROUNDWATER EXTRACTION

ARCO HARBOR ISLAND TERMINAL 21T
1652 Southwest Lander Street
Seattle, WA 98134

FIGURE 5



LEGEND

- ● GM-12S MONITORING WELL (S=SHALLOW, D=DEEP)
- ▲ RW-1 RECOVERY WELL
- ⊗ SVE-1 SOIL VAPOR EXTRACTION WELL
- ⊕ PROPOSED AIR SPARGING WELL

N

0 20 40
SCALE IN FEET

TECHSOLV
TechSolv Consulting Group, Inc.

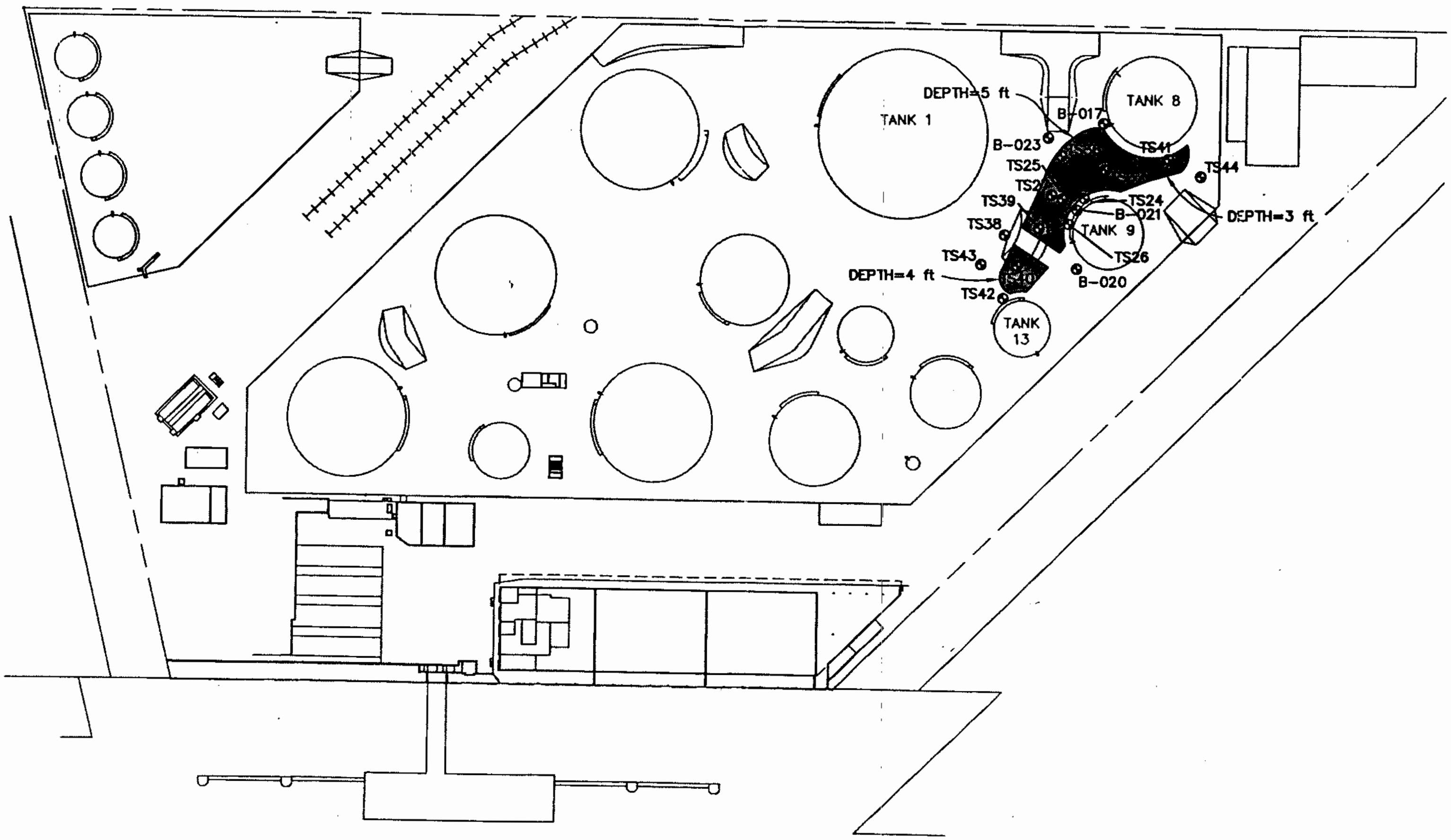
PRELIMINARY MULTI-WELL CONFIGURATION FOR AIR SPARGING

ARCO HARBOR ISLAND TERMINAL 21T
1652 Southwest Lander Street
Seattle, WA 98134

FIGURE 6

FILENAME: S11433\11433AB2.DWG CREATED: MAY 06 1993 19:07:51 UPDATED: NOV 12 1999 13:46:57 PLOTTED: NOV 12 1999 13:47:04 (WRH) 400-365

FILENAME: S:\11433\11433AB2.DWG CREATED: MAY 06 1993 19:07:51 UPDATED: NOV 08 1999 14:28:50 PLOTTED: NOV 08 1999 14:29:02 (WRH) 400-357



LEGEND

SOIL BORING

REMEDIATION AREA

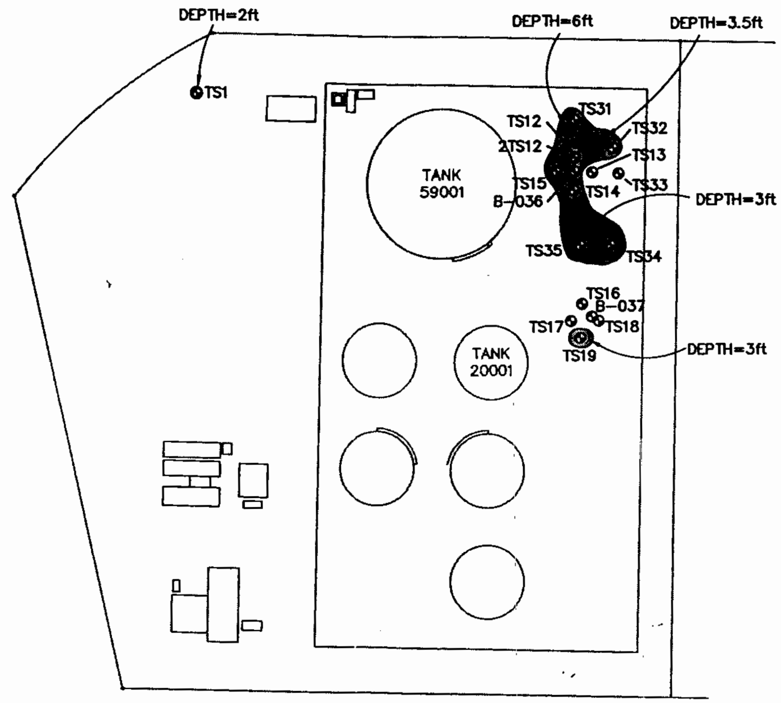
0 100 200
SCALE IN FEET

TECHSOLV
TechSolv Consulting Group, Inc.

PLANT 1 PROPOSED EXCAVATION AREA

ARCO HARBOR ISLAND TERMINAL 21T
1652 Southwest Lander Street
Seattle, WA 98134

FIGURE 7



LEGEND

SOIL BORING

REMEDIATION AREA

0 100 200

SCALE IN FEET

N

TECHSOLV

TechSolv Consulting Group, Inc.

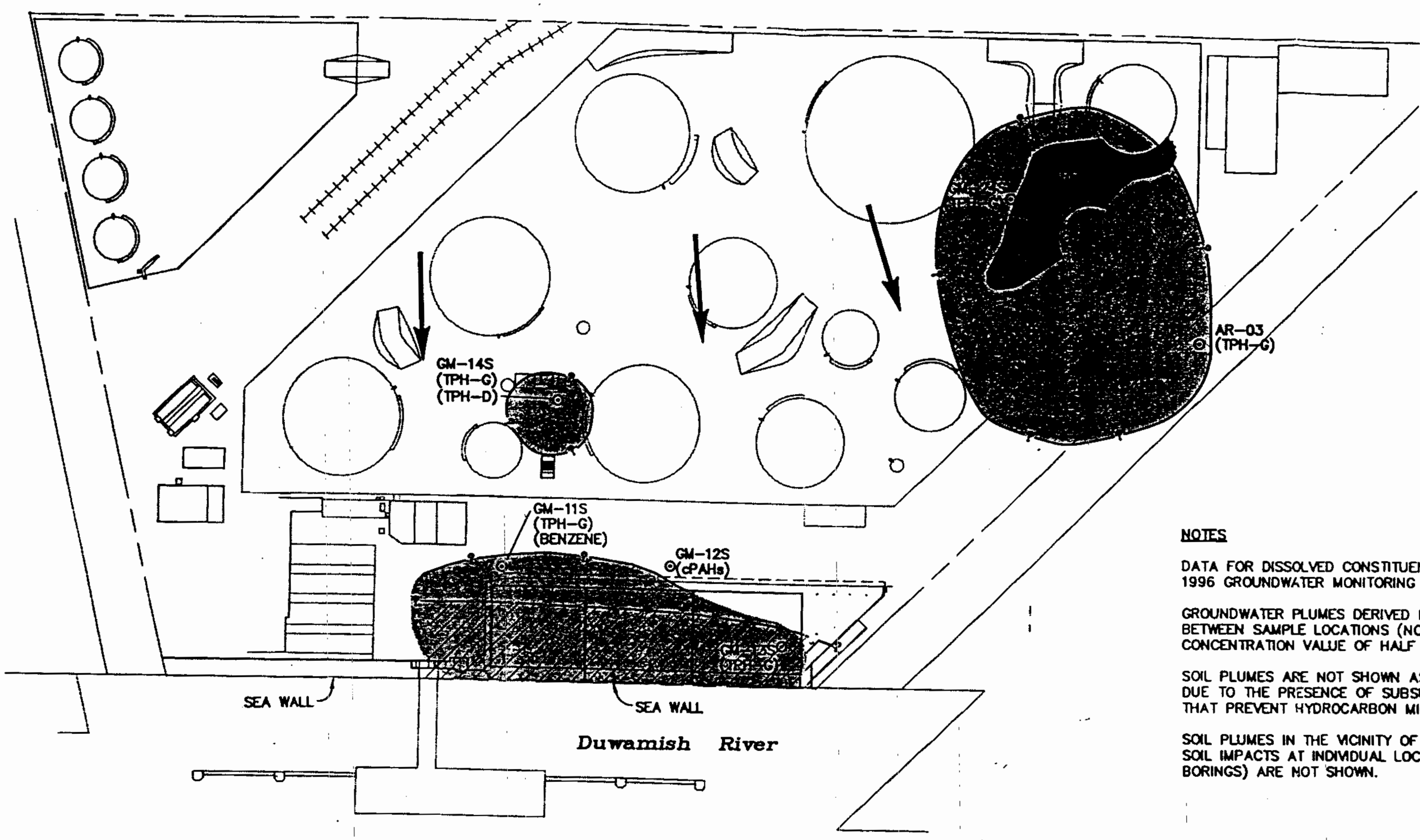
PLANT 2 PROPOSED EXCAVATION AREAS

ARCO HARBOR ISLAND TERMINAL 21T
1652 Southwest Lander Street
Seattle, WA 98134

FIGURE

8

CREATED: MAY 06 1993 19:07:51 UPDATED: NOV 08 1999 14:28:50 PLOTTED: NOV 08 1999 14:29:02 (VRM) 400-358



NOTES

DATA FOR DISSOLVED CONSTITUENTS FROM FEB 1996 AND NOV 1996 GROUNDWATER MONITORING EVENTS.

GROUNDWATER PLUMES DERIVED FROM LINEAR INTERPOLATION BETWEEN SAMPLE LOCATIONS (NON-DETECTS ASSIGNED A CONCENTRATION VALUE OF HALF THE METHOD DETECTION LIMIT).

SOIL PLUMES ARE NOT SHOWN AS EXTENDING BENEATH TANKS DUE TO THE PRESENCE OF SUBSURFACE TANK RING FOUNDATIONS THAT PREVENT HYDROCARBON MIGRATION BENEATH THE TANKS.

SOIL PLUMES IN THE VICINITY OF THE WAREHOUSE AREA AND SOIL IMPACTS AT INDIVIDUAL LOCATIONS (e.g., SELECT SOIL BORINGS) ARE NOT SHOWN.

LEGEND

⊙ SAMPLE LOCATION

B-005 SAMPLE # (S=SHALLOW, D=DEEP)

cPAHs CARCINOGENIC POLYNUCLEAR AROMATIC HYDROCARBONS

(BENZENE) CONSTITUENT EXCEEDED GROUNDWATER CLEANUP LEVEL

AREAS W/ TOTAL TPH IN SOIL ABOVE 10,000 mg/kg (DOTTED WHERE INFERRED)

AREAS W/ TPH-G IN GROUNDWATER IN EXCESS OF NPDES LIMIT OF 1000 ug/L

APPROXIMATE GROUNDWATER FLOW DIRECTION

PRODUCT PLUME

0 100 200
APPROXIMATE SCALE IN FEET

GERAGHTY & MILLER, INC.
Environmental Services

DRAWING NO. 400-324

ARCO HARBOR ISLAND TERMINAL 21T

PLANT 1, PETROLEUM IMPACTS IN SOIL AND GROUNDWATER AND PRODUCT PLUME

FIGURE 9

FILENAME: S11433\11433HOT.DWG CREATED: DEC 04 1996 11:12:44 UPDATED: APR 11 1997 14:56:09 PLOTTED: APR 11 1997 14:59:09 (VS830/NJ)

EXHIBIT C

CONSENT DECREE
ACCESS AND OPERATING PROCEDURES
FOR ARCO TERMINAL

1. All personnel who enter the Site pursuant to the Consent Order (hereinafter "personnel") shall notify the Terminal Superintendent prior to entering the Site and upon leaving the Site.
2. Automobiles of all personnel shall be operated and parked in areas designated by the Terminal Superintendent. Driveways and plant roads shall be kept clear to eliminate interference with normal operations and provide access for emergency equipment.
3. Smoking by personnel is absolutely prohibited on ARCO property, except in certain designated locations that have been approved for this purpose. Temporary smoking areas for use during major construction may be approved by the Terminal Superintendent and/or Safety Section. Personnel entering the site shall not bring upon ARCO property "strike anywhere" matches and cigarette lighters having exposed flint-operating mechanisms.
4. The possession, sale, and consumption of alcoholic beverages and/or drugs on ARCO property by personnel is strictly prohibited.
5. Personnel shall immediately advise the Terminal Superintendent of all accidents involving personnel occurring on ARCO property.
6. Personnel shall comply with all instruction from the Terminal Superintendent pertaining to safety apparel, such as hard hats, goggles, masks and gloves and safety equipment such as a breathing apparatus.
7. Personnel shall comply with all instructions by the Terminal Superintendent regarding health and safety risks or conditions.
8. In lieu of requiring personnel to provide home telephone numbers to ARCO, the Washington State Department of Ecology shall maintain a list of such telephone numbers and shall notify the next of kin of such personnel in the event of any incident requiring such notification.

RESTRICTIVE COVENANT

ARCO

Terminal 21T, Harbor Island

1652 S.W. Lander Street, Seattle, Washington

This Declaration of Restrictive Covenant is made pursuant to RCW 70.105D.030(1)(f) and (g) and WAC 173- 340- 440 by Atlantic Richfield Company (ARCO), a Delaware Corporation (which is a wholly owned subsidiary of BP Amoco PLC), its successors and assigns.

Remedial action (hereafter "Remedial Action") is to be conducted on the Property that is the subject of this Restrictive Covenant. The Remedial Action is described in the Final Cleanup Action Plan (CAP) ARCO Terminal 21T, Harbor Island. This document is an exhibit to the Consent Decree entered in State of Washington, Department of Ecology vs. ARCO Products Company, King County Case No. 00-2-05-714-8SEA.

This Restrictive Covenant is required because residual concentrations of dissolved total petroleum hydrocarbons and its constituents (e.g. benzene, cPAH), that exceed the Surface Water Quality standards for groundwater established under WAC 173- 340- 720 may remain after Remedial Action is completed and because total petroleum hydrocarbon contaminated soils may be left in the subsurface at the Property.

The undersigned, ARCO, is the fee owner of real property (hereafter "Property") in the County of King, State of Washington that is subject to this Restrictive Covenant. The Property is legally described in Attachment A of this Restrictive Covenant and made a part hereof by reference.

ARCO makes the following declaration as to limitations, restrictions, and uses to which the Property may be put and specifies that such declarations shall constitute covenants to run with the land, as provided by law and shall be binding on all parties and all persons claiming under them, including all current and future owners of any portion of or interest in the Property (hereafter "Owner").

Section 1.

a. The Property shall be used only for traditional industrial uses, as described in RCW 70.105D.020(22) and defined in and allowed under the City of Seattle's zoning regulations codified in the City of Seattle Zoning Code as of the date of this Restrictive Covenant.

b. No groundwater may be taken for any purpose from the Property that is inconsistent with the Remedial Action implementation.

Section 2.

a. As of the date the Consent Decree was entered, a portion of the Property contains total petroleum hydrocarbons in the soil, polynuclear aromatic hydrocarbons (cPAHs), dissolved total petroleum hydrocarbons in the groundwater, floating product on the water table, vapors in soil located under the warehouse and near the loading rack as shown in the attached figure (Attachment B). The Owner shall not alter, modify, or remove the existing structure(s) in any manner that may result in the release or exposure to the environment of the contaminated soil or create a new exposure pathway without prior written approval from Ecology, which approval will not be unreasonably withheld. Site workers conducting construction activities within the protective zone of contamination will be instructed on precautionary actions to avoid direct contacts with contaminated soils, groundwater or exposure to vapor and fumes and on appropriate methods for handling such wastes.

b. Elevated concentrations of residual petroleum hydrocarbons are also present in the area of above- ground storage tanks no.1, 4, 5, 6, 8, 9, 11, 13 and the loading rack in Plant 1, and near tanks 20001, 20007, 20008 and 59001 in Plant 2. These areas are shown in the figures in Attachment B. Site workers conducting construction activities within these areas will follow the Safety and Health Plan. Also they will be instructed on precautionary actions to avoid direct contact with contaminated soils and groundwater to ensure protection of site workers.

c. Any activity on the Property that is inconsistent with the Remedial Action implementation, or may create a new pathway to the existing contamination that endangers the public health and the environment, is prohibited without written approval from Ecology, which approval shall not be unreasonably withheld.

Section 3. The Owner of the Property must give thirty (30) days advance written notice to Ecology prior to a conveyance or transfer of any interest in the Property. No conveyance of title, easement, lease, or other interest in the Property shall be consummated by the Owner without adequate and complete provision for continued monitoring, operation, and maintenance of the Remedial Action if such Remedial Action is necessary and ongoing at the time of any conveyance or transfer of any interest in the Property.

Section 4. The owner must restrict leases to uses and activities consistent with the Restrictive Covenant ~~and notify all lessees of the restrictions on the use of the Property~~.

Section 5. The Owner must notify and obtain approval from Ecology prior to any use of the Property that is inconsistent with the terms of this Restrictive Covenant. Ecology may approve any inconsistent use only after public notice and comment. Approval by Ecology pursuant to Section 5 shall not be unreasonably withheld.

Section 6. The Owner shall allow authorized representatives of Ecology the right to enter the Property at reasonable times for the purpose of evaluating the Remedial Action; to take samples, to inspect Remedial Actions conducted at the Property, and to inspect records that are related to the Remedial Action. Ecology will provide ARCO with advance notice of its entrance on the Property when appropriate. Ecology shall adhere to Access and Operating Procedures, which are attached to the Consent Decree as Exhibit C.

Section 7. The Owner of the Property reserves the right under WAC 173- 340- 440 to record an instrument that provides that this Restrictive Covenant shall no longer limit use of the Property or be of any further force or effect. However, such an instrument may be recorded only if Ecology, after public notice and opportunity for comment, concurs, which concurrence shall not be unreasonably withheld.

DATED: May 30, 2000

Atlantic Richfield Company (ARCO), a Delaware Corporation (which is a wholly owned subsidiary of BP Amoco PLC)

By C B Reed

Its Area Operations Manager

STATE OF ~~WASHINGTON~~ California)

) ss.

COUNTY ~~OF KING~~ Los Angeles)

On this 30th day of May, 2000, before me personally appeared C. B. Reed, to me known to be the Area Oper. Mgr. of ARCO, the corporation that executed the within and foregoing instrument, and acknowledged said instrument to be the free and voluntary act and deed of said corporation, for the uses and purposes therein mentioned, and on oath stated that C. B. Reed was authorized to execute the said instrument, and that the seal affixed, if any, is the corporate seal of said corporation.

IN WITNESS WHEREOF I have hereunto set my hand and affixed my official seal the day and year first above written.

DIANE M. COMFORT
Commission # 1123775
Notary Public — California
Los Angeles County
My Comm. Expires Jan 20, 2001

Diane M. Comfort
(Signature)

Diane M. Comfort
(Please print name legibly)

NOTARY PUBLIC, residing at
Long Beach, California

My commission expires: 1-20-01

ATTACHMENT A
Of
RESTRICTIVE COVENANT

Legal Description

PARCEL A

THOSE PORTIONS OF LOTS 1 THROUGH 4, INCLUSIVE, AND LOTS 47 THROUGH 53, INCLUSIVE, BLOCK 398, SEATTLE TIDELANDS, EXTENSION NO.1, ACCORDING TO THE MAPS ON FILE IN THE OFFICE OF THE COMMISSIONER OF PUBLIC LANDS IN OLYMPIA WASHINGTON; DESCRIBED AS FOLLOWS;

COMMENCING AT THE NORTHEASTERLY CORNER OF SAID BLOCK 398; THENCE SOUTH O1°08'16" WEST ALONG THE EASTERLY LINE OF SAID BLOCK 398 A DISTANCE OF 396.15 FEET TO THE TRUE POINT OF BEGINNING; THENCE NORTH 01°08'16" EAST A DISTANCE OF 227.93 FEET TO A POINT ON A NON-TANGENT CURVE WHOSE RADIUS IS 445.28 FEET AND WHOSE CENTER BEARS SOUTH 59°10'38" WEST; THENCE NORTHWESTERLY 192.64 FEET ALONG SAID CURVE TO A POINT ON THE NORTHERLY LINE OF SAID BLOCK 398; THENCE SOUTH 77°51'03" WEST ALONG THE NORTHERLY LINE OF SAID BLOCK 398 A DISTANCE OF 407.26 FEET TO THE NORTHWESTERLY CORNER OF SAID BLOCK 398; THENCE SOUTH 01°07'48" WEST ALONG THE WESTERLY LINE OF SAID BLOCK 398 A DISTANCE OF 128.71 FEET TO A POINT; THENCE NORTH 03°15'28" EAST A DISTANCE OF 41.74 FEET TO A POINT; THENCE SOUTH 87°39'23" EAST A DISTANCE OF 54.81 FEET TO A POINT ON A NON-TANGENT CURVE WHOSE RADIUS IS 382.00 FEET AND WHOSE CENTER BEARS SOUTH 58°04'07" WEST; THENCE SOUTHEASTERLY 195.41 FEET, MORE OR LESS, ALONG SAID CURVE TO THE TRUE POINT OF BEGINNING.

SAID PARCEL CONTAINING 90,518 SQUARE FEET, MORE OR LESS.

SITUATE IN THE COUNTY OF KING, STATE OF WASHINGTON

PARCEL B

LOTS 4 THROUGH 8, INCLUSIVE, AND 45 THROUGH 50, INCLUSIVE, BLOCK 398, SEATTLE TIDELANDS, EXTENSION NO. 1, ACCORDING TO THE MAPS ON FILE IN THE OFFICE OF THE COMMISSIONER OF PUBLIC LANDS IN OLYMPIA WASHINGTON; EXCEPT THOSE PORTIONS DESCRIBED AS FOLLOWS;

COMMENCING AT THE NORTHEASTERLY CORNER OF SAID BLOCK 398; THENCE SOUTH 01°08'16" WEST ALONG THE EASTERLY LINE OF SAID BLOCK 398 A DISTANCE OF 396.15 FEET TO THE TRUE POINT OF BEGINNING; THENCE NORTH 01°08'16" EAST A DISTANCE OF 227.93 FEET TO A POINT ON A NON-TANGENT CURVE WHOSE RADIUS IS 445.28 FEET AND WHOSE CENTER BEARS SOUTH 59°10'38" WEST; THENCE NORTHWESTERLY 192.64 FEET ALONG SAID CURVE TO A POINT ON THE NORTHERLY LINE OF SAID BLOCK 398; THENCE SOUTH 77°51'03" WEST ALONG THE NORTHERLY LINE OF SAID BLOCK 398 A DISTANCE OF 407.26 FEET TO THE NORTHWESTERLY CORNER OF SAID BLOCK 398; THENCE SOUTH 01°07'48" WEST ALONG THE WESTERLY LINE OF SAID BLOCK 398 A DISTANCE OF 128.71 FEET TO A POINT; THENCE SOUTH 88°56'19" EAST A DISTANCE OF 412.57 FEET TO A POINT; THENCE NORTH 03°15'28" EAST A DISTANCE OF 41.74 FEET TO A POINT; THENCE SOUTH 87°39'23" EAST A DISTANCE OF 54.81 FEET TO A POINT ON A NON-TANGENT CURVE WHOSE RADIUS IS 382.00 FEET AND WHOSE CENTER BEARS SOUTH 58°04'07" WEST; THENCE SOUTHEASTERLY 195.41 FEET, MORE OR LESS, ALONG SAID CURVE TO THE TRUE POINT OF BEGINNING.

SAID PARCEL CONTAINING 156,814 SQUARE FEET, MORE OR LESS.

SITUATE IN THE COUNTY OF KING, STATE OF WASHINGTON

PARCEL C

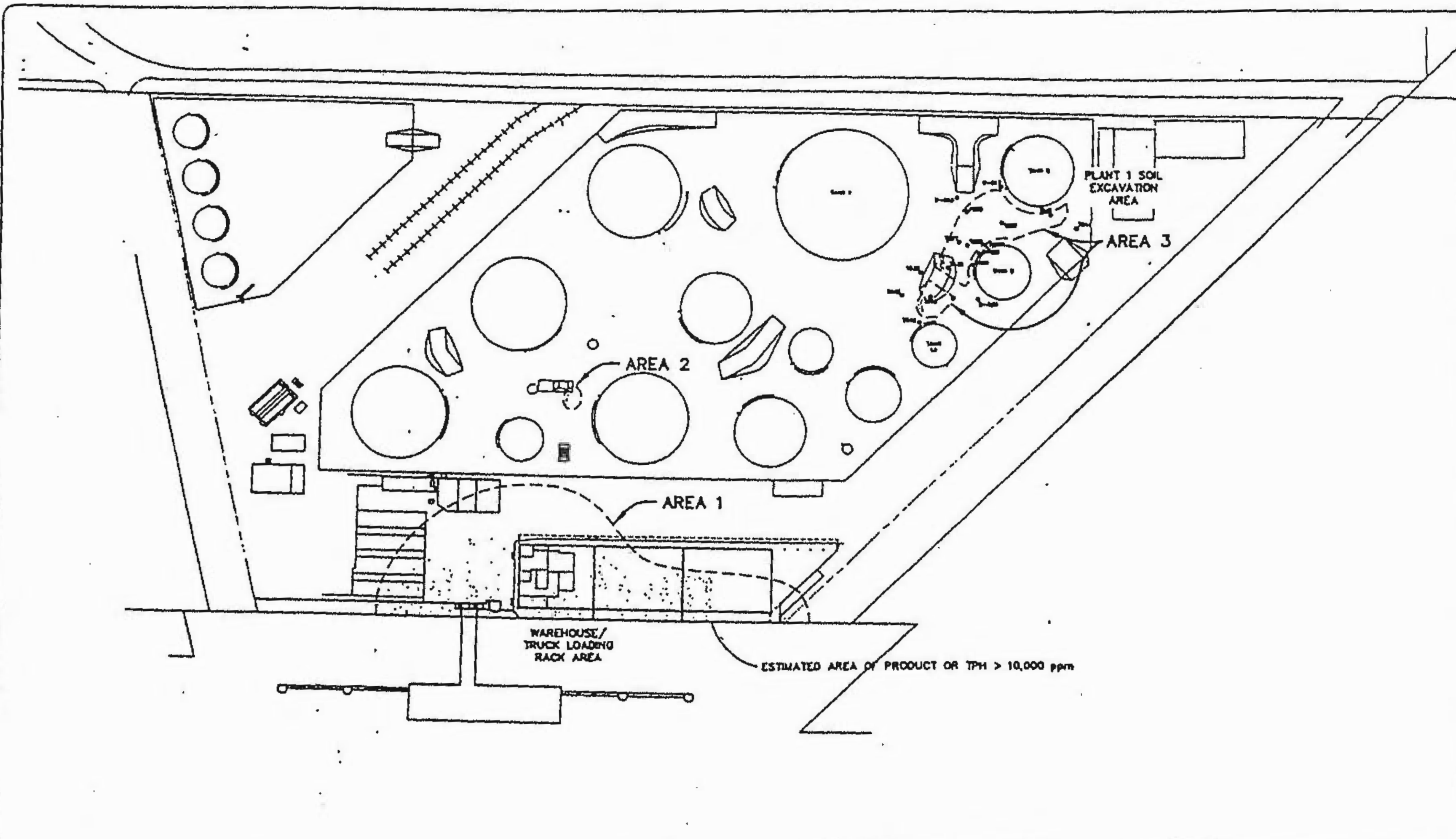
LOTS 1 THROUGH 14 INCLUSIVE OF BLOCK 405 OF THE SEATTLE TIDE LANDS; TOGETHER WITH THE SEATTLE TIDE LANDS EXTENSION NUMBER 1; TOGETHER WITH THE SOUTHERLY 50 FEET IN WIDTH OF VACATED FLORIDA STREET ADJACENT TO SAID BLOCK 405.

SUBJECT TO EASEMENTS OF RECORD

CONTAINING 616,098 SQUARE FEET OR 14.144 ACRES MORE OR LESS.

ATTACHMENT B

Figures

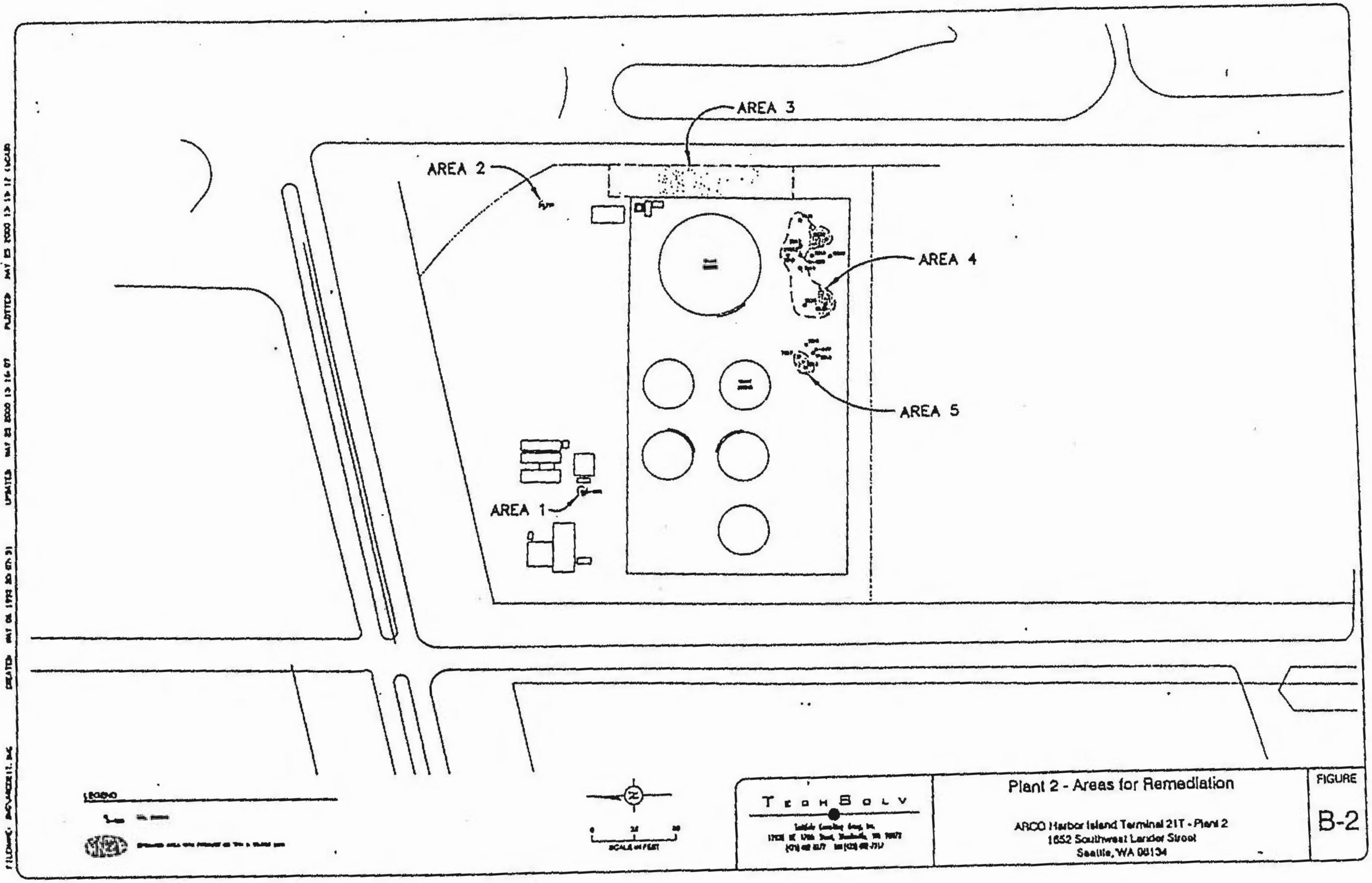


TechSolv

Plant 1 - Areas for Remediation

ARCO Harbor Island Terminal 21T - Plant 1
1652 Southwest Lander Street
Seattle, WA 98134

FIGURE B-1

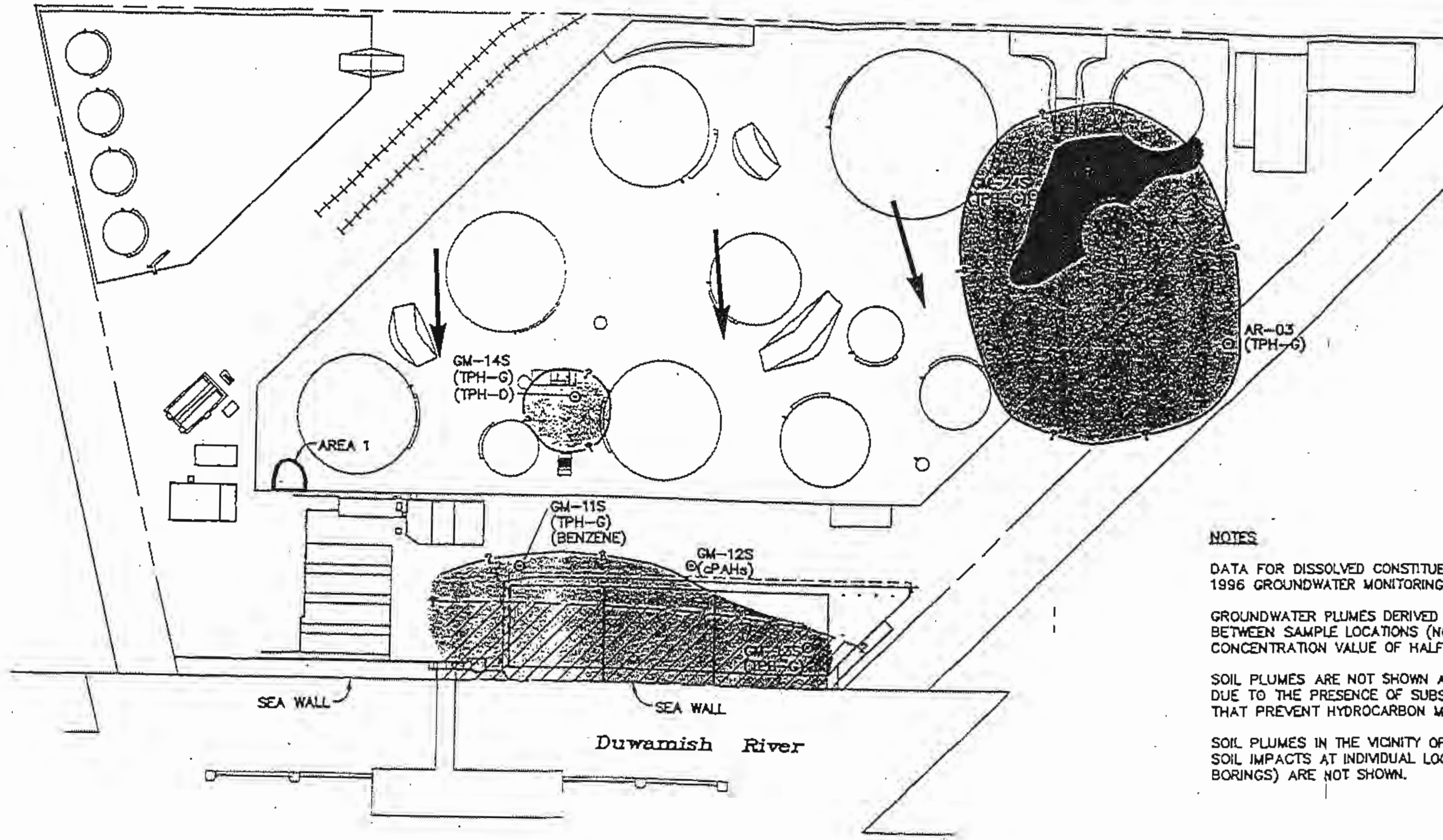


Plant 2 - Areas for Remediation

ARCO Harbor Island Terminal 21T - Plant 2
1652 Southwest Lander Street
Seattle, WA 98134

FIGURE B-2

FILENAME: S11433\11433H01.DWG CREATED: DEC 04 1996 11:12:44 UPDATED: APR 11 1997 14:56:09 PLOTTED: APR 11 1997 14:59:09 (VS83D/N)



NOTES

DATA FOR DISSOLVED CONSTITUENTS FROM FEB 1996 AND NOV 1996 GROUNDWATER MONITORING EVENTS.

GROUNDWATER PLUMES DERIVED FROM LINEAR INTERPOLATION BETWEEN SAMPLE LOCATIONS (NON-DETECTS ASSIGNED A CONCENTRATION VALUE OF HALF THE METHOD DETECTION LIMIT).

SOIL PLUMES ARE NOT SHOWN AS EXTENDING BENEATH TANKS DUE TO THE PRESENCE OF SUBSURFACE TANK RING FOUNDATIONS THAT PREVENT HYDROCARBON MIGRATION BENEATH THE TANKS.

SOIL PLUMES IN THE VICINITY OF THE WAREHOUSE AREA AND SOIL IMPACTS AT INDIVIDUAL LOCATIONS (e.g., SELECT SOIL BORINGS) ARE NOT SHOWN.

LEGEND

- ⊙ SAMPLE LOCATION
- B-005 SAMPLE # (S=SHALLOW, D=DEEP)
- cPAHs CARCINOGENIC POLYNUCLEAR AROMATIC HYDROCARBONS
- (BENZENE) CONSTITUENT EXCEEDED GROUNDWATER CLEANUP LEVEL
- AREA W/ TOTAL TPH IN SOIL ABOVE 10,000 mg/kg (DOTTED WHERE INFERRED)
- AREAS W/ TPH-G IN GROUNDWATER IN EXCESS OF NPDES LIMIT OF 1000 ug/L
- APPROXIMATE GROUNDWATER FLOW DIRECTION
- INACCESSIBLE AREA W/ TOTAL TPH IN SOIL ABOVE 10,000 mg/kg
- PRODUCT PLUME

N

0 100 200

APPROXIMATE SCALE IN FEET

GERAGHTY & MILLER, INC.
Environmental Services

DRAWING NO. 400-324

ARCO HARBOR ISLAND TERMINAL 21T

PLANT 1, PETROLEUM IMPACTS IN SOIL AND GROUNDWATER AND PRODUCT PLUME

FIGURE 3

EXHIBIT E

ARCO HARBOR ISLAND REMEDIAL DESIGN (RD) CONSENT DECREE SCHEDULE

November 19, 1999

Written Notification to Ecology with name and qualifications of RD/RA coordinating contractor	Within 10 days after signing of this Consent Decree (CD) by the Court
Draft Remedial Engineering Design (RD) Report	Within 90 days after entry of this CD in Court.
Final RD Report Incorporating Pilot Studies Findings and excavation considerations	Within 30 days of receipt of Ecology's written approval of Draft RD Report.
Implement Final Remedy beneath the warehouse	Within 60 days of receipt of Ecology's written approval of Final RD Report.
Begin excavation of accessible inland TPH soil hot spots in Plants 1 and 2	Within the first summer season that occurs within 90 days of Ecology's written approval of Final RD Report
Complete free product removal beneath the warehouse	Within 18 months after system installation and startup to the extent practicable after excercising best effort by ARCO
Begin confirmation, performance and compliance monitoring inland areas of the site	Within 45 days of completing Preferred Corrective Action at the inland accessible areas of the site
Begin confirmation, performance and compliance monitoring at shoreline	Within 45 days of completing Preferred Corrective Action under the warehouse
Implement contingency plans	Within 30 days of making contingency plan determination.
Ecology will recommend to EPA for ARCO to be de-listed from the Federal NPL lists	After completion of the first year of groundwater compliance monitoring
Ecology will review removing ARCO from the Confirm and Suspected Contaminated Site Database	After 5 years of completing groundwater compliance requirement
Complete restoration of site groundwater	Within 5 years of implementing Preferred Cleanup Plan/ Contingency Plan Actions on site to the extent practicable after excercising best effort by ARCO

EXHIBIT F

GROUNDWATER COMPLIANCE MONITORING AND CONTINGENCY PROGRAM

ARCO HARBOR ISLAND TERMINAL 21T

SEATTLE, WASHINGTON

ISSUED TO

WASHINGTON STATE DEPARTMENT OF ECOLOGY

SUBMITTED BY

ARCO TERMINAL 21T

November 19, 1999

PREPARED BY

TechSolv Consulting Group, Inc.
12510 128th Lane NE
KIRKLAND, WASHINGTON

Table of Contents

1.0 INTRODUCTION

1.1 Purpose

This Groundwater Compliance Monitoring and Contingency Program has been prepared to describe the protocol and procedures that will be used to confirm that cleanup requirements have been achieved at the ARCO Products Company (ARCO) Harbor Island Terminal 21T in Seattle, Washington (Figure 1). The monitoring plan has been prepared to satisfy the requirements of the Model Toxics Control Act (MTCA) regulations WAC 173-340-410, -720, and –820. This plan was also prepared in accordance with requirements of the Consent Decree, cooperatively entered into between ARCO and the Washington State Department of Ecology (Ecology).

The purpose of this Groundwater Compliance Monitoring and Contingency Program is to specify actions to be followed to confirm that human health and the environment are protected during remedial actions, to confirm that cleanup standards have been achieved, and to confirm the long-term effectiveness of the cleanup actions at Plants 1 and 2 at the ARCO Harbor Island Terminal 21 T.

This plan includes the following components:

1) <u>Introduction</u>: Discuss site location and overview of site and hydrogeology, cleanup action summary, monitoring objectives and rationale, types of monitoring, and monitoring locations and schedule to be used for compliance monitoring are provided in this section;

2) <u>Protection Monitoring</u>: Describe the criteria for protection monitoring under WAC 173-340-400;

3) <u>Performance Monitoring</u>: Describe the criteria and methodology for performance monitoring of free product recovery, natural attenuation, and other selected remedial technologies to document that the cleanup action is performing as anticipated;

4) <u>Confirmation Monitoring</u>: Describe the confirmation criteria which monitors the long-term effectiveness of the cleanup action once cleanup and performance standards have been attained;

5) <u>Criteria for Meeting Performance and Compliance Standards</u>: Discuss criteria to be used to determine if performance and compliance standards have been met; and

6) <u>Data Evaluation and Reporting:</u> Discuss free product monitoring, groundwater sampling and analytical procedures, data validation, evaluation procedures, reporting, and monitoring schedules;

7) <u>Contingency Plans:</u> Discuss the steps that will be implemented in the event the proposed cleanup actions are not effective.

1.2 SITE LOCATION

The ARCO Harbor Island Terminal 21T is located in Seattle, Washington (Figure 1). The ARCO site is comprised of two plants. Plant 1 is located along the West Waterway of the Duwamish River, and Plant 2 is located inland, in the north-central part of Harbor Island.

1.3. Summary of Site Hydrogeology

Harbor Island is a flat-lying island consisting of hydraulic and mechanical fills overlying native deltaic deposits. The hydraulic fill consists of approximately 15 to 20 feet of poorly graded fine to medium sand with silt. The native deltaic deposits also consist of poorly graded fine to medium sand with silt and are distinguished during drilling from the overlying fill deposits by the presence of silt and clay interbeds and abundant rootlets.

The ARCO terminal is mostly capped with concrete or asphalt, except within the tank farms, where much of the areas are capped with gravel or are covered by the above ground storage tanks. Less than approximately 30 percent of the ARCO facility is uncapped. Within the tank farm areas, most rainwater infiltrates through the unsaturated zone and recharges the groundwater. The water table occurs at depths ranging from one to eight feet below ground surface (bgs).

Unconfined groundwater occurs within the fill and native deltaic deposits. The groundwater occurs as a freshwater lens overlying saline water at depth. Saline water occurs at depths of approximately 40 feet bgs near the Island edge at Plant 1 and 80 feet bgs near the center of the Island at Plant 2. Groundwater beneath Harbor Island generally flows in a radial pattern outward from the center of Harbor Island to the Island's edge. Groundwater generally flows to the west at Plant 1. At Plant 2, shallow groundwater flow is generally to the northwest in the spring and summer, but flows in a radial pattern in the fall and winter due to ponding within the tank farm.

Groundwater levels near the Island edges respond in the short term to tidal changes in the surrounding surface water. The Duwamish Waterway adjacent to the site has a tidal fluctuation of up to approximately 14 feet. The tidal fluctuation affects the shallow groundwater near the Island edge and results in daily groundwater fluctuations of approximately one to two feet. The observed groundwater fluctuations are dampened by the warehouse foundation and Island bulkhead, which are located near the edge of Harbor Island. These barriers create a "damming" effect on groundwater entering the Duwamish River. Due to these barriers, groundwater is forced to flow out primarily in the narrow area beneath the foundation and bulkheads and above the saltwater interface.

The warehouse foundation and Island bulkhead also form a "hanging wall" that traps the migration of floating product into the Duwamish River. The water table elevations also fluctuate seasonally approximately only one to two feet due to rainfall. The combined fluctuation due to tidal influence and seasonal rainfall is approximately three to four feet. The shallow water table elevation does not drop below the base of the subsurface barriers.

1.4 SELECTED CLEANUP ACTION SUMMARY

The selected cleanup action is designed to accomplish the following requirements: protect human health and the environment, comply with cleanup standards established in WAC 173-340-700, comply with applicable state and federal laws under WAC 173-340-710, provide compliance monitoring as set forth in WAC 173-340-410, use permanent solutions to the maximum extent practicable as mandated in WAC 173-340-360 (2), (3), (4), (5), (7), and (8), provide a reasonable time restoration in accordance with WAC 173-340-360 (6) and consider public concerns as designated in WAC 173-340-600.

Cleanup actions at the site include source removal in the soil and groundwater, treatment, and recycling/off-site disposal, monitoring, natural attenuation, and institutional controls.

Soil. The goal of soil cleanup standards for petroleum hydrocarbons are to protect the beneficial use of groundwater (surface water quality and associated ecosystem). The preferred alternatives will result in substantive compliance with the soil cleanup standards by reducing concentrations of contaminants in soils to levels that will support and maintain compliance with ground water quality standards. The specific cleanup actions are:

- In-situ treatment of soil that includes Soil Vapor Extraction (SVE), Air Sparging, and Natural Attenuation/Intrinsic Biodegradation in Plant 1 shoreline area.

- Excavation of accessible total petroleum hydrocarbons (TPH) subsurface soil hot spots with concentrations above 10,000 milligrams per kilogram (mg/kg) in Plant 1 southeast area of the site (Figure 2).

- Excavation of accessible TPH subsurface hot spots with concentrations above 20,000 mg/kg in Plant 2 (Figure 3).

- Intrinsic biodegradation/natural attenuation of inaccessible TPH in subsurface soils in Plant 1 and Plant 2.

- Contingency plans, institutional controls/deed restriction.

Groundwater. The achievement of cleanup levels in groundwater shall be measured at points of performance and compliance located within the product plume area and at the downgradient edge of the site. The wells at the downgradient edge of the site are considered points of compliance wells. These points of compliance and performance shall consist of a network of monitoring wells located in the product plume area and on the downgradient property boundary. Other wells (sentry well) situated off-site will also be used to document plume migration, performance standards, and to warn of any unanticipated change in off-site groundwater conditions. Exact locations of these wells are identified in the later sections of this Groundwater Compliance Monitoring Program, Exhibit F, for the site. The specific cleanup actions are:

- Expansion of product skimming enhanced by depression of the water table in Plant 1 shoreline area.
- Groundwater treatment and proper disposal.
- Expansion of air sparging below the water table in Plant 1 shoreline area.
- Surface water boom maintenance and sheen monitoring in the Duwamish River.
- Free product monitoring in Plants 1 and 2. (Figure 2 and Figure 3)
- Groundwater monitoring in point of compliance (confirmation), performance and offsite (sentry) wells in Plants 1 and 2.
- Contingency Plans, Institutional control in the form of a deed restriction for the site

1.4.1 Indicator Hazardous Substances

The following hazardous substances serve as indicator hazardous substances (IHS's) established in the RI/FS for purposes of defining site cleanup requirements for ARCO Terminal 21T:

Groundwater IHS's-

- Dissolved copper
- Total petroleum hydrocarbons as gasoline (TPH-G)
- Total petroleum hydrocarbons as diesel (TPH-D)
- Total petroleum hydrocarbons as oil (TPH-O)
- Benzene
- Carcinogenic polynuclear aromatic hydrocarbons (cPAH's): benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)flouranthene, chrysene, dibenz(a,h) anthracene, indeno(1,2,3-cd)pyrene
- Free-phase product

Soil IHS's-

- TPH-G

- TPH-D
- TPH-O
- Free-phase product

1.5 MONITORING OBJECTIVES AND RATIONALE

The cleanup action incorporates monitoring to determine that cleanup standards are achieved and maintained after remedial actions have been completed. During the remedial actions, performance monitoring will be conducted to confirm that cleanup actions are performing as anticipated and have attained cleanup standards and treatment goals. After remedial actions are performed, compliance monitoring will be conducted to confirm and determine that cleanup actions have attained cleanup standards and performance standards. Protection monitoring will be used to adequately protect human health and the environment during construction and operation of the cleanup actions.

The determination of adequate soil treatment will be based on the ability for the remedy to comply with the groundwater cleanup standards for the site, to meet performance standards designed to minimize human health or environmental exposure to soils above cleanup levels, and to provide practicable treatment of contaminated soils.

The achievement of cleanup levels in groundwater shall be measured at points of performance and compliance located within the free product plume area and at the downgradient edge of the site. The overall objective of the compliance monitoring wells downgradient of the free product plumes and on the property boundaries is to provide additional safeguards by providing both Ecology and ARCO with early warning of potential contamination migration and basis for contingency plan reviews and implementation, if necessary. Sentry wells, situated off property limits and downgradient of dissolved petroleum hydrocarbon plumes, will also be used to monitor migration of dissolved petroleum constituents and contingency plan determination.

Monitoring methods, monitoring locations, and types of analyses were selected to monitor the effectiveness of the cleanup actions in attaining the soil, free product, and groundwater cleanup standards for the site. The specific details of these monitoring activities are described in subsequent sections of this document.

1.5.1 Soil

The sum of the TPH-G, TPH-D, and TPH-O at specific sampling locations were above levels requiring action at the site.

TPH in Plant 1. Accessible soil TPH concentrations were above the cleanup action levels (10,000 mg/kg) southeast of the site next to Tanks 1, 8, 9, and 13. These soil TPH concentrations are in the vicinity of soil borings B-17, B-20, B-21, B-23, TS-23, TS-25, TS-26, TS-27, TS-36, TS-27, TS-39, TS-40, TS-41 and TS-42.

TPH in Plant 2. Accessible soil TPH concentrations were above the cleanup action levels (20,000 mg/kg) southeast of the site next to Tanks 59001, 20001 and in the northeast corner of the site. These soil TPH concentrations are in the vicinity of soil borings B-36, B-37, TS-1, TS-12, TS-14, TS-15, TS-17, TS-19, TS-31, TS-32, TS-34 and TS-35.

1.5.2 Groundwater

Groundwater will be monitored for benzene, TPH-G, TPH-D, TPH-O, and free product in specific areas of the site prior, during and after implementation of the cleanup action discussed in Section 1.4. The selected analysis and monitoring locations addresses soils cleanup actions areas, areas of product recovery, and the water quality chemistry data for the site.

Wells Not Included in Compliance Monitoring Program. Monitoring wells not included in the confirmation, performance, or the sentry wells are excluded from this Compliance Groundwater Monitoring Program. After the one-year review of the site groundwater analytical data as discussed in Section 3.2.2, Ecology and ARCO will review potential wells for abandonment as appropriate.

Damaged Wells Due To Cleanup Action Implementation. Monitoring wells designated for confirmation, performance or sentry wells that become disabled as a result of the cleanup action implementation must be replaced. Ecology must approve the new proposed location before replacement of the damaged groundwater monitoring well.

Plant 1 Areas Above Cleanup Levels

Benzene and TPH Areas: Monitoring wells with periodic or consistent detection of benzene or TPH above the cleanup levels include, shallow monitoring well no. 11 (GM-11S), AR-03, GM-12S, GM-13S, GM-14S and GM-24S.

CPAH Areas: Monitoring well with periodic or consistent detection of total cPAHs above the cleanup levels is GM-12S.

These wells are located in or around Plant 1 and due to historic detection of petroleum-hydrocarbon-related IHSs above cleanup levels (Table 1), these monitoring wells (including the newly proposed wells along the shoreline AMW-01 through AMW-05) will be included in the compliance monitoring program. Monitoring in these wells will be focused on the IHSs for groundwater to provide water quality data for baseline data and trend analysis. Further these wells will be monitored for natural attenuation parameters (Table 2).

Plant 2.

Benzene and TPH Areas: Monitoring wells with periodic or consistent detection of benzene or TPH above the cleanup levels include, shallow/deep monitoring wells GM-19S, MW-03, GM-21S, GM-23S, and GM-19D.

These wells are located in or around Plant 2 and due to historic detection of petroleum-hydrocarbon-related IHSs and copper above cleanup levels (Table 1), these monitoring wells will be included in the compliance monitoring program. Monitoring in these wells will be focused on the IHSs for groundwater to provide water quality data for baseline data and trend analysis. Further these wells will be monitored for natural attenuation parameters (Table 2).

1.6 Compliance Monitoring Types and Schedule

The three forms of compliance monitoring will be performed in accordance with WAC 173-340-410. Groundwater compliance monitoring will consist of free product monitoring, groundwater elevation monitoring, and groundwater sampling.

- Free product monitoring will consist of measuring free product levels in areas of the site as part of the performance standard evaluation after implementation of the preferred remedial alternatives.

- Groundwater elevation monitoring will be performed during free product monitoring events and during groundwater sampling events.

- Groundwater samples will be collected from designated ARCO compliance monitoring, performance monitoring wells.

Three types of monitoring will be performed under the Groundwater Compliance Monitoring and Contingency Program to meet the monitoring program objectives:

- Protection Monitoring. Protection monitoring will be performed to confirm that human health and the environment are protected adequately during all phases of the cleanup actions (WAC 173-340-410(1)(a)). Protection monitoring will be addressed in the health and safety plan to be prepared in conjunction with the engineering design report, construction plans and specifications, and operation and maintenance plan (WAC 173-340-400).

- Performance Monitoring will be performed to confirm that the cleanup action has attained cleanup standards and other performance standards.

- Confirmational Monitoring will be performed to confirm the long-term effectiveness of the cleanup action once cleanup actions and other performance standards have been attained.

Monitoring Locations. Figures 6 and 7 show the locations of all wells in which product will be monitored, groundwater levels will be measured, and groundwater samples will be collected as part of the site compliance monitoring program. Table 3 provides a list of compliance monitoring wells, identifying the well location, monitoring objective, and well use. A summary of the analytical parameters to be used in compliance monitoring is presented in Tables 1 and 2. Detail plans for Plants 1 and 2 performance and confirmational monitoring component, including the media type, location, and schedule, is presented in Section 2.0.

Monitoring Schedule. Groundwater sampling will begin after the quarter the Consent Decree is approved (January 2000) and will continue for five years (January 2005). Sampling will occur quarterly for the first year. Ecology and ARCO will review the data after one year. This review will focus on evaluating the reasonableness/effectiveness of the remedies in the monitoring program. If trends are declining, the sampling frequency and number of parameters may be reduced. Ecology shall not unreasonably withhold approval of reductions in the monitoring program.

2.0 Groundwater Compliance Monitoring

A list of compliance monitoring wells identifying the general well location and monitoring objective is presented in Table 3. A summary of the analytical parameters to be used in compliance monitoring is presented in Tables 1 and 2. The location of all wells in which free product will be monitored, groundwater levels will be measured, and groundwater samples will be collected as part of the site compliance monitoring program are presented on Figures 6 and 7.

Compliance monitoring will begin after the quarter the Consent Decree is approved (January 2000) and will continue for five years (January 2005). Groundwater sampling will be performed quarterly for the first year. Ecology and ARCO will review the data after one year. If monitoring data shows that trends are declining, the sampling frequency and number of parameters may be reduced.

2.1 Protection Monitoring

The objective of protection monitoring is to confirm that human health and the environment are adequately protected during construction and operation and maintenance of the cleanup action [WAC 173-340-410(1)(a)]. Protection monitoring will be addressed in the health and safety plan prepared in conjunction with the engineering design report, construction plans and specifications, and operation and maintenance plan (WAC 173-340-400).

2.2 Performance Monitoring

The objective of performance monitoring is to confirm that the cleanup action has attained cleanup standards and other performance standards as appropriate [WAC 173-340-410(1)(b)]. Performance monitoring will consist of free product monitoring during product recovery activities and groundwater sampling to evaluate the effectiveness of soil and groundwater cleanup actions and natural attenuation.

2.2.1 Plant 1 Performance Monitoring

The Plant 1 performance monitoring program includes a combination of monitoring the expanded product recovery system and waterway surface water booms, and sampling of a selected well network. The monitoring program is designed to evaluate the effectiveness of the remedy in removing product and residual and dissolved hydrocarbons from beneath the warehouse and to evaluate the long-term effectiveness of intrinsic biodegradation/natural attenuation of inaccessible soils.

There are presently 16 monitoring wells being used to develop groundwater elevation contours for the site. When the 5 proposed monitoring wells along the shoreline are installed a total of 21 monitoring will be located in Plant 1.

Performance monitoring wells in Plant 1 will consist of fourteen wells (GM-11S, GM-l2S, GM-13S, GM-14S, GM-15S, GM-16S, GM-17S, GM-24S and AR-03) with five wells to be installed along the waterfront (AMW-0l, AMW-02, AMW-03, AMW-04, and AMW-05) (Figure 6). These wells will be monitored for petroleum-hydrocarbon-related IHSs (Table 1), to provide water quality data for baseline data and trend analysis. Also, these wells will be monitored for natural attenuation parameters (Table 2).

- Wells AMW-01 AMW-02, AMW-03, AMW-04, and AMW-05 will be installed primarily for confirmational monitoring but will also be included in the performance monitoring to assist in evaluating the effectiveness of the recovery system. The wells will be installed as described in Section 2.2.5. The wells will be sampled quarterly for the first year for the parameters listed in Tables 1 and 2. Subsequent sampling frequency will be determine during the first annual review (Section 3.2.1).

- GM-11S, GM-12S, and GM-13S will be monitored monthly for the presence of free product or sheens to monitor the performance and effectiveness of the product recovery system in the warehouse area. GM-13S has historically had free product.

- GM- 14S will be monitored monthly for the presence of free product or sheens to monitor the performance and effectiveness of intrinsic biodegradation/natural attenuation of the sheen historically detected in the well.

Tables 1 and 2 lists the field parameters and laboratory analytes that will be collected during sampling activities. Table 3 lists the performance wells, analytes, and sampling frequency. All of the performance wells will also be monitored for the presence of free product or sheens. If product is detected in the well, groundwater samples will not be collected for laboratory analysis. The product will be removed using a bailer, sorbents or other appropriate means.

Background Wells GM-16S and GM-17S, are located upgradient in Plant 1 along a westerly groundwater flow direction and will serve as the site background monitoring wells. These wells will be monitored for the IHSs for groundwater and natural attenuation parameters (Tables 1 and 2) to establish baseline and background groundwater quality data. Also, these monitoring wells will monitor the background rate of intrinsic biodegradation/natural attenuation upgradient of the TPH hot spot excavation area.

Sentry Well AR-03 will also be used as a "sentry" well to provide early warning for contaminant migration

Free Product: All monitoring wells where water level measurements are taken will be measured for free product. A measurable thickness of free product is defined as greater than or equal to 0.01 feet thick. Shallow wells located in or around a free product plume in Plant 1 with historic and current free product detection include, GM-11S, GM-13S and GM-14S.

Product performance monitoring will be performed in these wells prior, during and after implementation of the remedial action alternatives discussed in Section 1.4. The product performance standard is removal to the maximum extent practicable or a “measurable product thickness”, and the product cleanup standard is “no visible sheen.” After the performance standard has been met in these wells, they will be sampled for IHSs (Table 1) and natural attenuation parameters (Table 2). Product shall be removed from the water table throughout the site, when ever present.

Areas Below Cleanup Levels:

TPH and benzene were not detected above the groundwater cleanup levels (Table 1) more than once in shallow monitoring wells GM-10S, GM-10D, GM-13D, GM-16S, GM-17S, GM-17D, AR-04, and MW-04. Most of these wells are located east and some are north of Plant 1.

Total cPAHs were not detected above the groundwater cleanup levels (Table 1) more than once in shallow monitoring wells GM-13S, GM-14S, GM-16S and GM-24S.

2.2.1.1 Recovery System Monitoring

The operation of the expanded recovery system along the waterfront at Plant 1 will be monitored on a monthly basis to ensure the cleanup criteria are achieved within the established restoration time frame. A summary of monthly O&M and monitoring activities generally consists of the following activities and will be further detailed in the O&M manual:

- Inspecting equipment and piping;
- Monitoring operational parameters of the groundwater depression/product recovery system (water flow rate, system pressure, power usage, etc.);
- Gauging product and water levels in all of the recovery wells;
- Adjusting water flow rates, completing site visit report forms and daily log forms;
- Monitoring SVE system operational parameters (flow rate, system vacuums, hydrocarbon concentrations, power usage, etc.);
- Measuring applied vacuums, air flow rates, and hydrocarbon concentrations at each SVE wellhead;
- Measuring induced vacuums and water level elevations at observation wells;
- Measuring air injection pressure and flow rate at air sparging wells; and
- Sampling the groundwater influent and effluent streams.

Data collected during the O&M of the recovery system will be evaluated to monitor product and groundwater recovery rates, monitor capture of the dissolved plume, and evaluate the biodegradation rate for residual hydrocarbons.

2.2.1.2 Product Recovery System Monitoring

Product recovery system influent and effluent samples will be collected in accordance with the procedures detailed in the attached SAP (Appendix A). The influent and effluent samples will be analyzed monthly for benzene, toluene, ethylbenzene, total xylenes (BETX), TPH-G, TPH-D, and TPH-O. In addition, effluent samples will be analyzed semi-annually for total metals and annually for non-polar fats, oils, and greases (FOG) to comply with discharge permit requirements. Results of the influent and effluent sampling will be reviewed upon receipt of the analytical report from the laboratory to monitor for continued reductions in dissolved IHS's (Table 1) and to verify compliance with the King County Department of Natural Resources (KCDNR) Water and Land Resources Division, Industrial Waste Section permit which exists for the treated groundwater discharge. If a discharge permit limit is exceeded during operation of the recovery system, KCDNR Industrial Waste Section will be notified of the discharge exceedance and consulted as to the actions to be taken.

The recovery wells will be monitored for the presence of free product. This monitoring will be initially conducted on a monthly basis, and quarterly thereafter. The product recovery system will collect data regarding the amount of product recovered by the system and the recovery rate of the system. Operation of the product recovery system will be terminated upon removal of free product from the recovery wells to the extent technically practicable, and the recovery wells will continue to be monitored for the presence of free product to confirm the long-term effectiveness of the recovery system cleanup actions.

2.1.2.3 SVE System Monitoring

The SVE system vapor stream will be monitored at each wellhead and at the combined vapor stream manifold to monitor the removal of volatile hydrocarbons and the continued biodegradation of residual hydrocarbons remaining in the soils in the warehouse area. Concentrations of volatile organics will be monitored using field instruments such as an explosimeter to measure oxygen concentrations and percentage of lower explosive limit, and an organic vapor meter (OVM) to measure the concentrations of volatile organic compounds present in the vapor streams. The SVE system will be operated in a manner that will not exceed effluent concentrations greater than 50 parts per million (ppm) of TPH based on the Puget Sound Air Pollution Control Agency (PSAPCA) permit for the system. Given the preceding condition, the SVE system will not require off-gas treatment for the combined vapor stream. In order to ensure compliance with the permit limit for TPH discharge, the expanded SVE system will have a phased startup process, which will allow each section of the SVE system to be started individually and limit the effluent emissions of the system.

Geochemical fingerprinting has identified the product in the warehouse area as weathered diesel and minor amounts of detected weathered gasoline and heavy oil, which yield relatively low vapor concentrations in the unsaturated zone. Based on experience with the interim SVE system currently in operation, the vapor concentrations at startup will contain moderate TPH concentrations, which will decrease rapidly. Although vapor concentrations have never been observed in the warehouse or office, the operation or the SVE system will ensure that this potential exposure pathway is interrupted. Should SVE combined vapor stream concentrations exceed PSAPCA permit limits, off-gas treatment or other system modifications will be considered. All modifications to the existing treatment system will be discussed with PSAPCA and properly permitted prior to system startup and prior to any system changes.

2.1.2.4 Air Sparging System Monitoring

Air sparging will be used to enhance the removal of product from soils above and below the water table. Air sparging in conjunction with SVE, accomplishes this by 1) accelerating the mobilization and recovery of residual hydrocarbons, 2) enhancing natural intrinsic biodegradation by the injection of air into the saturated zone along the waterfront beneath the warehouse area, and 3) stripping volatile hydrocarbons dissolved in the groundwater and from the smear zone. Startup of the air sparging system will be initiated following removal of the majority of free product and will be determined based on product recovery system product recovery volumes and rates. Following startup, the air sparging system will be monitored on a monthly basis to ensure proper operating conditions and that all equipment is in proper working condition. Air injection pressure and airflow rate will be recorded for each of the air sparging wells. Adjustments will be made to the air injection pressure as necessary.

2.2.2 Plant 2 Performance Monitoring

The Plant 2 performance monitoring program includes sampling of a selected well network. The monitoring program is designed to evaluate the effectiveness of the remedy in removing product and residual and dissolved hydrocarbons and to evaluate the long-term effectiveness of intrinsic biodegradation/natural attenuation of inaccessible soils. There are presently nine monitoring wells being used to develop groundwater elevation contours for the site.

Performance monitoring wells in Plant 2 will consist of five wells (GM-19S, GM-l9D, GM-21S, GM-22S and MW-03 (Figure 7). These wells will be monitored for petroleum-hydrocarbon-related IHSs (Table 1), to provide water quality data for baseline data and trend analysis. Also, these wells will be monitored for natural attenuation parameters (Table 2).

- MW-03 will be monitored monthly for the presence of free product or sheens to monitor the performance and effectiveness of the product and cleanup action in this area.

Tables 1 and 2 lists the field parameters and laboratory analytes, which will be collected during sampling activities. Table 3 lists the performance wells and sampling frequency. All of the performance wells will also be monitored for the presence of free product or sheens. If product is detected in the well, groundwater samples will not be collected for laboratory analysis. The product will be removed using a bailer or sorbents.

Free Product: All monitoring wells where water level measurements are taken will be measured for free product. A measurable thickness of free product is defined as greater than or equal to 0.01 feet thick. Shallow wells located in or around a free product plume in Plant 2 with historic and current free product detection includes, MW-03.

Product performance monitoring will be performed in this well prior, during and after implementation of the remedial action alternatives discussed in Section 1.4. The product performance standard is removal to the maximum extent practicable or a "measurable product thickness", and the product cleanup standard is "no visible sheen." After the performance standard has been met in this well, it will be sampled for IHSs (Table 1) and natural attenuation parameters (Table 2). Product shall be removed from the water table throughout the site, when ever present.

Areas Below Cleanup Levels:

TPH and benzene were not detected above the groundwater cleanup levels (Table 1) more than once in shallow monitoring wells GM-20s, GM-22S and GM-22D.

Total cPAH were not detected above the groundwater cleanup levels (Table 1) in shallow monitoring wells GM-19S, GM-19D, GM-21S and GM-23S.

2.2.3 Plant 1 Performance Criteria

Separate-Phase Hydrocarbons: To monitor the effectiveness of the preferred remedial alternative discussed in Section 1.4 for free product, the performance criterion will be removal to the maximum extent practicable or a lack of measurable product thickness in compliance monitoring wells, product recovery systems and until a persistent sheen is no longer observed on the waterway. A measurable thickness of free product is defined as greater than or equal to 0.01 feet thick.

Dissolved TPH Constituents: Groundwater cleanup levels (Table 1) are based on the protection of aquatic organisms and on human ingestion of such organisms. The Point of Compliance for the site groundwater is the property boundary and is represented by the confirmational monitoring wells (Section 2.2.5).

Natural Attenuation: To demonstrate that natural attenuation is occurring to reduce contaminant concentrations, the performance criteria will be periodic monitoring of constituent plume data (i.e., benzene and TPH) and a variety of other indicators of natural attenuation processes. These processes include physical, chemical, or biological processes in the form of biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization or destruction of contaminants. Following is the rationale for the selection of the natural attenuation monitoring parameters (from USEPA, 1994c).

Constituent Plume Characteristics

In the absence of natural attenuation mechanisms, constituent concentrations would remain relatively constant within the plume and then decrease rapidly at the edge of the plume. If natural attenuation is occurring, constituent concentrations will decrease with distance from the source along the flow path of the plume as a result of dispersion. If other natural attenuation mechanisms are occurring, the rate at which concentrations of constituents are reduced will be accelerated.

Monitoring of constituent concentrations in the groundwater over time will give the best indication of whether natural attenuation is occurring. If natural attenuation is occurring, the contaminant plume will migrate more slowly than expected based on the average groundwater velocity. Receding plumes typically occur when the source has been eliminated. Natural attenuation may also be occurring in plumes that are expanding, but at a slower than expected rate. For example, in sandy soils [similar to Harbor Island] with relatively low organic carbon content (about 0.1 percent), BTEX constituents are expected to migrate at one-third to two-thirds of the average groundwater speed velocity (McAllister, 1994). Higher organic carbon content would further retard constituent migration. If constituents are migrating more slowly than expected based on groundwater flow rates and retardation factors, then other natural attenuation mechanisms (primarily biodegradation) are likely reducing constituent concentrations. For stable plumes, the rate at which contaminants are being added to the system at the source is equal to the rate of attenuation. A plume may be stable for a long period of time before it begins to recede, and in some cases, if the source is not eliminated, the plume may not recede.

Occurrence of biodegradation might also be deduced by comparison of the relative migration of individual constituents. The relative migration rates of BTEX constituents, based on the chemical properties, are expected to be in the following order:

benzene > toluene, o-xylene > ethylbenzene, m-xylene, p-xylene

If the actual migration rates do not follow this pattern, biodegradation may be responsible.

Dissolved Oxygen Indicators

The rate of biodegradation will depend, in part, on the supply of oxygen to the contaminated area. At levels of dissolved oxygen (D.O.) below 1 to 2 mg/L in the groundwater, aerobic biodegradation rates are very slow. If background D.O. levels (upgradient of the contaminant source) equal or exceed 1 to 2 mg/L, the flow of groundwater from the up-gradient source will supply D.O. to the contaminated area, and aerobic degradation is possible.

Where aerobic biodegradation is occurring, an inverse relationship between D.O. concentration and constituent concentrations can be expected (i.e., D.O. levels increase as constituent levels decrease). Thus, if D.O. is significantly below background within the plume, aerobic biodegradation is probably occurring at the perimeter of the plume.

Geochemical Indicators

Certain geochemical characteristics can also serve as indicators that natural attenuation, particularly biodegradation, is occurring. Aerobic biodegradation of petroleum products produces carbon dioxide and organic acids, both of which tend to cause a region of lower pH and increased alkalinity within the constituent plume.

Anaerobic biodegradation may result in different geochemical changes, such as increased pH. Under anaerobic conditions, biodegradation of aromatic hydrocarbons typically causes reduction of Fe^{3+} (insoluble) to Fe^{2+} (soluble), because iron is commonly used as an electron acceptor under anaerobic conditions. Thus, soluble iron concentrations in the groundwater tend to increase immediately downgradient of a petroleum source as the D.O. is depleted, and conditions change to be come anaerobic (i.e., reduced). The concentration of methane increases, another indication that anaerobic biodegradation is occurring.

Oxidation/Reduction Potential

The oxidation/reduction (redox) potential of groundwater is a measure of electron activity and is an indicator of the relative tendency of a solution to accept or transfer electrons. Because redox reactions in groundwater are biologically mediated, the rates of biodegradation both influence and depend on redox potential. Many biological processes operate only within a prescribed range of redox conditions. Redox potential also can be used as an indicator of certain geochemical activities (e.g., reduction of sulfate, nitrate, or iron). The redox potential of groundwater generally ranges from 800 millivolts to about -400 millivolts... The lower the redox potential, the more reducing and anaerobic the environment.

Measurement of redox potential of groundwater also allows for approximate delineation of the extent of the contaminant plume. Redox potential values taken from within the contaminant plume will be lower than background (upgradient) redox values and values from outside the plume. This is due in part to the anaerobic conditions that typically exist within the core of the dissolved hydrocarbon plume.

Methane. Methanogenesis has been determined to be a predominant biodegradation mechanism for fuel spills. During the aerobic biodegradation of petroleum constituents, methane is produced. Methane concentrations above background levels may indicate the occurrence of aerobic biodegradation of petroleum constituents.

Nitrate. After dissolved oxygen has been depleted, nitrate may be used as an electron acceptor for anaerobic biodegradation. Nitrate concentrations below background levels may indicate the occurrence of anaerobic biodegradation of petroleum compounds.

Sulfate. After dissolved oxygen and nitrate have been depleted, sulfate may be used as an electron acceptor for anaerobic biodegradation. Sulfate concentrations below background levels may indicate the occurrence of anaerobic biodegradation of petroleum compounds.

On-going natural attenuation has been documented at the terminal (Geraghty & Miller 1997). A biotreatability study was conducted as part of the RI to evaluate the feasibility of in-situ biological treatment for TPH-impacted soils. Soil samples were collected from a variety of locations at the terminal and evaluated for biotreatability parameters including microbial plate counts. The results of the study concluded that natural attenuation is ongoing at the site. These conclusions are further supported by the on going stabilization of the dissolved plumes at the site that are associated with the soil hot spots.

The effectiveness of continued natural attenuation at the site will be evaluated as part of the performance monitoring program. This evaluation will focus primarily on documenting loss of contaminant mass in groundwater and monitoring trends in biogeochemical parameters. The extensive database developed as part of the on-going groundwater monitoring program will support documenting trends in water quality. Biogeochemical trends will be established by analyzing groundwater samples for the parameters of Tables 1 and 2.

2.2.3.1 SVE System Performance Criteria

The purpose of operating the SVE system is to remove volatile hydrocarbons from the vadose zone, ensuring that the soil vapor to air pathway in the area of the product plume is interrupted. Also, SVE operation will maintain elevated oxygen concentrations within the vadose, zone and accelerate the in-situ biodegradation of residual hydrocarbons in the smear zone.

Operation of the SVE system will continue until volatile petroleum hydrocarbons are recovered and residual, hydrocarbons are, degraded to a level that ensures continued compliance of cleanup criteria in the warehouse area confirmational wells.

2.2.3.2 Air Sparging Performance Criteria

The purpose of operating the air sparging system is to enhance the removal of product from below and above the water table. The air sparging system will be operated until the effect on product recovery becomes negligible (measurable product thickness), and residual hydrocarbons are degraded to level that ensures continued compliance of cleanup criteria in the warehouse area confirmational wells. A measurable thickness of free product is defined as greater than or equal to 0.01 feet thick.

2.2.3.3 Surface Water Boom Monitoring

The two booms located in the Duwamish River adjacent to the warehouse and loading rack areas of Plant 1 will continue to be maintained to contain the sheens, which occasionally appear on the waterway. The sorbent booms are monitored by field observation for soiling and damage and are replaced when necessary. The spent sorbent booms are sampled for waste classification and are properly disposed.

The presence of sheens on the waterway will continue to be monitored by visual observation. The observations will be recorded on a log as to the presence or absence of sheens, area, and location. These observations will be compared to historical sheen observations, operational status of the recovery system, and the tide stage of the waterway. The results of the sheen monitoring will be used to determine the effectiveness of the remedial actions on reducing the sheen and to evaluate if adjustments to the remedial actions are necessary along the waterfront. The booms will be maintained until there are no persistent sheens associated with the terminal detected.

2.2.4 Plant 2 Performance Criteria

To monitor the effectiveness of the preferred remedial alternative discussed in Section 1.4 for free product, the performance criterion will be removal of free product to the maximum extent practicable or a lack of measurable product thickness in compliance monitoring well(s) (Section 2.2.2). A measurable thickness of free product is defined as greater than or equal to 0.01 feet thick.

The effectiveness of continued natural attenuation at the site will be evaluated as part of the performance monitoring program. This evaluation will focus primarily on documenting loss of contaminant mass in groundwater and monitoring trends in biogeochemical parameters. The extensive database developed as part of the on-going groundwater monitoring program will support documenting trends in water quality. Biogeochemical trends will be established by analyzing groundwater samples for the parameters of Tables 1 and 2.

2.2.5 Plant 1 Confirmational Monitoring

The objective of confirmation monitoring is to confirm the long-term effectiveness of the cleanup action as discussed in Section 1.4, once performance and cleanup standards have been met [WAC 173-340-410(1)(c)].

Confirmational monitoring wells in Plant 1 will consist of six wells (AR-03 and the five wells to be installed along the waterfront AMW-0l, AMW-02, AMW-03, AMW-04, and AMW-05) (Figure 6). These wells will be monitored for petroleum-hydrocarbon-related IHSs (Table 1), to provide water quality data for baseline data and trend analysis. Further these wells will be monitored for natural attenuation parameters (Table 2).

The wells to be installed along the waterfront will be constructed to allow representative sampling of the zone of groundwater discharge that is located beneath the warehouse foundation and Island bulkhead and above the brackish groundwater. The wells will be constructed as close to the shoreline and inland of subsurface barriers as practical to intercept the area of groundwater flow. The wells will be screened across this zone from near the base of the bulkhead to above the top of the brackish zone resulting in screen depths extending from approximately 25 feet to 35 feet bgs. After quarterly sampling of the parameters listed in Tables 1 and 2, for the first year of confirmational monitoring, ARCO and Ecology will review the data. Based on that review, sampling frequency and number of parameters may be reduced based on the results of that evaluation.

All of the confirmational wells will also be monitored for the presence of free product or sheens. If product is detected in the well, groundwater samples will not be collected for laboratory analysis. The product will be removed using appropriate means. After the performance standard has been met in this well, confirmational monitoring will include sampling for IHSs (Table 1) and natural attenuation parameters (Table 2) quarterly for the first year. Subsequent sampling frequency and number of analytes to sample will be determined during the first year trend review and analysis (Section 3.2.2). Product shall be removed from the water table throughout the site, whenever present.

2.2.6 Plant 2 Confirmational Monitoring

Confirmational monitoring wells in Plant 2 will consist of five wells (GM-19S, GM-l9D, GM-22S, GM-21S and MW-03 (Figure 7). These wells will be monitored for petroleum-hydrocarbon-related IHSs (Table 1), to provide water quality data for baseline data and trend analysis. Further these wells will be monitored for natural attenuation parameters (Table 2).

- MW-03 will be monitored monthly for the presence of free product or sheens to monitor the performance and effectiveness of the product and cleanup action in this area.

All of the confirmational wells will also be monitored for the presence of free product or sheens. If product is detected in the well, groundwater samples will not be collected for laboratory analysis. The product will be removed using a bailer or sorbents. After the performance standard has been met in this well, confirmational monitoring will include sampling for IHS (Table 1) and natural attenuation parameters (Table 2) quarterly for the first year. Subsequent sampling frequency and number of analytes to sample will be determined during the first year trend review and analysis (Section 3.2.2). Product shall be removed from the water table throughout the site, when ever present.

2.2.7 Plant 1 Compliance Criteria for Confirmational Monitoring

Separate-Phase Hydrocarbons: To demonstrate that free product removal has been accomplished, the confirmational criterion will be a lack of sheen in compliance monitoring wells for a period of 1 year.

Groundwater: Cleanup levels are based on the protection of aquatic organisms and humans ingesting such organisms. The point of compliance where these cleanup levels will be met is at the property boundary of the ARCO site and this is represented by the cofirmational groundwater monitoring wells (Section 2.2.5). The groundwater cleanup levels are presented in Table 1.

Groundwater samples will be collected from the confirmational monitoring wells for a maximum of five years following attainment of cleanup levels, or until the concentrations are determined as no longer being affected by on-site sources. Indications of that criterion are groundwater concentrations below cleanup levels for four quarters or the concentration of the analytes have stabilized and reached equilibrium. Groundwater quality will be evaluated based on trends and not based on a single event or cleanup exceedance in a single well. Equilibrium concentrations of each analyte may be determined using statistical methods or another method approved by Ecology. If groundwater quality data indicate that at least 95 percent of the wells are below cleanup levels for four or more consecutive quarters, ARCO will petition Ecology for a site de-listing review for Plant 1. If Ecology concurs, the site shall be de-listed.

Sediment/biota Sampling Following completion of the product removal and compliance monitoring, one round of sediment/biota sampling will be conducted to ensure protection of the aquatic organisms in the Duwamish Waterway. The results of this sampling will be considered for the site de-listing.

2.2.8 Plant 2 Compliance Criteria for Confirmational Monitoring

Separate-Phase Hydrocarbons: To demonstrate that free product removal has been accomplished, the confirmational criterion will be a lack of sheen in compliance monitoring wells for a period of 1 year.

Groundwater: Cleanup levels are based on the protection of aquatic organisms and humans ingesting such organisms. The point of compliance where these cleanup levels will be met is at the property boundary of the ARCO site and this is represented by the confirmational groundwater monitoring wells (Section 2.2.6). The groundwater cleanup levels are presented in Table 1.

Groundwater samples will be collected from the confirmational monitoring wells for a maximum of five years following attainment of cleanup levels, or until the concentrations are determined as no longer being affected by on-site sources. Indications of that criterion are groundwater concentrations below cleanup levels for four quarters or the concentration of the analytes have stabilized and reached equilibrium. Groundwater quality will be evaluated based on trends and not based on a single event or cleanup exceedance in a single well. Equilibrium concentrations of each analyte may be determined using statistical methods or another method approved by Ecology. If groundwater quality data indicate that at least 95 percent of the wells are below cleanup levels for four or more consecutive quarters, ARCO will petition Ecology for a site de-listing review for Plant 2. If Ecology concurs, the site shall be de-listed.

2.2.9 Monitoring Schedule

Monitoring of the confirmation and performance groundwater monitoring wells will begin after the quarter the Consent Decree is approved (January 2000). Confirmation monitoring will continue for five years (January 2005) after completion of the cleanup action. Sampling will occur quarterly for the first year. Ecology and ARCO will review the data after one year. This review will focus on evaluating the reasonableness/effectiveness of the remedies in the monitoring program. If trends are declining, the sampling frequency and number of parameters may be reduced. Ecology shall not unreasonably withhold approval of reductions in the monitoring program.

3.0 DATA EVALUATION AND REVIEW

3.1 Data Evaluation

All data will be evaluated following collection of the data and/or validation of the laboratory analytical data after each monitoring event. All groundwater level and groundwater quality data will be entered into the comprehensive site database.

3.1.1 Data Validation

Laboratory analytical data from performance and confirmational monitoring will be validated according to the USEPA data validation guidelines (USEPA 1994b and 1994c). Data validation will include evaluation of holding times, method blank results, surrogate recovery results, field and laboratory duplicate results, completeness, detection limits, laboratory control sample results, and chain-of-custody forms. The data validation process also includes qualification of data if necessary. Data validation procedures are described in further detail in the SAP (Appendix A). All groundwater quality data will be entered into the site database with any applicable qualifiers following data validation.

3.1.2 Practical Quantitation Limits

Practical Quantitation Limits (PQL's) will be established for each analyzed groundwater quality constituent to determine whether any are above the corresponding cleanup level. Per WAC 173-340-707(2), if the PQL for any constituent is above the corresponding cleanup level, the cleanup level will be considered to be attained if the constituent is undetected at the PQL or detected below the PQL. The PQL will be determined by multiplying the lowest method detection limit obtained by the laboratory for groundwater samples collected from the site by a factor of ten (Ecology 1993). It is anticipated that PQL's will be used as cleanup levels for cPAH's only.

3.1.3 Product Monitoring and Recovery System Data

Product monitoring data and product recovery system influent and effluent data will be evaluated monthly following the monthly site O&M visit to determine if adjustments to the product recovery system are necessary and monitor the effectiveness of the system. The Waterway sheen monitoring information will be reviewed to evaluate the effectiveness of the product recovery system.

3.1.4 Performance Monitoring Data

The results of the performance monitoring will be evaluated to monitor trends in groundwater quality and confirm that cleanup levels have been attained or that concentrations are determined as no longer being affected by on-site sources. Indications of that criterion are concentrations below cleanup levels for four quarters or the concentrations of the analytes have stabilized and reached equilibrium. Equilibrium concentrations of each analyte may be determined using statistical methods or another method approved by Ecology.

3.1.5 Confirmational Monitoring Data

The results of the confirmational monitoring will be evaluated to confirm the long-term effectiveness of the cleanup actions at the site. The data evaluation will include comparisons with trends established by the existing groundwater monitoring data. Statistical analysis may be used to support the data evaluations. The statistical methodologies that may be used are outlined in Ecology's statistical guidance document (Ecology 1992) and supplement (Ecology 1993).

3.2 Data Review

3.2.1 One Year Site Review

Following one year of performance monitoring at Plants 1 and 2, all groundwater performance data (recovery system data, groundwater level data, product level data, and groundwater quality and biogeochemical data) will be reviewed by ARCO and Ecology. The review will focus on evaluating the effectiveness of the cleanup actions and monitoring programs.

Appropriate adjustments to the cleanup actions or monitoring programs that effect attaining remedial action objectives and restoration time frames of the site may be made based on the results of the review. Additional reviews may be requested by ARCO and Ecology based on performance of the remedies.

Groundwater level data will be reviewed and groundwater contour maps for Plants 1 and 2 will be plotted to verify that groundwater flow directions have not significantly changed from historical groundwater flow patterns.

Biogeochemical data will be evaluated to determine the effectiveness and rate of natural attenuation, as discussed in the USEPA guidance document (USEPA 1994d).

Groundwater quality data from performance monitoring will be evaluated using time-trend analysis and also by comparing the data to cleanup levels. The one-year of quarterly performance data may be utilized along with the historic groundwater monitoring data when appropriate to evaluate long-term trends in the data. ARCO and Ecology will review sampling frequency based on the trends, and sampling frequency and/or number of parameters may be reduced.

3.2.2 Five Year Site Review

At a minimum, all groundwater data (groundwater level data, product level data, and groundwater quality and biogeochemical data) will be reviewed by ARCO and Ecology five years after performance monitoring begins at the site. This review will focus on evaluating the reasonableness/effectiveness of the remedies in the monitoring program. If trends are declining, the sampling frequency and number of parameters may be reduced. Ecology shall not unreasonably withhold approval of reductions in the monitoring program.

Groundwater level data will be reviewed and groundwater contour maps for Plants 1 and 2 will be plotted to verify that groundwater flow directions have not significantly changed from historical groundwater flow patterns.

Biogeochemical data will be evaluated to determine the effectiveness and rate of natural attenuation, as discussed in the USEPA guidance document (USEPA 1 994d).

Groundwater quality data from monitoring activities will be evaluated using time trend analysis and also by comparing the data to cleanup levels. Statistical evaluation may be used to evaluate trends in individual wells if at least one result for a constituent is above the cleanup level. Any statistical evaluation will be completed per WAG 173-340-720(8) and Ecology guidance documents (Ecology 1992 and 1993).

The site has a five-year restoration time frame and it is anticipated that ARCO will petition Ecology for site delisting at the five-year site review, if prior site delisting was not requested and approved. Groundwater quality data must indicate that at least 95 percent of the wells are below cleanup levels for four or more consecutive quarters before requesting site delisting. Contingency plans will be enacted if ARCO does not meet the five-year restoration time frame for the site.

4.0 Reporting

Performance and confirmational monitoring data and information will be provided to Ecology throughout the restoration time frame for the site. The frequency and content of the reporting is as follows:

Monthly Reports. Product recovery system data and information will be provided to Ecology on a monthly basis for the first quarter after startup of the recovery system, and quarterly thereafter. The Monthly Status Report will include product recovery system operation and performance information, product monitoring data, groundwater influent and effluent data, SVE system field parameters, and any changes to the treatment system. Compliance with KGDNR Industrial Waste Section and PSAPCA permits will also be discussed.

Quarterly Reports. Laboratory analytical reports will be provided to Ecology following receipt of the laboratory report for quarterly sampling activities.

Annual Reports. Groundwater monitoring data will be provided to Ecology on an annual basis in the form of an Annual Groundwater Monitoring Report. The annual report will include a discussion of the activities completed, a discussion of the data, data validation information, data tables, concentration graphs, and laboratory analytical reports for the wells in the monitoring well network. A total of five annual reports will be completed and submitted to Ecology based on the five-year restoration time frame for cleanup and monitoring activities at the site. The annual report will also replace the quarterly monitoring report for the quarter it is submitted to Ecology.

Five Year Review Report. Following five years of cleanup actions and groundwater monitoring activities, one report summarizing the product recovery system data and groundwater monitoring data will be completed and submitted to Ecology for review. The report will include groundwater elevation data; analytical data from the product recovery system, SVE system, and groundwater monitoring; waterway sheen monitoring information; product monitoring data; product recovery system operational data and information; SVE and air sparging system operational information; groundwater data tables and concentration graphs; any statistical information used to support the data; a comparison of the data to cleanup levels; and a discussion of natural attenuation.

5.0 Contingency Plan

A contingency plan is a cleanup technology that serves as a "backup" remediation technology in the event the preferred option fails or proves ineffective in a timely manner. A contingency plan is included as part of this Groundwater Compliance Monitoring and Contingency Program in the event that the remedial actions are not effective within the five-year restoration time-frame anticipated for site cleanup and monitoring activities to be completed.

Contingency Criteria

Implementation of the contingency plan will be based on the results of the performance and confirmational monitoring program. A contingency plan will be initiated and implemented within 30 days of meeting any of the following criteria:

- If, after implementing the selective remedial action, the results of the groundwater monitoring program indicate elevated contaminant concentration over the specified restoration time frame of 5 years;

- If contaminants are newly identified in point of compliance wells located beyond the original plume boundary, indicating renewed contaminant migration.

Detail contingency outline for the shoreline and the inland are summarized below.

<u>Shoreline Contingency</u>

- A persistent sheen is observed on the waterway adjacent to the ARCO terminal;

- Product is observed in any monitoring well or recovery well. Confirmational groundwater monitoring results indicate increasing concentrations above cleanup levels of one or more IHS' s which are attributable to historical on-site releases or which may indicate a new release.

Shoreline Contingency plan components

Implementation of one or more of the following alternatives may be selected in response to any of the above occurrences:

- Review the efficiency of the existing remedial actions and restoration time frame to determine if the remedial actions are effective in providing sufficient protection but will take longer than anticipated to achieve the cleanup criteria.;

- Identification and removal to the extent practicable of the source(s) causing the criteria to be triggered;

- Initiate passive or active product recovery in the well(s) in which product is observed;

- Startup or adjustment of specific elements of the product recovery system, SVE system, or air sparging system based on the location of product (i.e., in a monitoring or recovery well, or a persistent sheen on the waterway);

- Evaluate the effectiveness of the product recovery system, SVE system, or air sparging system based on the location of product to ensure system influence in that area, and expand the recovery system if necessary;

- Statistical evaluation of the groundwater monitoring data if groundwater monitoring results indicate an increasing trend above cleanup levels of one or more IHS's in a monitoring well;

Inland Soils

The process for evaluating the results of monitoring and contingency actions for the inland soil's remedy are contained in the flow chart in Figure 8 and summarized below.

- Addition of nutrients to further enhance intrinsic biodegradation/natural attenuation of the residual TPH in inaccessible soils. The results of the biotreatability study conducted as part of the RI concluded that natural attenuation is ongoing at the site, and that it may be further enhanced by the addition of nutrients such as nitrates and/or phosphates.

- Evaluate and implement groundwater migration control options, if necessary.

In the event that the contingency plan should be implemented, ARCO will prepare a contingency work plan within 30 days of making contingency determination that contains engineering design criteria as needed to address the criteria triggering the contingency action.

6.0 References

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U.S. Environmental Protection Agency (USEPA). 1995. "A Guide for Corrective Action Plan Review, How to Evaluate Alternative Cleanup Technologies for Underground Storage Tank Site, *510-B-95-007"*. May 1995.

Washington State Department of Ecology (Ecology). 1992. "Statistical Guidance for Ecology Site Managers". Publication No.92-54. August 1992.

Washington State Department of Ecology (Ecology). 1993. "Statistical Guidance for Ecology Site Managers, Supplement S-6. Analyzing Site or Background Data with Below-Detection Limit or Below-PQL Values (Censored Data Set)". August 1993.

Table 1
Groundwater Cleanup Levels
ARCO Harbor Island Terminal
Seattle, Washington

Constituent	Cleanup Level (mg/L)
Benzene	0.071
CPAH	0.000031
Product	No Sheen
TPH-G	1
TPH-D	10
TPH-O	10

Table 2
Natural Attenuation Indicator Parameters
ARCO Harbor Island Terminal
Seattle, Washington

Field Parameters	Biogeochemical Analytes
pH	pH
Temperature	Carbon dioxide
Conductivity	Hardness
Turbidity	Methane
Water level	Redox
Product level	DO
	Conductivity
	Alkalinity
	Ferrous iron
	Sulfate and Sulfide
	Nitrate and Chloride

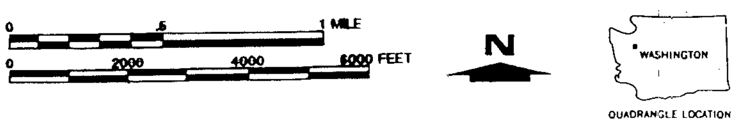
Table 3
Compliance Monitoring Wells
ARCO Harbor Island Terminal
Seattle, Washington

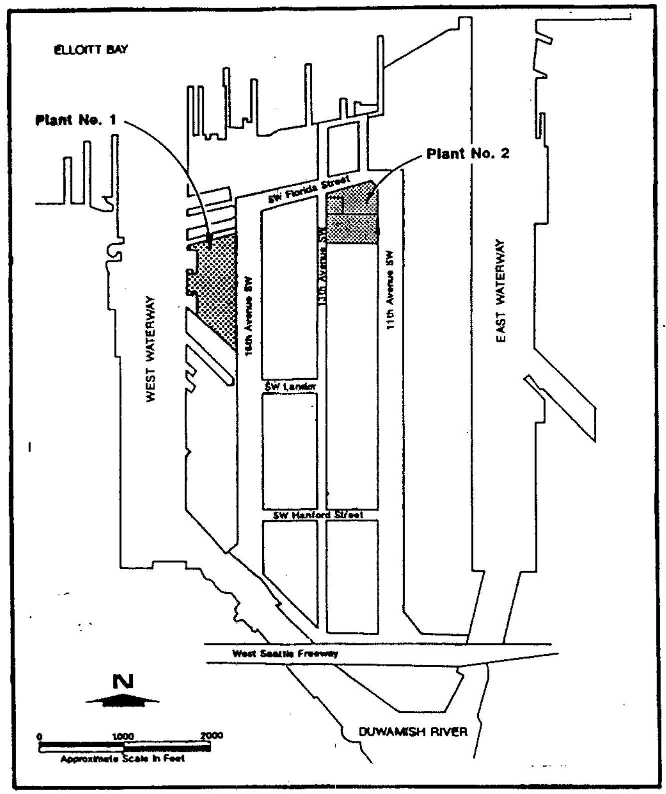
Monitoring Well	Well Location	Compliance Monitoring Objective
AR-03	Plant1	Performance/Confirmational / Sentry
AMW-01	Plant 1	Performance/Confirmational
AMW-02	Plant 1	Performance / Confirmational
AMW-03	Plant 1	Performance/Confirmational
AMW-04	Plant 1	Performance/Confirmational
AMW-05	Plant 1	Performance/Confirmational
GM-11S	Plant 1	Performance
GM-12S	Plant 1	Performance
GM-13S	Plant 1	Performance
GM-14S	Plant 1	Performance
GM-15S	Plant 1	Performance
GM-16S	Plant 1	Performance
GM-17S	Plant 1	Performance
GM-24S	Plant 1	Performance
GM-19S	Plant 2	Performance / Confirmational
GM-19D	Plant 2	Performance / Confirmational
GM-21S	Plant 2	Performance / Confirmational
GM-22S	Plant 2	Performance / Confirmational
GM-23S	Plant 2	Performance
MW-03	Plant 2	Performance / Confirmational/Sentry

FIGURES

183135

SOURCE: USGS 7.5 x 15 Minute Topographic Map, SEATTLE SOUTH, WASHINGTON Quadrangle, Dated 1983.





DWG DATE: MAR 1994 | PRJCT NO.: WA0254.003 | FILE NO.: | DRAWING: | CHECKED: | APPROVED: LER | DRAFTER: SAC

SITE LOCATION MAP

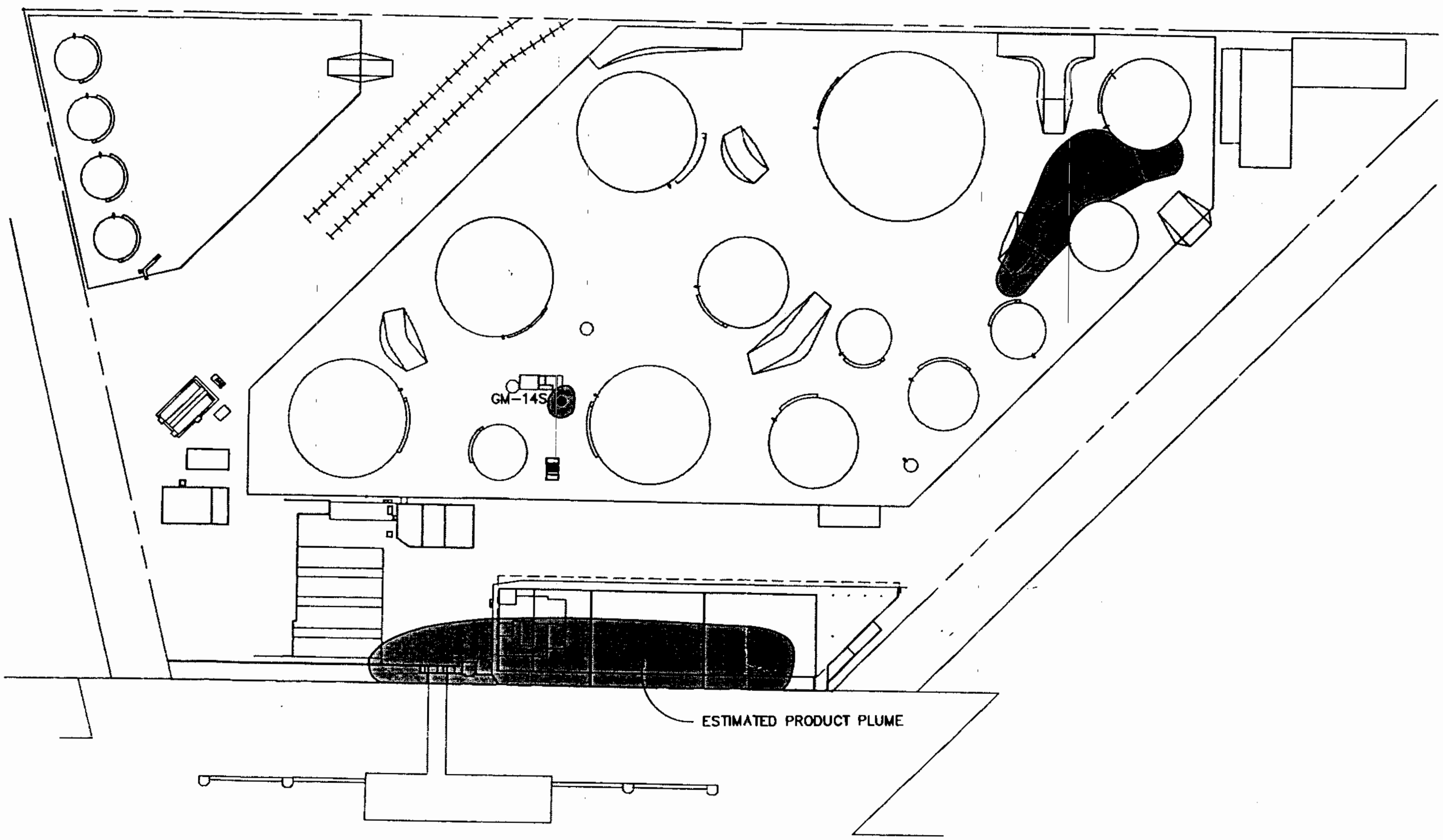
ARCO Harbor Island Terminal 21T

1652 SW Lander Street

Seattle, Washington

FIGURE

1



LEGEND

- ● MONITORING WELL
- REMEDIATION AREA

N

0 100 200
SCALE IN FEET

TECHSOLV
TechSolv Consulting Group, Inc.

PLANT 1 REMEDIATION AREAS

ARCO HARBOR ISLAND TERMINAL 21T
1652 Southwest Lander Street
Seattle, WA 98134

FIGURE
2

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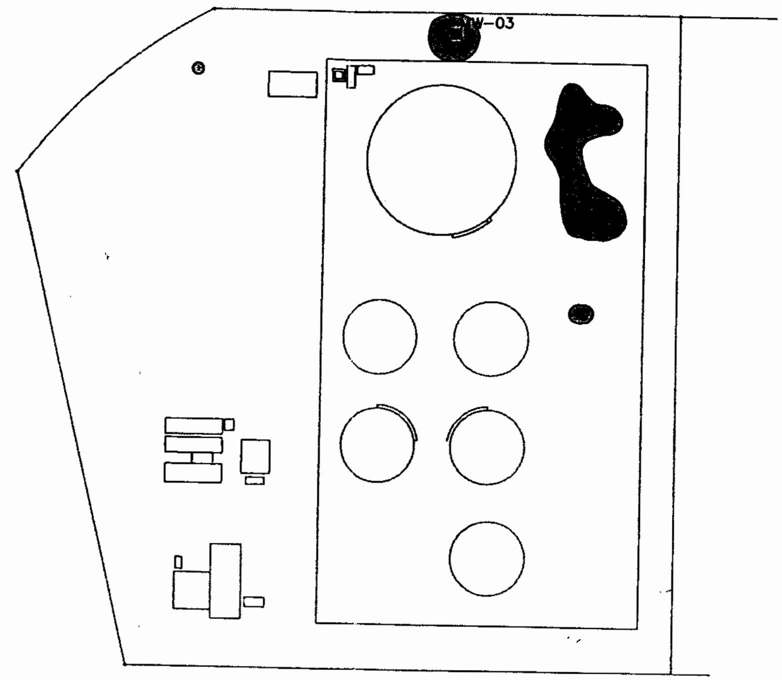


LEGEND

- ■ MONITORING WELL
- REMEDIATION AREA

0 100 200
SCALE IN FEET

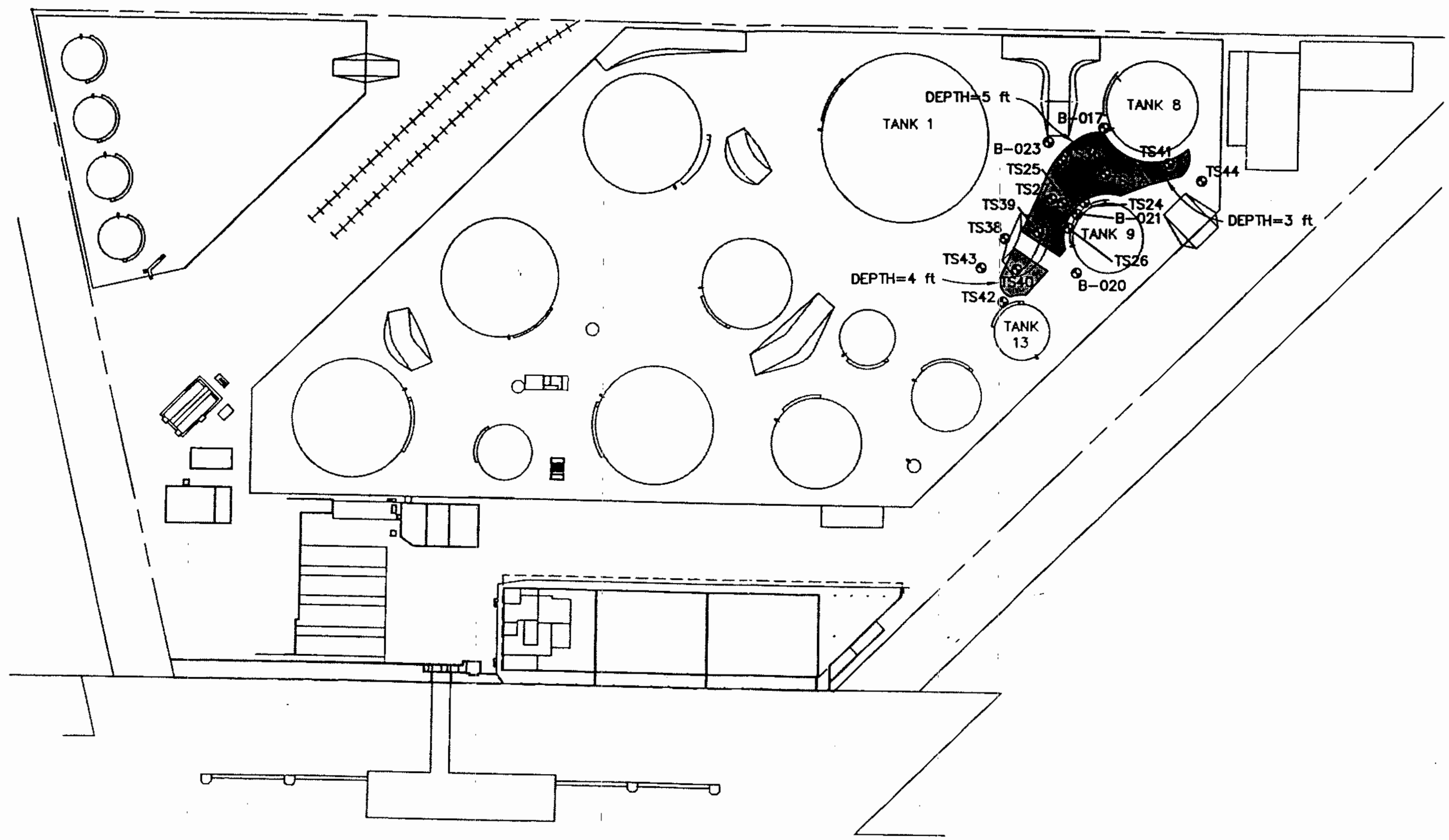
N

TECHSOLV
TechSolv Consulting Group, Inc.

PLANT 2 REMEDIATION AREAS

ARCO HARBOR ISLAND TERMINAL 21T
1652 Southwest Lander Street
Seattle, WA 98134

FIGURE 3



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LEGEND

- SOIL BORING
- REMEDIATION AREA

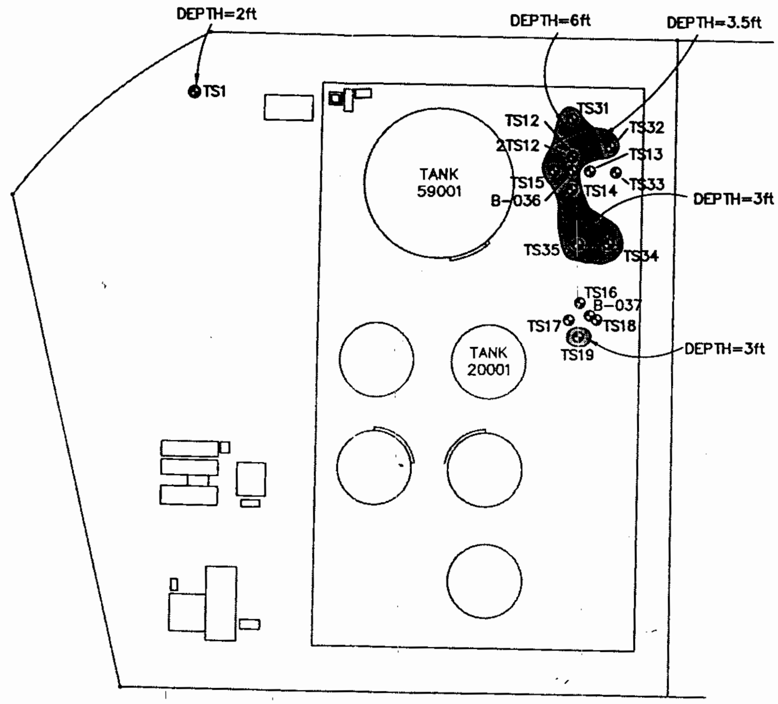
0 100 200
SCALE IN FEET

TECHSOLV
TechSolv Consulting Group, Inc.

PLANT 1 PROPOSED EXCAVATION AREA

ARCO HARBOR ISLAND TERMINAL 21T
1652 Southwest Lander Street
Seattle, WA 98134

FIGURE
4



LEGEND

SOIL BORING
REMEDIATION AREA

0 100 200
SCALE IN FEET

TECHSOLV
TechSolv Consulting Group, Inc.

PLANT 2 PROPOSED EXCAVATION AREAS

ARCO HARBOR ISLAND TERMINAL 21T
1652 Southwest Lander Street
Seattle, WA 98134

FIGURE
5

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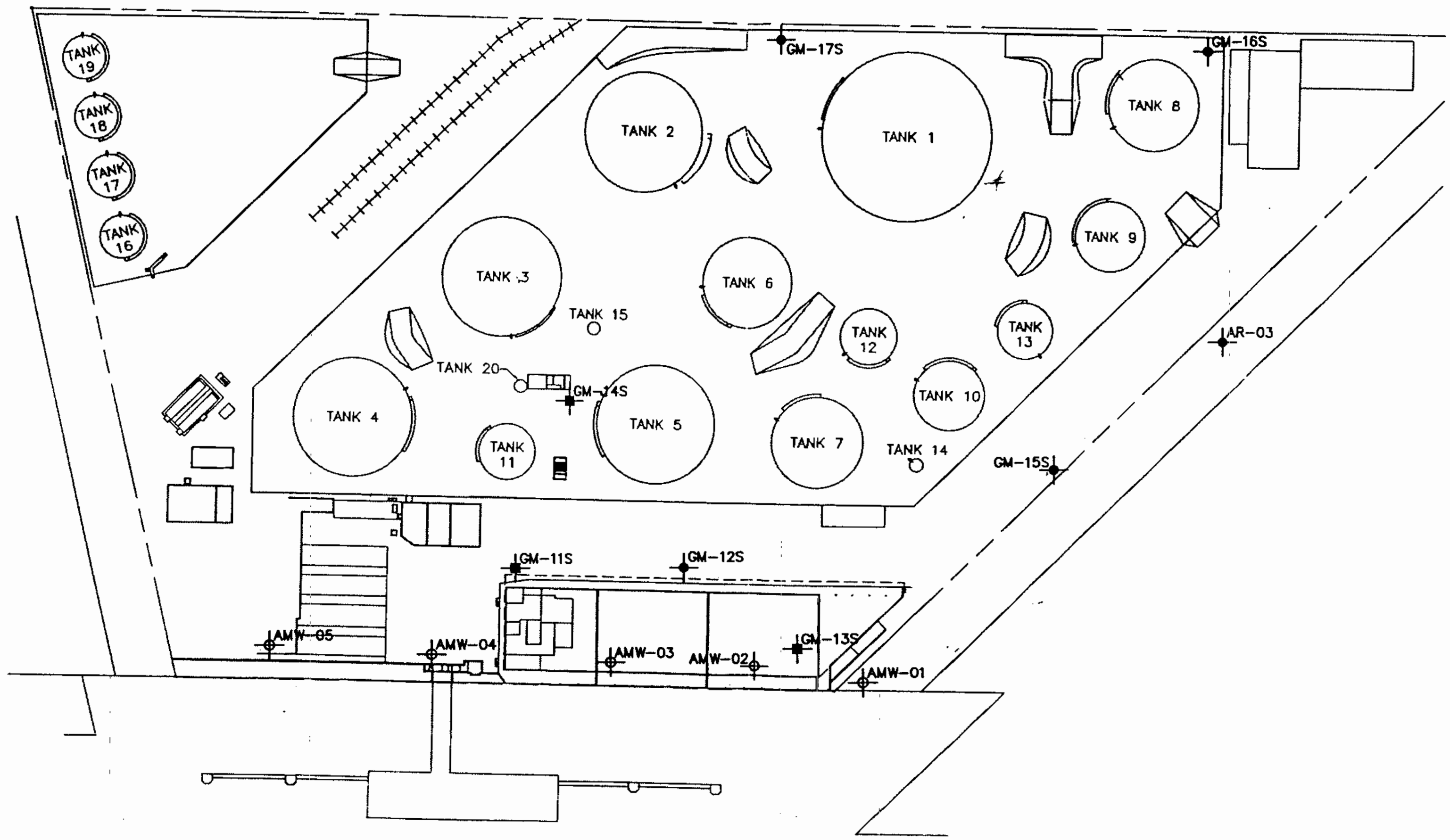

LEGEND

GM-16S	PERFORMANCE WELL
GM-11S	PRODUCT PERFORMANCE WELL
AMW-01	PROPOSED PERFORMANCE/CONFIRMATION WELL

N

0 100 200

SCALE IN FEET

TECHSOLV

TechSolv Consulting Group, Inc.
12510 120th Lane NE, Kirkland, WA 98034
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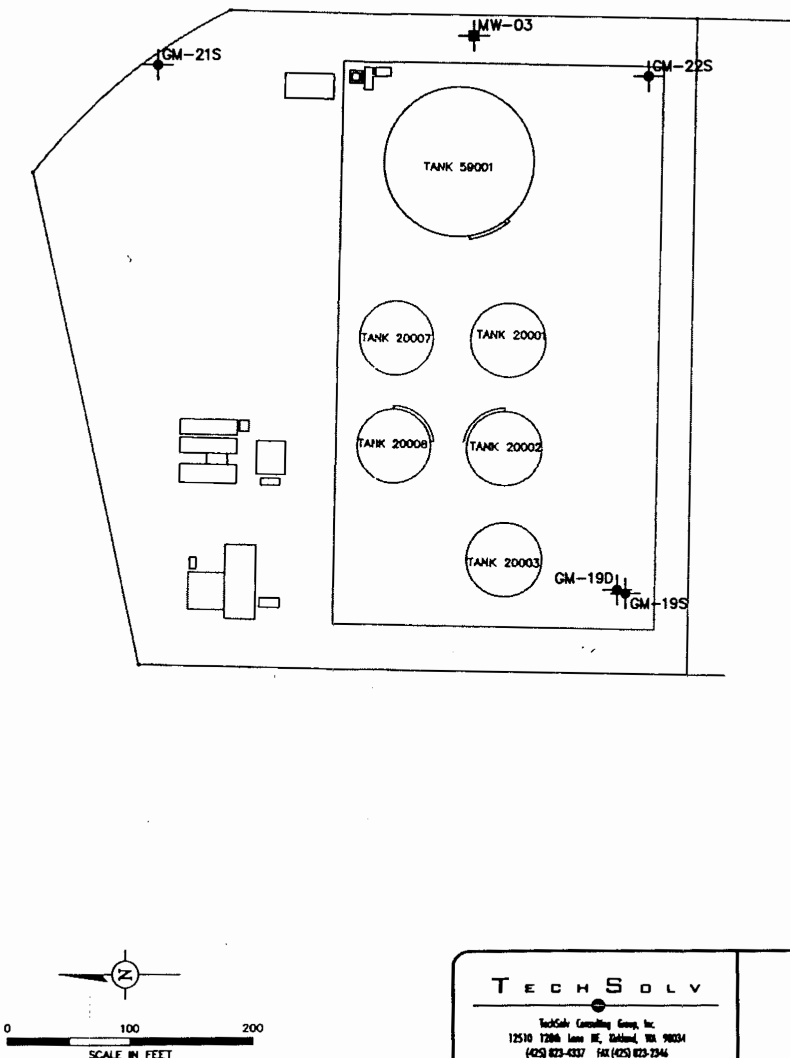
PLANT 1 MONITORING WELL NETWORK

ARCO HARBOR ISLAND TERMINAL 21T
1652 Southwest Lander Street
Seattle, WA 98134

FIGURE

6



LEGEND

GM-19S PERFORMANCE/CONFIRMATION WELL

MW-03 PRODUCT PERFORMANCE WELL

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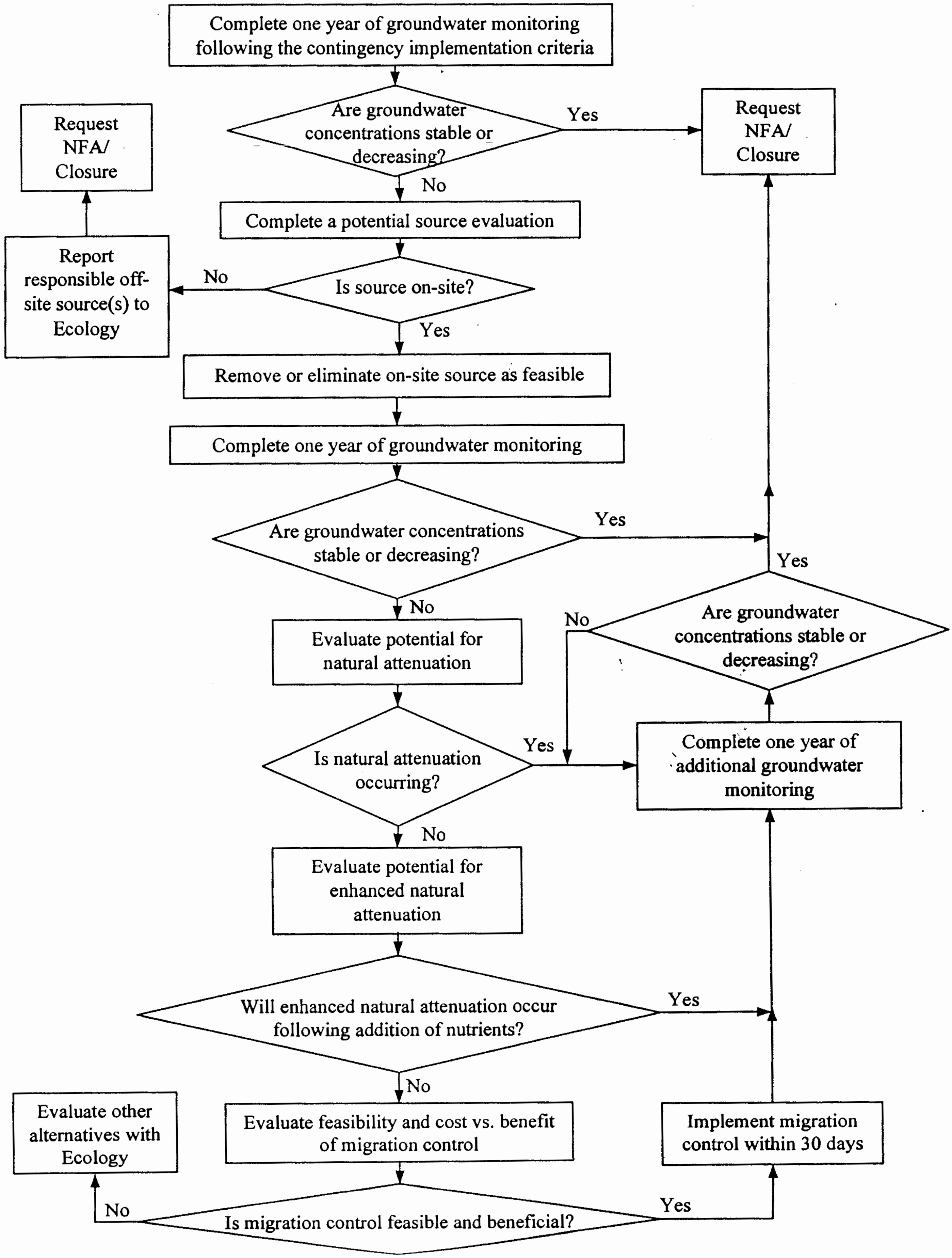
PLANT 2 MONITORING WELL NETWORK

ARCO HARBOR ISLAND TERMINAL 21T
1652 Southwest Lander Street
Seattle, WA 98134

FIGURE 7

FILENAME: S11433\11433A82.DWG CREATED: MAY 06 1993 19:07:51 UPDATED: NOV 24 1999 14:33:15 PLOTTED: NOV 24 1999 14:33:22 (VRM) 400-360

FIGURE 8. INLAND GROUNDWATER AND SOILS CONTINGENCY PLAN ARCO HARBOR ISLAND TERMINAL 21T, SEATTLE, WA



SAMPLING AND ANALYSIS PLAN

ARCO HARBOR ISLAND TERMINAL 21T

SEATTLE, WASHINGTON

November 1999

Prepared for

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TABLE OF CONTENTS

TABLES

1. INTRODUCTION

This Sampling and Analysis Plan (SAP) was prepared by TechSolv Consulting Group, Inc. (TechSolv) in conjunction with ARCADIS Geraghty & Miller (Geraghty & Miller) as part of the remedial design activities and development of the Groundwater Compliance Monitoring and Contingency Program for the ARCO Products Company (ARCO) Harbor Island Terminal 21T in Seattle, Washington. Field and analytical activities as well as site history and conditions are discussed in general terms in the Groundwater Compliance Monitoring and Contingency Program. The SAP establishes specific procedures and protocols for sample collection and field analysis activities to be conducted during implementation of the remediation activities and Groundwater Compliance Monitoring and Contingency Program. This SAP fulfills the requirement for a sampling and analysis plan as defined in the Washington State Model Toxics Control Act (MTCA) (WAC 173-340-820) and meets the provisions of the Agreed Order between ARCO and the Washington State Department of Ecology (Ecology).

The sections that follow describe detailed procedures to be followed for tasks to be completed during the field program, as well as specific laboratory analytical procedures and data quality assurance. All personnel carrying out field tasks as part of the remedial design and Groundwater Compliance Monitoring and Contingency Program will be required to adhere to the health and safety provisions set forth in the Site Health and Safety Plan (SHSP). The Groundwater Compliance Monitoring and Contingency Program, SAP, and SHSP will be available to all field personnel for procedure guidance.

2. OBJECTIVES

The overall objective of the sampling program is to obtain data of known and defensible quality. In addition, the data collected during the remedial design and compliance monitoring program must be comparable with data collected during the RI activities previously completed at the site. To achieve these goals, data collection, sample collection, sample handling, and field documentation conventions must be well-defined prior to the initiation of the remedial design and compliance monitoring program and stringently adhered to during the course of the program. A detailed account of the procedures to be followed during the remedial design and compliance monitoring program is provided below. If any procedures are modified during the course of the program, the change will be documented in the field notes, explaining the change in procedure.

In addition to the overall objective, a number of the field program objectives are specific to individual tasks. The specific objectives are detailed below:

2.1 Groundwater Sampling

Groundwater samples will be collected from selected monitoring wells installed at the site to verify trends in water quality, confirm cleanup objectives have been attained, and verify cleanup objectives are maintained.

2.2 Soil Sampling

Soil samples may be collected during the installation of performance/confirmational monitoring wells along the waterfront to further define the vertical extent of petroleum hydrocarbons in the soils beneath the warehouse.

Soil samples will be collected from the perimeter of the inland soil excavations in both Plant 1 and Plant 2 to assist in quantifying any residual total petroleum hydrocarbons (TPH) remaining in the inland soils.

2.3 Sediment and Biota Sampling

One round of sediment/biota sampling will be conducted following completion of product removal and compliance monitoring to ensure protection of the aquatic organisms in the

Duwamish waterway. Sediment/biota sampling will be implemented in accordance with the procedures outlined in the State of Washington Sediment Management Standards.

2.4 Data Quality Objectives

The overall quality assurance (QA) objective is to develop and implement procedures for field sampling, chain-of-custody, laboratory analysis, and reporting that will provide data of a known quality which are usable, defensible, and can be used for decision making.

Specific procedures for sampling, chain-of-custody, calibration, laboratory analysis, reporting of data, internal quality control (QC), audits, preventive maintenance, and corrective action are described in other sections of this SAP. The purpose of this section is to address the specific objectives for accuracy, precision, completeness, representativeness, and comparability.

2.4.1 Level of Quality Control Effort

Field blank, trip blank, field duplicate, and matrix spike samples will be analyzed to assess the quality of the data. Field and trip blanks provide a means to assess the quality of the data resulting from the field sampling program. Field blank samples are analyzed to check for procedural contamination at the site, which may cause sample contamination. Trip blanks are used to assess the potential for contamination of samples due to contamination migration during sample shipment and storage. Field duplicate samples are analyzed to check for sampling and analytical reproducibility. Matrix spike and matrix duplicate (MD) samples provide information about the effect of the sample matrix on the digestion and measurement methodology. For organic analyses, all matrix spikes are performed in duplicate and are hereinafter referred to as MS/MSD samples. For inorganic analyses, QC samples include MS’s and MD’s.

The general level of the QC effort will be one field duplicate and one field blank for every ten or fewer investigative samples. One volatile organic compound (VOC) trip blank consisting of distilled deionized ultra-pure water will be included with each shipment of aqueous VOC samples. One set of MS/MSD samples will be collected for every twenty or fewer investigative samples collected for organic analyses. Soil MS/MSD samples require no extra volume for VOCs or extractable organics; however, aqueous MS/MSD samples must be collected at triple the volume for VOCs and triple the volume for extractable organics. The quantities may vary when field conditions or sample screening dictates a change to the SAP.

2.4.2 Accuracy and Precision

Accuracy is the degree of agreement of a measured value with the true or expected value of the quantity of concern. In other words, accuracy answers the question of how close the measurement is to the true value. The farther the measurement is from the true value, the less accurate.

Precision is the degree of mutual agreement, characteristic of independent measurements, that occurs as the result of repeated application of a process under specified conditions. Precision is a measure of the reproducibility of a given measurement system and is concerned with the closeness of results.

The fundamental QA objective with respect to accuracy and precision of laboratory analytical data is to achieve the QC acceptance criteria of the analytical protocols. The accuracy and precision requirements are specified in the method protocols for organics and inorganics.

2.4.3 Completeness, Representativeness, and Comparability

2.4.3.1 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under normal conditions. It is expected that the subcontracted laboratory will provide data meeting QC acceptance criteria for 95 percent or more for all samples tested. Following completion of the analytical testing, the percent completeness will be calculated by the following equation:

$$Completeness\,(\%) = 100\ x\ \frac{Number\ of\ measurements\ judged\ valid}{\begin{array}{c}Total\ number\ of\ measurements\ necessary \\ to\ achieve\ a\ specified\ statistical\ level \\ of\ confidence\ in\ decision\ making\end{array}}$$

2.4.3.2 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, a process condition, or an environmental condition. Representativeness is a qualitative parameter which is dependent upon the proper design of the sampling program and proper laboratory protocol. The sampling network was designed to provide data representative of the site conditions. During development of this network, consideration was given to past disposal practices, existing analytical data, and physical setting and processes. Representativeness will be satisfied by ensuring that the proper sampling techniques are used, proper analytical procedures are followed, and holding times of the samples are not exceeded in the laboratory. Representativeness will be assessed by the analysis of field duplicate samples.

2.4.3.3 Comparability

Comparability expresses the confidence with which one data set can be compared with another. The extent to which existing and planned analytical data will be comparable depends on the similarity of sampling and analytical methods. Depending on the analytical procedures and QA objectives, the analytical data collected under this program may or may not be directly comparable to existing data; however, an attempt will be made to collect data in a manner consistent with data collected under the USEPA RI/FS at Harbor Island and previous RI data collected for ARCO.

3. FIELD PROCEDURES

The following procedures will be used by all personnel when conducting field activities at ARCO Terminal 21T. Field activities consist of all site visits, including visits to collect data and samples.

3.1 GENERAL

3.1.1 Documentation

All field activities will be documented in field notes using a pen with indelible ink bound in a three-ring binder and stored at the consultant's office. Information to be recorded in the notes will include the following:

- Date
- Weather conditions
- Names of the field team members
- Times of site arrival and departure
- Documentation of all field activities conducted
- Details regarding equipment calibration and malfunctions
- Odd or unusual occurrences
- Site visitors

The field supervisor will sign the field notes at the end of each day of field work. Attachment sheets will be used to record detailed information for specific activities including, but not necessarily limited to, soil borings, well installations, soil sampling, water monitoring, and water sampling. All attachment sheets will be included with the field notes in the three-ring binder and stored at the consultant's office.

Field equipment calibration procedures will be documented in the field notes during or immediately following calibration of the instrument. The following information will be recorded for each calibration event:

- Date
- Time
- Instrument make and model
- Instrument reading of standard prior to calibration
- Instrument reading of standard following calibration
- Calibration standard used

- Any deviation from standard calibration procedures
- Reason for calibration

3.1.2 Coded Sample Identification System

Every sample collected will be labeled according to the coded identification system outlined below. Each identification code will be unique to each individual sample collected, according to the guidelines detailed below.

3.1.2.1 Primary Samples

Matrix identifiers consisting of a two-letter code will be used to designate the type of sample collected. The complete list of eligible matrix identifiers is as follows:

Code	Matrix Identifier
SD	Sediment
SS	Soil (Surface or subsurface)
GW	Groundwater
FB	Field Blank
EB	Equipment Rinsate Blank
TB	Trip Blank

A one- to three-letter code followed by a number will identify the sample location. A list of representative sample location designators follows:

Designator	Sample Location
B001	Boring B001
EX001	Excavation Sample EX001
AMW01	ARCO Monitoring Well AMW01
SW1	Surface Water Monitoring Station SW1

If more than one sample of the same matrix type is collected on a given day at the same sample location, the samples will be differentiated with a unique sample identification number separated by a hyphen from the end of the sample location designator. Notes regarding the depth of sample collection and requested sample analyses will be recorded in the field notes.

A complete sample identification code will first identify whether the sample was collected in Plant 1 or Plant 2; second, identify a sample matrix type; third, provide a unique sample location designator; and fourth, identify the quarter and year of sample collection. The following are examples of appropriate sample identification codes:

P1-SSEX004-100-1, where:

P1 indicates the sample was collected in Plant 1,

SS identifies the sample as a soil sample,

EX004 indicates the sample was collected from an excavation at location EX004,

100 indicates the sample was collected in the First Quarter of the year 2000, and

1 indicates a unique sample identifier.

P2-GWAMW06-100, where:

P2 indicates the sample was collected in Plant 2;

GW indicates the sample is a groundwater sample;

AMW06 indicates the sample was collected from ARCO Monitoring Well 06; and

100 indicates the sample was collected in the First Quarter of the year 2000

Note: As only one sample was collected at this location on this date, no unique identifier follows the sample location designator.

3.1.2.2 Field Replicate Samples

Field replicate samples (splits and blind duplicates) will be identified using the matrix codes and adding 200 to the sample location designator. All sample labeling will be recorded on soil or water sampling logs so that the sample can be traced to any field data recorded or analytical data received for that sample.

3.1.3 Equipment Calibration

All field instruments will be operated, calibrated, and maintained according to the manufacture's instructions using industry-accepted calibration standards. Operation and maintenance manuals for all field equipment will be provided to field personnel and kept in a field file in the consultant’s office for reference. Field instruments will be calibrated and checked for proper operation at least as often as that listed in Table 1. Instruments will be calibrated on an as-needed basis should they exhibit evidence of power failure, instrument drift, or general failure.

The following instruments will be used to collect field data during the groundwater compliance monitoring program:

- Organic Vapor Meter (OVM) photoionization detector (PID)
- Explosimeter/combustible and toxic gas indicator
- Conductivity Meter
- pH Meter
- Electronic water-level indicator
- Oil/water interface probe

3.1.4 Equipment Decontamination

During remedial and groundwater compliance monitoring program field activities, equipment decontamination will be required to prevent cross-contamination of borings, wells, and samples as well as to prevent the potential transport of contaminants off site. Activity-specific decontamination procedures are summarized in Table 2 and described below.

3.1.4.1 Drilling and Soil Sampling Equipment

All drilling equipment will be cleaned prior to drilling each soil boring. This cleaning will consist of a high-pressure rinse with potable water to remove any grease, oil, or soil on the rig. Following this rinse, the drill rig will be steam cleaned with potable water. Drill rods, auger flights, bits, and sampling equipment will be steam cleaned with potable water. Steam-cleaning activities will take place in a designated area at least 50 feet from any boring location. The designated area will be lined with plastic and constructed such that decontamination rinsate products can be easily collected for storage and disposal, as outlined in Section 3.1.6, Waste Management and Disposal.

All reusable soil sampling equipment will be decontaminated before each use with a tap water rinse, followed by a detergent wash (Liquinox, Alconox, or a comparable laboratory-grade detergent), a 10-percent hydrochloric or nitric acid solution rinse, a 10-percent n-propyl alcohol or methanol solution rinse, and a final distilled water rinse.

Acid and solvent rinses will be stored in spray bottles pending use. All other decontamination washes/rinses will be stored in stainless steel buckets equipped with dedicated cleaning brushes. Rinsate from decontamination washes and rinses will be handled as described in Section 3.1.6, Waste Management and Disposal.

3.1.4.2 Water Monitoring and Sampling Equipment

Prior to measuring water levels and between each individual water level measurement, the instrument used for measurement will be decontaminated by first washing the instrument with a laboratory-grade detergent (Liquinox, Alconox, or other) and then rinsing with distilled water. If liquid hydrocarbons are encountered when collecting water level data, the probe used for measurement will be washed with a laboratory-grade detergent, rinsed with a 10-percent n-propyl alcohol or methanol solution, and then rinsed with distilled water.

Prior to monitoring well development and groundwater sampling, any reusable downhole equipment, such as pumps, will be decontaminated by first washing the equipment with a laboratory-grade detergent and then rinsing it with potable water. During decontamination, approximately 5 gallons of each laboratory-grade detergent solution and distilled water will be circulated through any pump used to purge or sample wells. Reusable bailers, spigots, and beakers will be decontaminated by washing with a laboratory-grade detergent, rinsing with distilled water, rinsing with 10-percent hydrochloric or nitric acid, a second distilled water rinse, a 10-percent n-propyl alcohol or methanol rinse, and a final rinse of distilled water.

Dedicated or disposable equipment will be used for water sampling whenever feasible to reduce the possibility of sample cross-contamination. Any equipment for which decontamination is either impossible or impractical, due to either the natures of the equipment or the nature of the contaminants, will be disposed of following each sampling event.

3.1.5 Sample Handling

All samples collected during the groundwater compliance monitoring program will be processed in a consistent manner. Water and soil samples collected for chemical and physical analysis will be immediately stored in an insulated container with solid cold packs pending delivery to the laboratory. Ice will not be used to cool samples.

Samples will be accompanied by a properly completed chain-of-custody form provided by ARCO or the contracted laboratory The sample numbers and locations will be listed on the chain-of-custody form. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the record. This record documents transfer of custody of samples from the sampler to another person, to the permanent laboratory, or to/from a secure storage area.

Samples will be properly packaged for shipment and dispatched to the appropriate laboratory for analysis with a separate signed custody record enclosed in each sample box or cooler. Shipping containers will be secured with strapping tape for shipment to the laboratory. The cooler will be strapped shut with strapping tape in at least two locations.

The chain-of-custody record identifies the contents of the shipping cooler and the analyses to be performed on the samples contained therein. The original and one copy of the associated chain-of-custody record will accompany each shipment to the laboratory; the original will be attached to the report of analytical results sent to the consultant. The third copy of the chain-of-custody record will be retained by the sampler and returned to the consultant’s office where it will be maintained in the permanent project files.

Field personnel will not retain any sample longer than two days after collection before shipment to the laboratory. One trip blank will be included in each sample shipping container possessing samples to be analyzed for volatile organic compounds. Samples will be delivered to the laboratory by the consultant’s personnel whenever practicable. When personal delivery is not practicable, a bonded, private courier service that offers same-day or next-day service will be used. The day of delivery will be dependent on the proximity of the selected analytical laboratory to the site.

Bonded couriers handling sample shipments will not be required to sign off on the custody form as long as the custody forms remain sealed inside the sample cooler and the strapping tape on the cooler remains intact.

3.1.6 Waste Management and Disposal

All generated wastes will be dealt with in accordance with the guidance provided below. Wastes include drilling/sampling-generated soil and liquid, decontamination rinsate, personal protective equipment, and disposable sampling equipment. Wastes will fall into one of the following categories:

- Drill cuttings and soil samples not submitted for laboratory analysis.
- Excavated soils.
- Purge water from sampling and development of monitoring wells.
- Decontamination rinse water.
- Disposable personal protection equipment (PPE) (Tyvek® suits, gloves, etc.).

- Disposable sampling equipment (bailers, etc.).

3.1.6.1 Drill Cuttings

Drill cuttings and soil samples not submitted for laboratory analysis will be contained in sealed 55-gallon drums and temporarily stored on-site. The drums will be labeled with the following information:

- Date
- Waste category
- A unique identification number corresponding to the physical location at which the waste was generated.

Disposal of the drums will depend on the results of chemical analyses performed on the contained materials.

If encountered, hazardous waste materials will be segregated from non-hazardous wastes. Hazardous wastes will be stored in appropriate containers and labeled in conformance with Washington State Department of Transportation requirements. Disposal of both non-hazardous and hazardous wastes and will be handled through a licensed transport, storage, and disposal company.

3.1.6.2 Excavated Soils

Prior to soil excavation field activities at both Plants 1 and 2, representative soil samples will be collected from the excavation areas and analyzed for waste disposal parameters. These in-situ soil samples will identify the waste classification (hazardous or non-hazardous) of the excavated soils prior to excavation activities. When the excavations occur, the soils will be able to immediately be properly transported off-site by a licensed transport, storage, and disposal company.

3.1.6.3 Purge and Decontamination Rinse Water

Purge water and decontamination rinse water will be temporarily contained in 55-gallon drums and transported to the on-site groundwater treatment system in operation along the waterfront. All purge water and decontamination rinse water will be processed through the treatment system prior to discharge to the sanitary sewer in accordance with the existing King

County Department of Natural Resources Industrial Waste Division permit in place for the treatment system.

3.1.6.4 Disposable Equipment

Disposable PPE and sampling equipment will be contained in drums temporarily stored at the terminal. The terminal properly disposes of this type of waste as part of the normal waste management practices of the facility.

3.2 Groundwater Monitoring Well Installation

Five groundwater monitoring wells will be installed prior to beginning performance and confirmational sampling along the waterfront in the warehouse and loading rack area at the site to enable long-term collection of chemical and physical data regarding the aquifer beneath the warehouse and loading rack. Details regarding the locations of the wells are included in the Groundwater Compliance and Contingency Plan. Drilling and installation of groundwater monitoring wells at the site will conform to *Minimum Standards for Construction and Maintenance of Wells* (Chapter 173-160 WAC) and the guidance provided in the *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells* (EPA 1991).

During the installation of each well, soil samples may be collected and submitted for chemical characterization.

3.2.1 Preparation for Drilling, Sampling, and Well Installation

Following the selection and marking of monitoring well locations, the area will be checked for subsurface lines and utilities. Utilities and lines will be located and cleared by a professional locating service using active electrical or magnetic anomaly methods. Borings will be considered cleared for drilling if no utilities, lines, or subsurface structures are located within a 5-foot radius of the monitoring well location. In the event that utilities, lines, or subsurface structures are identified within this 5-foot radius, the monitoring well location will be re-evaluated and either relocated or abandoned.

Before beginning drilling, field personnel conducting well installation and associated sampling activities will assemble the appropriate equipment. In addition, all forms identified in this table will be completed to the extent practicable before drilling begins. All field instruments to be used during monitoring well installation will be checked to ensure proper calibration, as described in Section 3.1.3, Equipment Calibration. All equipment which will come in contact with the samples will be decontaminated before drilling commences and prior to the collection of each individual sample. Decontamination of equipment will be performed in accordance with the procedures outlined in Section 3.1.4, Equipment Decontamination.

Well construction materials, such as well screen, filter pack, well casing, and grout, will be assembled and inspected prior to drilling. Should unsuitable materials or equipment be identified during this initial inspection, drilling will be postponed until adequate materials can be assembled.

3.2.2 Drilling Methods

A qualified drilling subcontractor will complete borings for all monitoring wells using the hollow-stem auger drilling method under the supervision of field personnel. Two drill rigs will be used at the site to cope with variable access conditions. In areas where access is restricted by the presence of surface piping, buildings, or overhead obstacles, borings will be drilled using a limited access drill rig equipped with an 10.25-inch-diameter hollow-stem auger. In areas where access is unrestricted, borings will be drilled using a drill rig equipped with an 10.25-inch-diameter hollow-stem auger.

The wells will be drilled in two stages to prevent the shallow groundwater zone where product has been encountered from cross-contaminating the deeper groundwater zone. During the first stage, the boring will be advanced to a depth of approximately 20 feet below ground surface (bgs) using large diameter hollow-stem augers. Temporary conductor casing will then be installed to a depth of approximately 20 feet. Grout will be installed in the bottom of the borehole and allowed to set, such that any floating contaminants occurring at the top of the water table will be sealed out of the temporary conductor casing. Following the placement of this conductor casing, all drilling equipment will be thoroughly steam-cleaned. Drilling will then proceed to the desired depth of the well by drilling through the conductor casing using smaller diameter hollow-stem augers.

Borings will be advanced to the desired depths for soil sampling and well installation as described below. Water will not be added to the borehole to suppress heaving sands encountered during soil sampling. Water may be added during well construction if it is deemed that heaving sands will otherwise prevent successful well construction. Any water added during well construction will be sampled and submitted to a laboratory for analysis for the analytes that will be monitored for the well according the compliance monitoring program.

3.2.2.1 Soil Sampling and Logging

If soil samples are collected during drilling, the soil samples will be collected using a decontaminated stainless-steel sampling spoon. Soil will be placed directly in a laboratory-supplied glass sample jar with a screw-tight lid. Each sample jar will be completely filled with sample prior to sealing. In addition to filling the sample container, one air-tight plastic bag will be filled with a soil sample and retained for description and headspace analysis as described below. Plastic bags used to contain samples for headspace analysis will be labeled with the sample number.

When the sample jar is completely filled with sample, it will be closed by hand tightening the cap. The capped sample container will then be wiped clean and clearly labeled per Section 3.1.2, Coded Sample Identification System. The capped and labeled sample will then be handled in accordance with the procedures outlined in Section 3.1.5, Sampling Handling. For each sample collected, new vinyl gloves will be worn both as a health and safety precaution and to reduce the possibility of sample contamination from external sources. Should the gloves come in contact during sampling with material other than the sampling equipment, the sample material, or the sample container, the soiled gloves will be replaced with clean gloves prior to continuing with sampling.

During the advancement of boreholes, soil samples may be obtained at 2.5-foot intervals for the purpose of describing the materials encountered. The sampler will be driven using a 140-pound hammer designed to free-fall 30 inches before driving the sampler and drill rod.

Soils collected at the surface and retrieved in the sampler will be logged by field personnel using the ASTM Visual-Manual Procedure (D 2488). Soil descriptions, blow counts, and the results of field screening will be recorded on a Soil Boring Log. Sampled collected in the upper half of the sampler will be used for descriptive and field screening purposes. Soils collected in the lower half of the sampler will be retained for possible submission for chemical analysis, as dictated by the sample depth and the field-screening process.

Soil samples will be quickly transferred from the sampler with minimal disturbance to a pre-cleaned glass sample jar. Glass sample jars will be closed by hand tightening the cap. The capped sample container will then be wiped clean and clearly labeled per Section 3.1.2, Coded Sample

Identification System. The capped and labeled sample will then be handled in accordance with the procedures outlined in Section 3.1.5, Sample Handling. New vinyl gloves will be worn during sample collection and the same precautions against sample cross-contamination will be observed.

Soils retained for field screening will be placed in clearly-labeled, air-tight plastic bags and set aside. These samples will then be screened for the presence of volatile organic compounds using the PID. The PID will be used to sample the headspace in the sealed plastic bag for each portion of sample set aside for field screening. The highest reading noted on the PID for each screening sample will be noted on the Boring Log.

Samples will be selected for submission to the laboratory on the basis of field parameters of headspace analysis, presence of staining or odor, and variation in lithology. The criteria and reasoning used for selection of samples from each borehole will be documented in the field notebook. If, during the course of the investigation, it is necessary to further define the vertical distribution of subsurface contaminants, additional samples will be collected from each boring. Soil samples will be collected below the encountered water table in selected locations and submitted for analysis for physical characteristics as described in the groundwater compliance monitoring program.

3.2.2.2 Well Installation

The monitoring wells will be 2 inches in diameter. Well construction details will be determined using data collected during the RI investigations. These details will be submitted to Ecology in a letter format for approval prior to the installation of any wells at the site.

All wells will be constructed using 2-inch Schedule 40 PVC threaded casing. The well screen will consist of 10-foot-long sections of continuous wrap, v-slot, Schedule 40 PVC screen. The well screen slot size will be determined based on the results of grain-size analyses conducted on soil samples collected during the RI investigation, but is assumed to be 0.01-inch. Casing and screen will be assembled according to the well specifications and lowered down the inside of the auger. All threaded sections of the well will be sealed with Viton® O-rings. All personnel handling well screen will wear clean vinyl or cotton gloves to keep the casing clean during installation. Should the casing or screen become visibly soiled during installation, it will be disassembled and cleaned to the specifications of the on-site field personnel.

The annular space between the well screen and the borehole wall will be backfilled with a filter pack of clean, No. 10-20 sorted silica sand. The sand will be poured inside the auger stem and allowed to fall into the borehole as the auger is slowly withdrawn. The filter pack will be slowly added in this fashion by alternately adding sand and withdrawing the auger until the filter pack extends at least 3 feet above the top of the well screen. A 0.5- to 1-foot-thick layer of clean, No. 35 grit silica sand will be placed on top of the filter pack before installing the well seal. The depth of the filter pack will be constantly monitored during installation by sounding the well with a weighted tape.

Well seals will consist of bentonite grout. A one foot layer of bentonite pellets will be placed atop the filter pack and allowed to hydrate for approximately 30 minutes, then bentonite grout will then be introduced into the boring annulus using a tremie pipe. The auger will be withdrawn in less than 5-foot steps as the annulus is filled with grout. The bentonite grout will seal the well from the top of the filter pack to approximately 1 foot bgs. The bentonite seal will be installed so that it fills any potential gap between the well casing and the conductor casing installed during boring advancement.

Wells will be protected at land surface with flush-mount, traffic-grade well monuments. Each monument will be set in concrete to a depth of at least 1 foot. In paved areas, the concrete will extend from the well monument at least 1.5 feet in all directions and will be poured flush with the existing pavement. A locking cap will be installed at each wellhead.

3.2.2.3 Well Development

All monitoring wells installed will be developed prior to collection of any water level data or water quality samples. The goals of well development are to remove fines left in the borehole and restore the hydraulic connection of the well to the aquifer following well drilling and installation. Monitoring well development will conform to the standards presented in *Minimum Standards for Construction and Maintenance of Well*, *Resource Protection Wells* (WAC 173-160-500) as well as the guidance presented in *Monitoring Well Installation and Development* (EPA 1991).

Prior to development, all wells will be checked for the presence of free product using a clear bailer. The bailer will be lowered into the well such that water or product surface is intersected. The bailer will then be withdrawn and examined. Should free product be discovered in the well, the well will not be developed. If, during continued monitoring, free-product is found to no longer occur in the well, the well will be developed prior to the initiation of groundwater sampling.

Wells will be developed using a surge-and-pump method. Surging will be conducted by using a loose-fitting block to develop differential pressures across the screened interval of the well. The surging action will settle the sand pack and loosen fines that remain in the borehole following well installation. Following surging, the well will be purged using either a hand bailer or an electric submersible pump. Each well will be surged at least three times during development.

During development, at least three well volumes of water will be removed from the well. Following the removal of each well volume, turbidity, temperature, specific conductivity, and pH will be recorded. Well development will continue either until turbidity, temperature, conductivity, and pH stabilize or five well volumes of water are removed.

All equipment used in well development will be decontaminated between wells using the procedures outlined in Section 3.1.4, Equipment Decontamination. Purge water and sediments removed from the wells will be drummed and managed in accordance with the procedures detailed in Section 3.1.5, Waste Management and Disposal.

3.2.2.4 Documentation

Soil sampling and boring information will be recorded on Soil Sampling and Boring Logs, respectively. The required information will be recorded on these logs at the time of collection or observation. Laboratory tracking and chain-of-custody documentation will be conducted as discussed in Section 3.1.5, Sample Handling.

Well construction logs will be completed for each monitoring well installed at the site. This log will be used to record details of well construction. Details regarding the development of groundwater monitoring wells will be recorded on a Well Development Log.

3.3 Hot Spot Soil Excavations

Excavations of TPH hot spots will occur at Plant 1 and Plant 2 as identified and detailed in the Groundwater Compliance Monitoring and Contingency Plan. Soil samples will be collected from the excavation perimeters following the specific procedures discussed in the sections below.

3.3.1 Sampling Locations

Soil samples will be collected from the perimeter of each of the excavations in Plants 1 and 2. The exact locations of the soil samples will be determined in the field during the excavation activities based on the actual extents of the excavations.

3.3.2 Sampling Preparation

Prior to sampling, field personnel will assemble the appropriate sampling equipment. Equipment that will come in contact with the soil will be decontaminated before each sample is collected. Decontamination will be performed in accordance with the procedures outlined in Section 3.1.4, Equipment Decontamination. Field instruments will be checked to ensure proper calibration according to the manufacturer's specifications and the procedures detailed in Section 3.1.3, Equipment Calibration.

3.3.3 Soil Sample Collection

Perimeter soil samples will be collected by using either a decontaminated hand auger or directly from the bucket of the excavation equipment using a decontaminated stainless-steel sampling spoon. Soil will be placed directly in a laboratory-supplied glass sample jar with a screw-tight lid. Each sample jar will be completely filled with sample prior to sealing. In addition to filling the sample container, one air-tight plastic bag will be filled with a soil sample and retained for description and headspace analysis as described below. Plastic bags used to contain samples for headspace analysis will be labeled with the sample number.

When the sample jar is completely filled with sample, it will be closed by hand tightening the cap. The capped sample container will then be wiped clean and clearly labeled per Section 3.1.2, Coded Sample Identification System. The capped and labeled sample will then be handled in accordance with the procedures outlined in Section 3.1.5, Sampling Handling. For each sample collected, new vinyl gloves will be worn both as a health and safety precaution and to reduce the possibility of sample contamination from external sources. Should the gloves come in contact during sampling with material other than the sampling equipment, the sample material, or the sample container, the soiled gloves will be replaced with clean gloves prior to continuing with sampling.

3.3.4 Sample Documentation

Sampling information including sample location and sample depth collected will be recorded on a Soil Sampling Log. In addition, a record of sample designation, the date, and time of collection will be recorded in the field notes. Laboratory tracking and chain-of-custody documentation is discussed in Section 3.1.5, Sample Handling.

3.4 Groundwater Sampling

Groundwater samples will be collected from monitoring wells installed during the RI and groundwater compliance monitoring program following the specific procedures discussed in the section below.

3.4.1 Sampling Locations and Frequency

Groundwater samples will be collected from the monitoring well network identified in the Groundwater Compliance and Contingency Plan, Exhibit F of the Cleanup Action Plan (CAP). The frequency of groundwater monitoring activities is also detailed in the Groundwater Compliance and Contingency Plan.

3.4.2 Sampling Preparation

Prior to sampling, field personnel will assemble the appropriate sampling equipment. Equipment that will come in contact with the ground water will be decontaminated before each sample is collected. Decontamination will be performed in accordance with the procedures outlined in Section 3.1.4, Equipment Decontamination. Field instruments will be checked to ensure proper calibration according to the manufacturer's specifications and the procedures detailed in Section 3.1.3, Equipment Calibration.

All wells will be sounded to verify identity and to determine the column of water currently present in each well. Static water-level measurements will be taken in all wells using the north side of the well casing as the measuring point (unless otherwise indicated) with an electric water level meter or interface probe. Water level measurements will be collected as described in Section 3.4.2. If product is observed in the well, both the water and product level measurements will be recorded using an interface probe. The electric water level meter and the interface probe will be decontaminated after use in each well in accordance with the procedures outlined in Section 3.1.4, Equipment Decontamination. Notes regarding the condition and integrity of the well will be recorded in the field notes at the time of water level measurement collection. Should product be encountered in a well, the well will not be purged or sampled.

Prior to sampling, each well will be purged 3 to 5 times the volume of standing water present in the well casing. The groundwater will be purged using either a submersible pump or a disposable polyethylene hand bailer. Purge water will be pumped into 5-gallon buckets before being emptied into 55-gallon drums. The approximate number of gallons purged from each well will be recorded on the Water Sampling Log. Purge water will be handled in accordance with the procedures outlined in Section 3.1.6, Waste Management and Disposal.

Temperature, specific conductivity, and pH will be monitored during well purging. These field parameters will be monitored at least once for each well volume removed and should stabilize with continued purging. Stabilized field parameters will indicate that the well is ready for sampling. Each measurement obtained of field parameters will be recorded on the Water Sampling Log. After purging, the pump or bailer will be removed from the well and decontaminated in accordance with the procedures outlined in Section 3.1.4, Equipment Decontamination. During sampling, plastic sheeting will be placed around the wellhead to provide a relatively clean surface on which to place all sampling-related equipment.

3.4.3 Groundwater Sample Collection

To collect a groundwater sample, a disposable polyethylene bailer will be gently lowered down the well using nylon twine. The bailer will be allowed to fill and then will be quickly but gently raised out of the well to avoid agitation of the sample. Sample containers will be filled in the order listed on Table 3. The time of sampling will be immediately recorded onto the sampling log, chain-of-custody form, and sample label. Samples will be immediately placed in a cooler with ice packs pending transport to the laboratory. Laboratory instructions regarding preservation and handling of the sample will be observed at all times. Samples will be handled in accordance with Section 3.1.5, Sample Handling.

During sample collection, all sampling personnel will wear disposable vinyl gloves while handling any of the sampling equipment. Care will be taken not to allow the bailer or the twine to come in contact with possible contaminants near the well. If the bailer should become soiled during sampling, it will be cleaned using decontamination procedures outlined in Section 3.1.4, Equipment

Decontamination. If the bailer cannot be adequately cleaned, it will be replaced before sampling continues.

3.4.4 Sample Documentation

Water level data and sampling information will be recorded on a Water Sampling Log. In addition, a record of sample designation, the date, and time of collection will be recorded in the field notes. Laboratory tracking and chain-of-custody documentation is discussed in Section 3.1.5, Sample Handling.

4. ANALYTICAL PROCEDURES

The analyses to be performed on the soil and water samples collected are described in the Groundwater Compliance Monitoring and Contingency Plan. The methods referenced and their associated quantitation limits will be followed exactly.

4.1 Analytical Methods and Procedures

All samples collected for chemical analysis will be submitted to analytical laboratories accredited by the State of Washington [Chapter 173-50 WAC (Washington Administrative Code)].

Assessment of laboratory performance in analytical parameters will be done through analysis of laboratory method blanks, spiked samples, surrogate spiked samples, duplicate samples, and laboratory control samples.

Groundwater parameters such as pH, specific conductivity, salinity, temperature, dissolved oxygen, and redox potential will be measured and recorded during sample collection events by trained personnel using properly calibrated instruments.

5. QUALITY CONTROL PROCEDURES

Quality control (QC) procedures will be implemented in both the field and laboratory. The kinds of internal checks that will be carried out are described below.

5.1 Field Activities (Measurements and Screening)

QC procedures for field measurements are limited to checking the reproducibility of the measurement by obtaining multiple readings or by calibrating the instruments, when appropriate.

QC of field sampling will involve collecting field duplicates, equipment blanks, and trip blanks.

5.2 Laboratory Analysis

Internal QC procedures are specified in the method protocols. These specifications include the compounds and concentrations to be used, the QC acceptance criteria for these audits, and the types of QC checks required (method blanks, reagent/preparation blanks, MS/MSDs, calibration standards, internal standards, surrogate standards, the frequency of each audit, the specific calibration check standards, laboratory duplicate analysis).

Laboratories have a written QA/QC program which provides rules and guidelines to ensure the reliability and validity of work conducted at the laboratory. Compliance with the QA/QC program is coordinated and monitored by the laboratory's QA department, which is independent of the operating departments.

The stated objectives of a laboratory QA/QC program are to as follows:

- Ensure that all procedures are documented, including any changes in administrative or technical procedures.
- Ensure that all analytical procedures are conducted according to sound scientific principles and have been validated.
- Monitor the performance of the laboratory by a systemic inspection program and provide for corrective action as necessary.
- Collaborate with other laboratories in establishing quality levels, as appropriate.
- Ensure that all data are properly recorded and archived.

All laboratory procedures are documented in writing as either Standard Operating Procedures (SOP’s) or method procedures (MP). Internal QC procedures for analytical services will be conducted by both analytical laboratories chosen to perform work under the RI/FS in accordance with their SOP's and the individual method requirements. The specifications for the SOP's and method requirements must include the type of audits required (sample spikes, surrogate spikes, reference samples, controls, blanks), the frequency of each audit, the compounds to be used for sample spikes and surrogate spikes, and the QC acceptance criteria for these audits.

The subcontracting laboratory will document in each data package provided that both initial and ongoing instrument and analytical QC functions have been met. Any samples analyzed in nonconformance with the QC criteria, excluding matrix effects, will be reanalyzed by the laboratory if sufficient sample volume is available.

6. DATA ASSESSMENT PROCEDURES

Following receipt of all analytical data for each sampling event, the field and laboratory data will be validated to determine whether the data quality objectives have been achieved. Data validation will be performed as described in the following sections.

6.1 Field Data Validation

After completing a sampling program, the field data package (field notes, calibration records, chain-of-custody forms, etc.) will be reviewed for completeness and accuracy. Items to be considered in the field data package validation procedure will include, but are not limited to, the following:

- A review of field data contained in sampling logs for completeness.
- A verification that equipment blanks, trip blanks, and field duplicates were properly prepared, identified, and analyzed.
- A verification of the calibration of field equipment.
- A review of chain-of-custody forms for proper completion, verification of signatures of field personnel and the laboratory sample custodian, and custodial dates.

6.2 Laboratory Data Validation

After validation of the field data package, validation of the analytical data package will be performed upon receipt of the data from the laboratory.

Items to be considered in the analytical data package validation procedure will include, but are not limited to, the following:

- A comparison of sampling dates, sample extraction dates, and analysis dates to check that samples were extracted and analyzed within proper holding times.
- A review of analytical methods and required quantitation limits to verify that they agree with the Groundwater Compliance Monitoring and Contingency Plan, Exhibit F of the CAP.
- A review of field and laboratory blanks to evaluate possible contamination sources (consideration should be given to preparation techniques and frequencies as well as the analytical results).
- A review of field duplicate data for evaluation of sampling and analytical precision.
- A review of selected laboratory QA data (blanks, surrogate spike recoveries, laboratory control sample recoveries, QC check sample recoveries, laboratory duplicate recoveries, etc.) for compliance with required acceptance criteria.

Data will be validated using the USEPA laboratory data validation functional guidelines for organic and inorganic review (USEPA 1993 and 1994). Appropriate data qualifier codes (B, J, R, U, UJ, as described in the USEPA functional guidelines) will be applied to those data for which QC results do not meet acceptance standards.

TABLES

Table 1.
Instrument Calibration Frequency
Sampling and Analysis Plan
ARCO Harbor Island, Seattle, Washington

Instrument	Calibration Frequency
OVM PID	Once per day
Explosimeter	Once per day (1)
PH meter	Once per day
DO meter	Once per day
Salinity/conductivity meter	Once per day
ORP Meter	Once per day
Water-level indicator/interference probe	Once at beginning of field program

(1) Instrument calibration will be checked once per day. If calibration is correct, instrument will be recalibrated.

Table 2.
Decontamination Procedures by Activity
Sampling and Analysis Plan
ARCO Harbor Island Terminal 21T, Seattle, Washington

	Procedure
Drill rug and excavation equipment	Pressure wash Steam clean (potable H2O)
Drill rods, auger flights, drill bits, split- spoon sampler	Steam clean (potable H2O)
Hand auger, sample barrels, sampling spoons, Hydropunch	Potable H2O rinse Detergent wash 10% HCL or HNO3 rinse Distilled H2O rinse 10% methanol Distilled H2O rinse Air Dry
Pumps	5 gallons of circulated detergent solution/detergent wash 5 gallons of circulated potable H2O Outside Housing of pumps also decontaminated with the following: 10% HCL of HNO3 rinse Distilled H2O rinse 10% methanol rinse Distilled H2O rinse Air dry
Downhole equipment (sounding line, water-level indicator)	Detergent wash Distilled H2O rinse
Water sampling equipment (field instruments, beakers)	Potable H2O rinse Detergent wash 10% HCL or HNO3 rinse Distilled H2O rinse 10% methanol rinse Distilled H2O rinse Air dry

Table 3.
Sample Container Filling Order
Sampling and Analysis Plan
ARCO Harbor Island Terminal 21T, Seattle, Washington

1. Volatile Organic Compounds
2. Total Petroleum Hydrocarbon Analysis
3. Carcinogenic Polynuclear Aromaic Hydrocarbons (cPAH's)
4. Conventional Water Quality Parameters
5. Metals (total and dissolved)

Appendix B.

EPA Superfund/Ecology Toxics Cleanup Program

Memorandum of Agreement

for Harbor Island Superfund Site
Operable Unit #2 in 1991 and 1994

1994 MEMORANDUM OF AGREEMENT FOR THE HARBOR ISLAND SUPERFUND SITE

RECEIVED
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DEPT. OF ECOLOGY

Purpose

The purpose of this site specific Memorandum of Agreement (MOA) between the Department of Ecology (Ecology) and the Environmental Protection Agency (EPA) is to clarify the roles and responsibilities of each agency with regard to site management and enforcement activities at the Harbor Island Superfund Site in Seattle, WA. This MOA supersedes the previous version dated February 5, 1991. Unless specified otherwise, the definitions and provisions set forth in the Superfund/Hazardous Waste Cleanup Memorandum of Agreement (SMOA) of 1989 between EPA and Ecology, will apply to this MOA.

Basic Enforcement Responsibilities

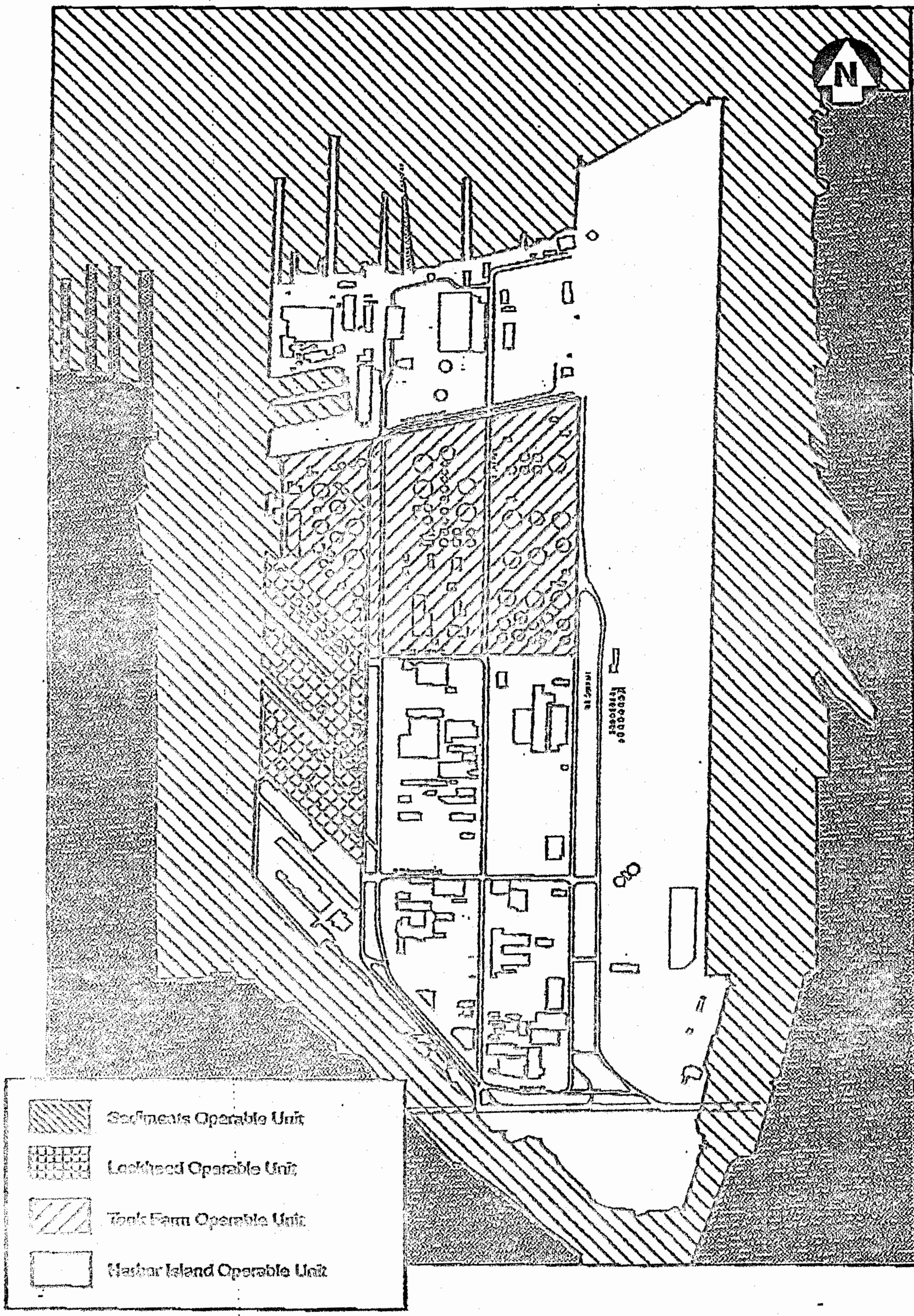
The Harbor Island Superfund Site has been broken up into four operable units (Fig. 1), which are: the petroleum tank farms, island-wide soil and groundwater, Lockheed Shipyard #1, and the marine sediments around the island. Ecology will be the lead agency for the petroleum tank farms because the primary contaminant at these tank farms is petroleum, which is identified as a hazardous substance under the Model Toxics Control Act (MTCA) but is not a hazardous substance under CERCLA. EPA will be the lead agency for the remaining three operable units.

Ecology will issue a Cleanup Action Plan (CAP) for each tank farm which will identify cleanup goals and select a remedial action for each tank farm. Ecology will use its authority under MTCA to have the selected remedies implemented by the Potentially Liable Persons (PLPs) associated with this unit. EPA will issue a Record of Decision (ROD) for each of its three operable units which will identify cleanup goals and select remedial actions for these operable units. EPA will use its authority under CERCLA to have the selected remedies implemented by the Potentially Responsible Parties (PRPs) associated with each of these units.

Basic Site Management Responsibilities

The tank farm operable unit is defined as property owned or leased by Shell Oil (including Yard "A"), Texaco, and ARCO. This unit also includes petroleum contamination which has migrated from these properties in the form of contaminated groundwater or petroleum product floating on groundwater. Ecology will manage the cleanup of the tank farm operable unit with no oversight by EPA. However, Ecology will keep EPA informed of all significant

Figure 1
Harbor Island Operable Units



events and accomplishments on the tank farm operable unit and will also provide two copies of all final reports to EPA.

For the EPA operable units, Ecology will provide support agency management assistance to EPA as specified in the SMOA. The most important remaining assistance tasks will be to: 1) review and comment on the Remedial Investigation/Feasibility Study (RI/FS) Reports for the Lockheed and Sediment units, and 2) review, comment and concur on the Proposed Plans and the RODs for the Lockheed and Sediment units. In addition, as stated in the SMOA, EPA and Ecology will meet prior to the start of all consent decree negotiations with responsible parties to discuss goals and bottom line positions for negotiations.

EPA's Sediment RI Report has identified large areas of contaminated sediments around Harbor Island which exceed the cleanup levels as specified in the Sediment Management Standards. EPA will use its knowledge of contaminant sources on Harbor Island, its understanding of contaminant transport in the sediments, Ecology's sediment clustering analysis, and best professional judgement to determine which contaminated sediments will be remediated under Superfund authority. Where there are contaminated sediment areas exceeding the cleanup levels outside of the Superfund site boundary, Ecology will be the lead agency for enforcing cleanup actions in these areas. EPA will coordinate sediment remedial actions selected for the Superfund site with remedial actions selected by Ecology in adjacent contaminated sediment areas.

Schedule

The ROD for island-wide soil and groundwater was signed on September 30, 1993. EPA intends to issue "special notice" letters to the PRPs in November, 1993, and to finalize a Consent Decree with these PRPs by the fall of 1994. EPA plans to complete a ROD for the Lockheed Shipyard in the spring of 1994, and to complete a Consent Decree for this unit in early 1995. EPA intends to complete a ROD for the marine sediment unit in the fall of 1994 and a Consent Decree in early 1995. Ecology intends to complete CAPs for each of the petroleum tank farms by January 1995. In general, remedial actions selected for sources of contamination will be initiated before initiating remedial actions selected for marine sediments.

Data Exchange

Ecology and EPA agree to exchange data in a manner which will facilitate decision making by both parties. Upon request, each agency shall have access to data collected by the other agency, its contractors, or by the PRPs conducting work under agreement with the other agency.

Dispute Resolution

In the event of dispute between EPA and Ecology concerning responsibilities for the Harbor Island site, the site managers for each agency will attempt to promptly resolve such disputes. If disputes cannot be resolved at this level, the problem will be referred to the supervisors of these persons for resolution. This supervisory referral and resolution process will continue, to the management level necessary to resolve the conflict.

In the event that schedules for remedial actions at the site conflict, EPA and Ecology will evaluate options to eliminate this conflict. Preference will be given to those remedial actions which will eliminate the most significant human health or environmental risks at the site in the shortest timeframe. Such decisions will be made on a case-by-case basis by both agency's site managers and program managers.

Carol L. Fleskes 2/10/94
Carol L. Fleskes — Date
Program Manager
Toxics Cleanup Program
Department of Ecology

Carol Rushin 3/3/94
Carol Rushin — Date
Chief
Superfund Remedial Branch
Environmental Protection Agency

SUPERFUND/TOXICS CLEANUP PROGRAM
MEMORANDUM OF AGREEMENT
FOR THE HARBOR ISLAND SUPERFUND SITE

Purpose

The purpose of this site specific memorandum of agreement (MOA) between Ecology and EPA is to clarify the roles and responsibilities of each agency with regard to site management and enforcement activities at the Harbor Island superfund site. This agreement applies only to EPA and Ecology activities at the Harbor Island site and does not apply to or influence the work of either party at other Superfund sites. This agreement is an addendum to the Superfund Memorandum of Agreement (SMOA) dated October 26, 1989. It is expected that this agreement will be in effect only until both the groundwater and soil/sediments Records of Decision (RODs), arising from EPA's investigations, are completed. At that time, it is anticipated that another MOA or perhaps a site specific cooperative agreement will be required.

Basic Enforcement Responsibilities

Since all of Harbor Island is one superfund site, EPA will retain the lead for most enforcement activities at the site. Ecology will be the lead agency for cleanup of three tank farms, (Shell Oil, Texaco, and Arco) on the site. Ecology agrees to pursue an order with each of these three facilities on the island and to require that investigations of groundwater, surface water (including storm water) and soils at each of these facilities be consistent, at a minimum, with the island wide work plan prepared by Roy F. Weston, Inc. for EPA.

Ecology agrees to use its own enforcement authorities through the Model Toxics Control Act (MTCA) to assure that the three tank farm sites are cleaned up. It is Ecology's understanding that EPA will divide the remainder of the site into two operable units, one to address groundwater and one to address soils and sediments. Each operable unit will require a Record of Decision and state concurrence. Ecology cleanups will endeavor to be as consistent as possible with the RODs with which Ecology has concurred. However, as stated in the SMOA, Ecology conducted cleanups are done without EPA involvement or oversight and as such will be done using state cleanup standards and procedures.

EPA will complete the RI/FS for the remainder of the island (soils and groundwater) as well as sediment and air investigations for the entire island, and will pursue required cleanup activities using CERCLA authorities. EPA will take the lead for all sites found to be contaminated with both petroleum and other contaminants, which at this time include Todd Shipyard/Mobile Oil property and the Shell terminal's Yard A. Following the issuance of the RODs, Ecology may accept responsibility for cleanup of additional sites which EPA, through its investigation, finds to be contaminated solely from petroleum products. Ecology and EPA shall meet and concur before any transfer of site responsibility occurs. Ecology will handle transferred sites as priorities and resources allow.

Basic Site Management Responsibilities

The site will remain an EPA lead site. Ecology will continue to complete the EPA oversight tasks outlined in the Management Assistance Cooperative Agreement. However, due to the high degree of interaction between EPA and the Urban Bay Action Team at Ecology's Northwest Regional Office (NWRO), Ecology will dedicate one staff member at NWRO assume these tasks, and the headquarters office will no longer be involved in oversight of EPA work. The NWRO staff person will serve as EPA's primary contact at Ecology for all Harbor Island issues, prepare MTCA orders for investigation and cleanup of the Shell, Texaco, and Arco properties and provide coordination between Ecology and EPA. NWRO staff will continue to pursue source control through the efforts of the Urban Bay Action Team.

EPA will provide to the NWRO staff contact three copies of documents to be reviewed. Review times by Ecology shall be consistent with those specified in the SMOA unless otherwise agreed upon by both EPA and Ecology. Ecology will assure that MTCA orders are consistent with the final approved work plan for the Phase II investigation without formal EPA oversight, as outlined in the SMOA. Ecology will keep EPA informed of all significant events and accomplishments at the state lead sites. Two copies of any reports or data submitted to Ecology by potential liable persons (PLPs) or their contractors shall be provided to EPA to assist in the island wide investigation.

Site Specific Responsibilities

1. Port of Seattle-Terminal 18. EPA will take the lead on this site which will include Shell Yard A and Terminal 18D. If investigation shows that the contamination of the property stems solely form petroleum products, Ecology may take responsibility for assuring cleanup on that portion of the Port of Seattle property.

2. Todd Shipyard-Mobil. EPA will take the lead on the entire Todd Shipyard property including the old Mobil tank farm. If the investigation shows that the contamination on the old Mobil property stems solely from petroleum products, Ecology may take responsibility for assuring cleanup on that portion of the Todd property.

3. Tank Farms-Shell Oil, Arco, Texaco. With the exception of Shell Yard A, Ecology will take the lead on these three tank farms and will follow through to final cleanup using MTCA authorities.

Schedules

EPA has decided to divide the site into two separate operable units and therefore will prepare two separate RODs for the site. The first ROD will address soils and sediments for the island and is scheduled to be

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completed by March, 1992. The second ROD will address groundwater and is proposed for completion in March, 199~~2~~3. Ecology intends to develop a schedule for its orders to the tank farms which will allow EPA and the tank farms to conduct concurrent groundwater sampling events. Ecology and EPA agree that soils data from the tank farms will not be available in time to be used in preparation of the soils/sediment ROD, but that Ecology's Cleanup Action Plans will address any necessary remediation indicated by that data.

Data Exchange

Ecology and EPA agree to exchange data in a manner to facilitate decision making by both parties. EPA shall have access to all data collected by Ecology and the PLPs including that done for source control. Ecology shall have access to all data collected by EPA, its contractors and the PRPs.

Dispute Resolution

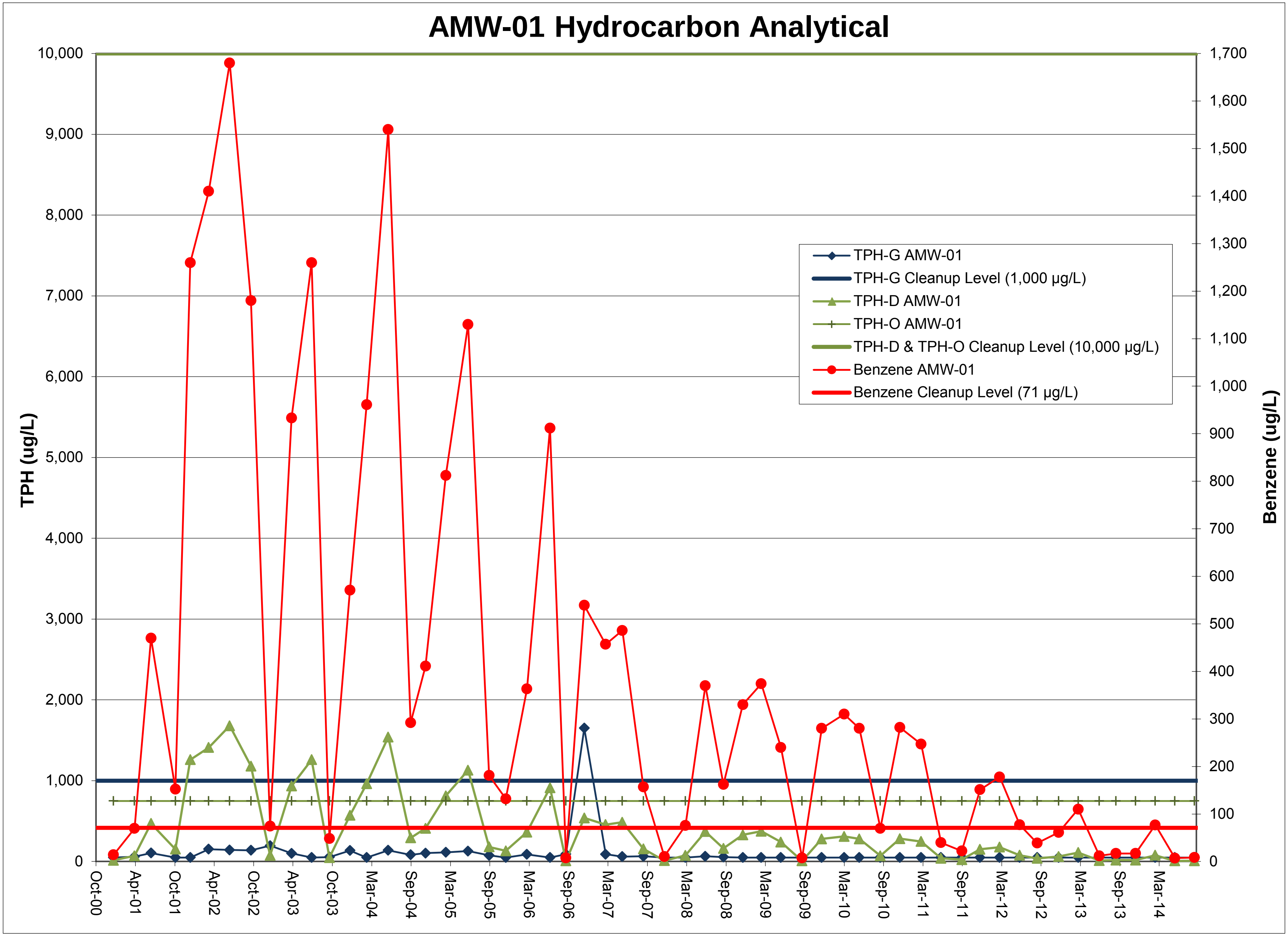
In the event of disputes between EPA and Ecology concerning site activities, the agency site managers will attempt to promptly resolve such disputes. If disputes cannot be resolved at this level, the problem will be referred to the supervisors of these persons for futher consultation. This supervisory referral and resolution process will continue, to the level necessary to resolve the conflict.

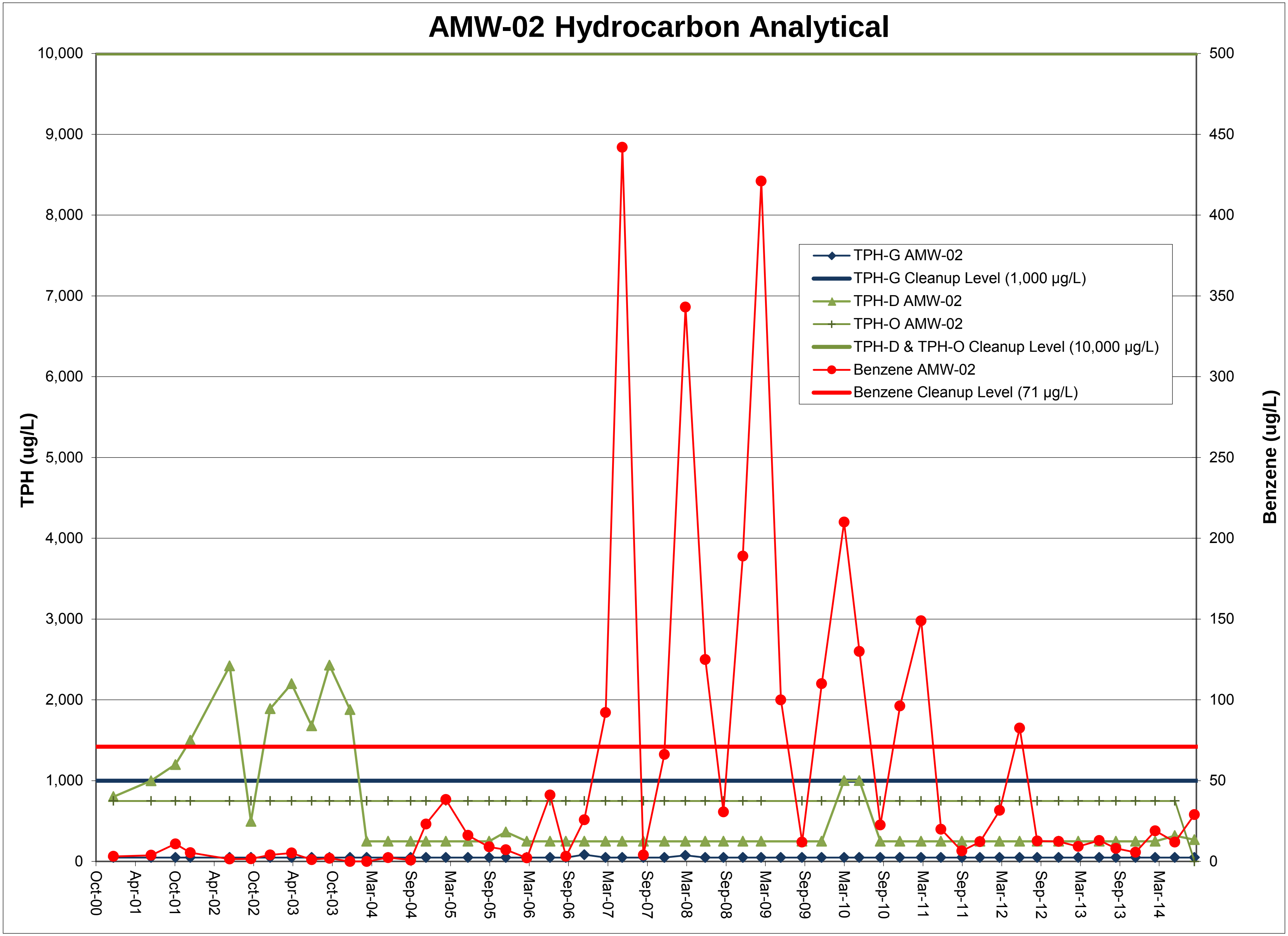
In the event that schedules for activities at the tank farms and the Weston investigation conflict, EPA and Ecology will meet to discuss options. Preference shall be given to those activities which are actively reducing a known threat to human health or the environment rather than to investigatory activities. Every effort shall be made to accomodate both activities. For example, product recovery operations at a tank farm have the potential to affect groundwater investigation results. EPA and Ecology shall give priority to the continuing operation of the product recovery system, yet may schedule an inactive period to allow the investigation to proceed. Such decisions will be made on a case by case basis by the agency project managers.

For the Department of Ecology	For the Environmental Protection Agency
Carol L. Fleskes 1/25/91	Philip G. Millam 2-5-91
Carol L. Fleskes Date	Philip G. Millam Date
Program Manager, Toxics Cleanup Program	Chief, Superfund Branch

Appendix C.

Monitoring Well Hydrocarbon Analytical Line Charts


AMW-01 Hydrocarbon Analytical
TPH (ug/L)
Benzene (ug/L)
TPH-G AMW-01
TPH-G Cleanup Level (1,000 µg/L)
TPH-D AMW-01
TPH-O AMW-01
TPH-D & TPH-O Cleanup Level (10,000 µg/L)
Benzene AMW-01
Benzene Cleanup Level (71 µg/L)
0
1,000
2,000
3,000
4,000
5,000
6,000
7,000
8,000
9,000
10,000
100
200
300
400
500
600
700
800
900
1,000
1,100
1,200
1,300
1,400
1,500
1,600
1,700
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Mar-04
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14


AMW-02 Hydrocarbon Analytical
TPH (ug/L)
Benzene (ug/L)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
500
450
400
350
300
250
200
150
100
50
0
TPH-G AMW-02
TPH-G Cleanup Level (1,000 µg/L)
TPH-D AMW-02
TPH-O AMW-02
TPH-D & TPH-O Cleanup Level (10,000 µg/L)
Benzene AMW-02
Benzene Cleanup Level (71 µg/L)
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Mar-04
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
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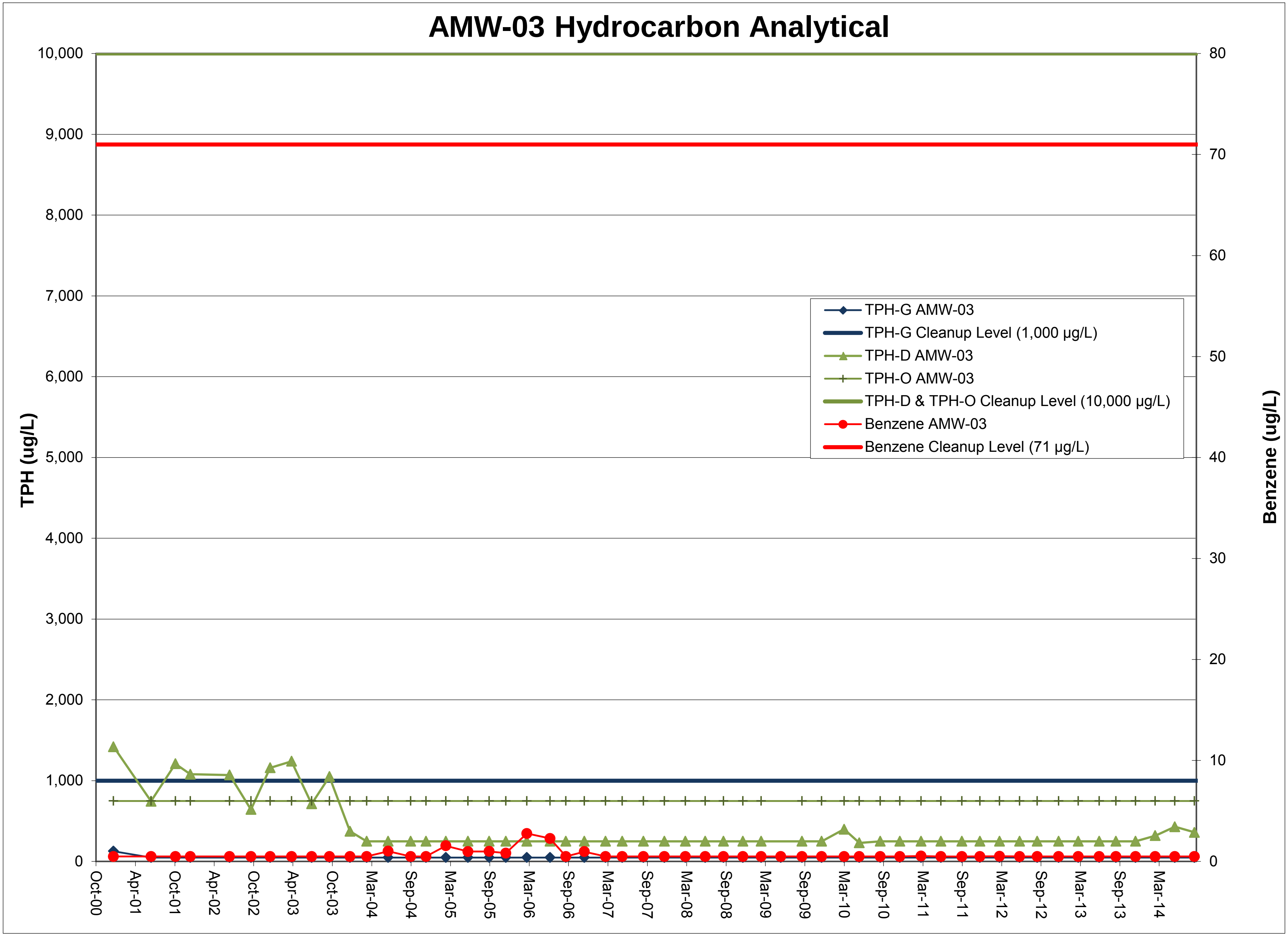
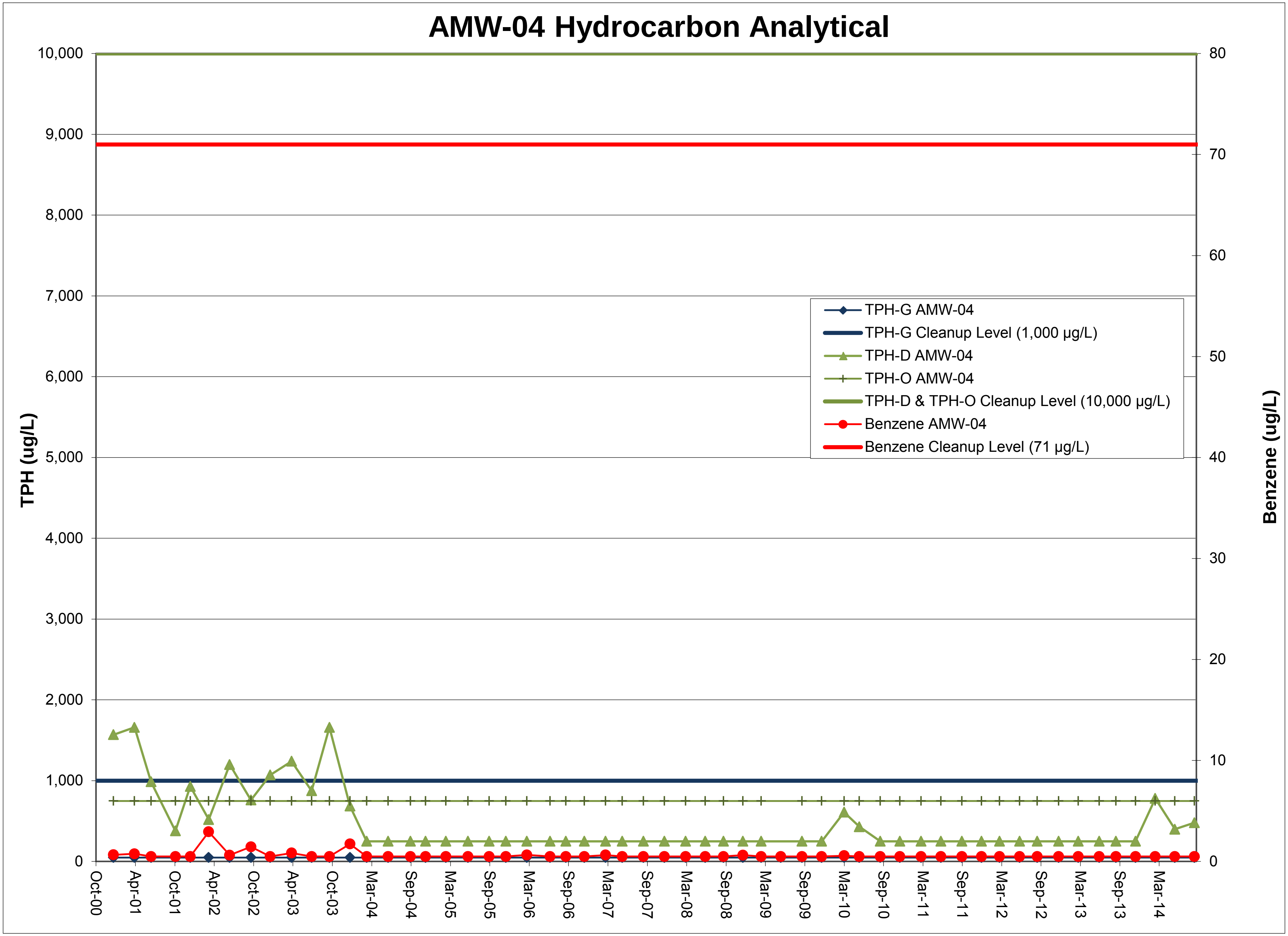
Mar-13
Sep-13
Mar-14



AMW-03 Hydrocarbon Analytical
TPH (ug/L)
Benzene (ug/L)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
80
70
60
50
40
30
20
10
0
TPH-G AMW-03
TPH-G Cleanup Level (1,000 µg/L)
TPH-D AMW-03
TPH-O AMW-03
TPH-D & TPH-O Cleanup Level (10,000 µg/L)
Benzene AMW-03
Benzene Cleanup Level (71 µg/L)
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Mar-04
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14



AMW-04 Hydrocarbon Analytical
TPH (ug/L)
Benzene (ug/L)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
80
70
60
50
40
30
20
10
0
TPH-G AMW-04
TPH-G Cleanup Level (1,000 µg/L)
TPH-D AMW-04
TPH-O AMW-04
TPH-D & TPH-O Cleanup Level (10,000 µg/L)
Benzene AMW-04
Benzene Cleanup Level (71 µg/L)
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Mar-04
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
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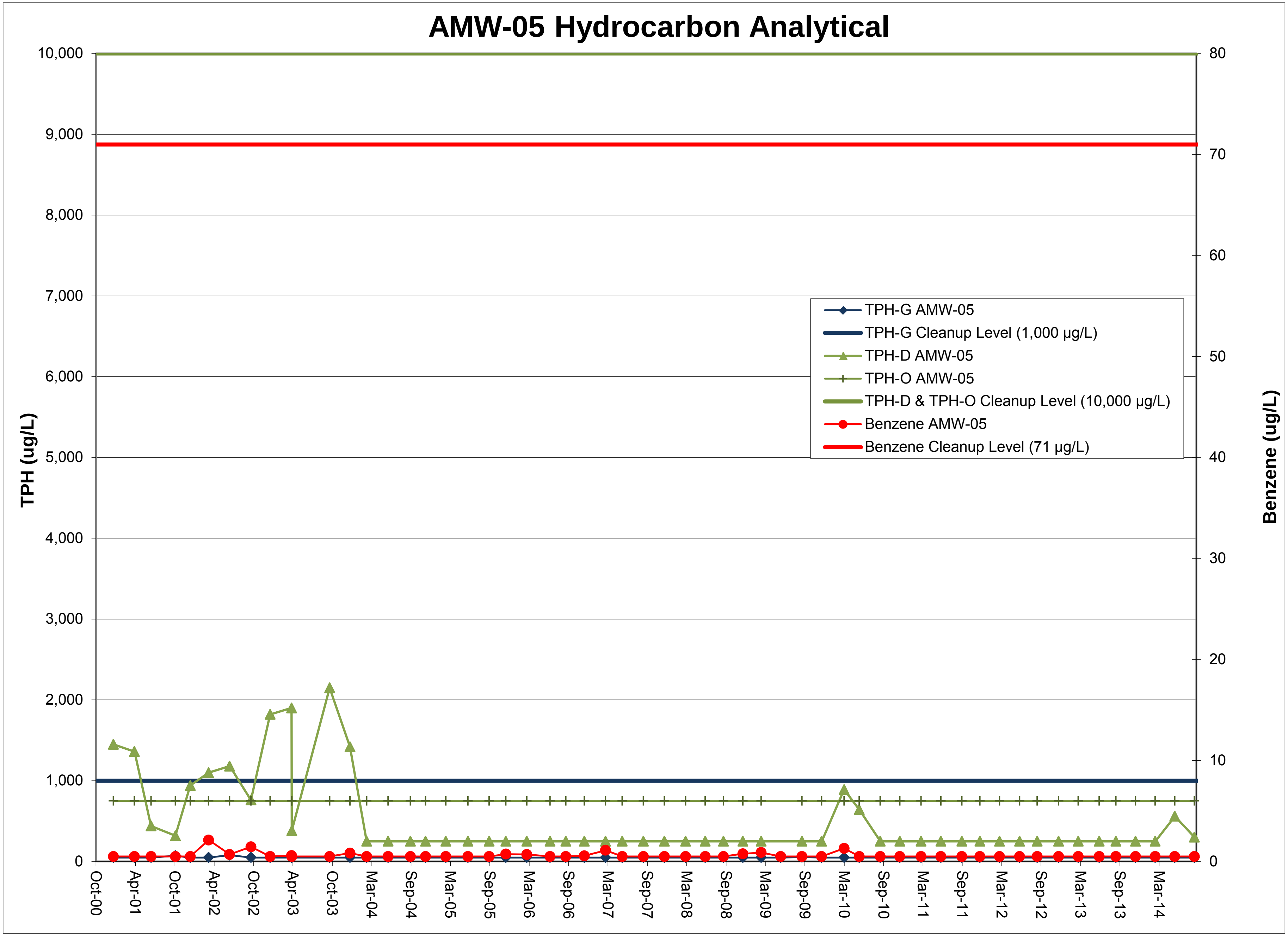
Mar-13
Sep-13
Mar-14



AMW-05 Hydrocarbon Analytical
TPH (ug/L)
Benzene (ug/L)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
80
70
60
50
40
30
20
10
0
TPH-G AMW-05
TPH-G Cleanup Level (1,000 µg/L)
TPH-D AMW-05
TPH-O AMW-05
TPH-D & TPH-O Cleanup Level (10,000 µg/L)
Benzene AMW-05
Benzene Cleanup Level (71 µg/L)
Oct-00
Apr-01
Oct-01
Apr-02
Oct-02
Apr-03
Oct-03
Mar-04
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
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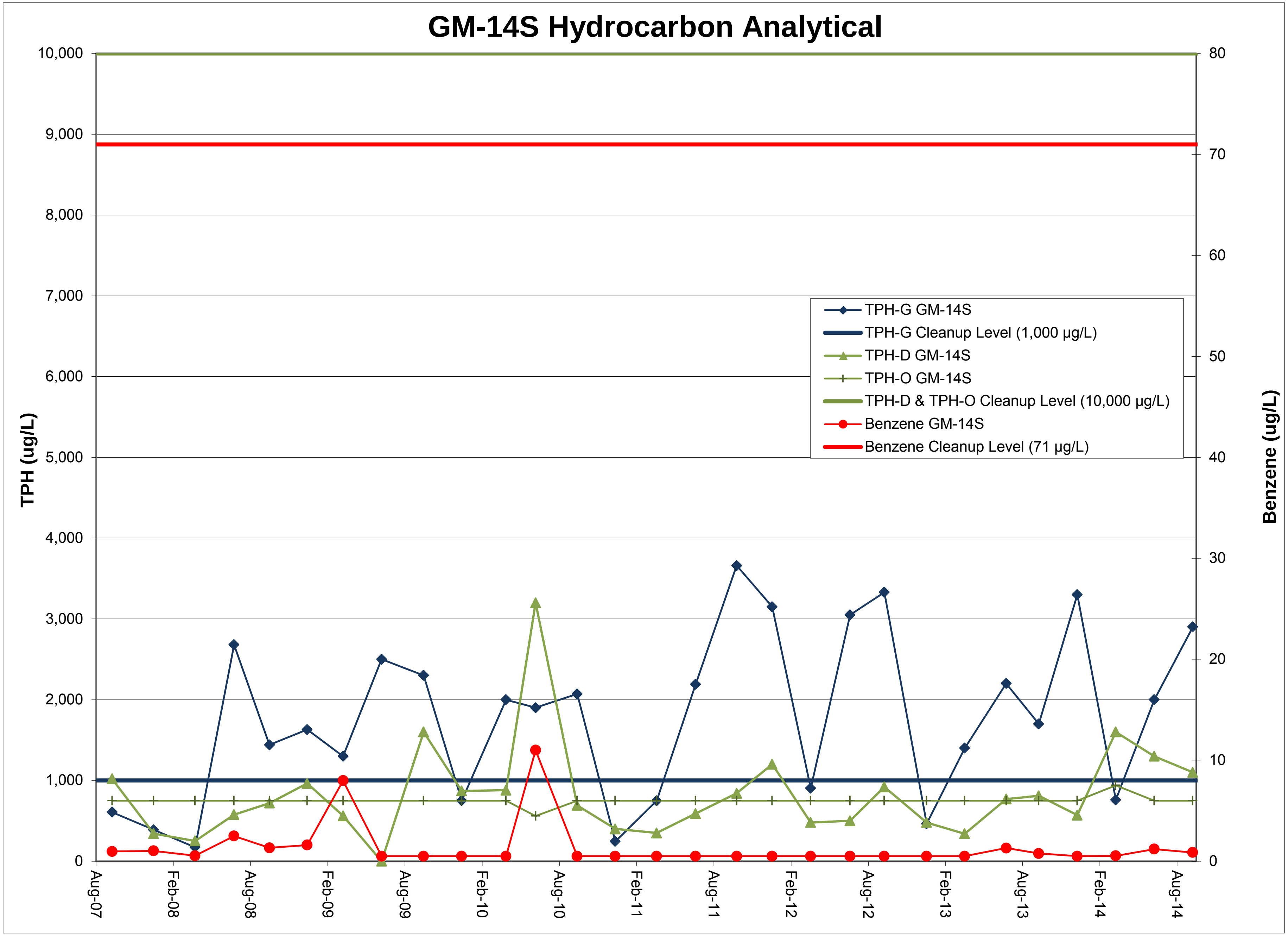
Sep-13
Mar-14



GM-14S Hydrocarbon Analytical
TPH (ug/L)
Benzene (ug/L)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
80
70
60
50
40
30
20
10
0
TPH-G GM-14S
TPH-G Cleanup Level (1,000 µg/L)
TPH-D GM-14S
TPH-O GM-14S
TPH-D & TPH-O Cleanup Level (10,000 µg/L)
Benzene GM-14S
Benzene Cleanup Level (71 µg/L)
Aug-07
Feb-08
Aug-08
Feb-09
Aug-09
Feb-10
Aug-10
Feb-11
Aug-11
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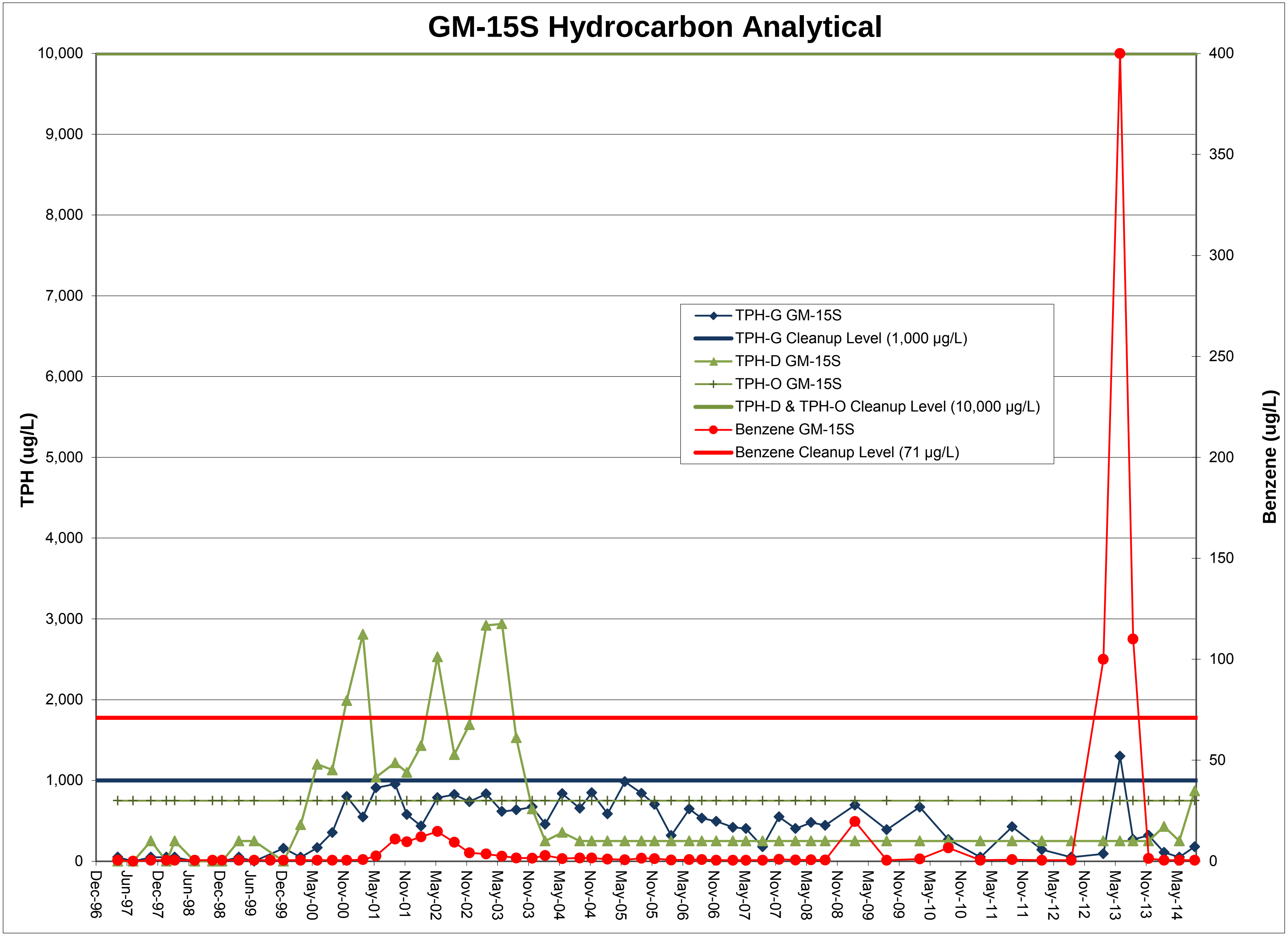
Aug-13
Feb-14
Aug-14



GM-15S Hydrocarbon Analytical
TPH (ug/L)
Benzene (ug/L)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
400
350
300
250
200
150
100
50
0
TPH-G GM-15S
TPH-G Cleanup Level (1,000 µg/L)
TPH-D GM-15S
TPH-O GM-15S
TPH-D & TPH-O Cleanup Level (10,000 µg/L)
Benzene GM-15S
Benzene Cleanup Level (71 µg/L)
Dec-96
Jun-97
Dec-97
Jun-98
Dec-98
Jun-99
Dec-99
May-00
Nov-00
May-01
Nov-01
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
May-05
Nov-05
May-06
Nov-06
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May-08
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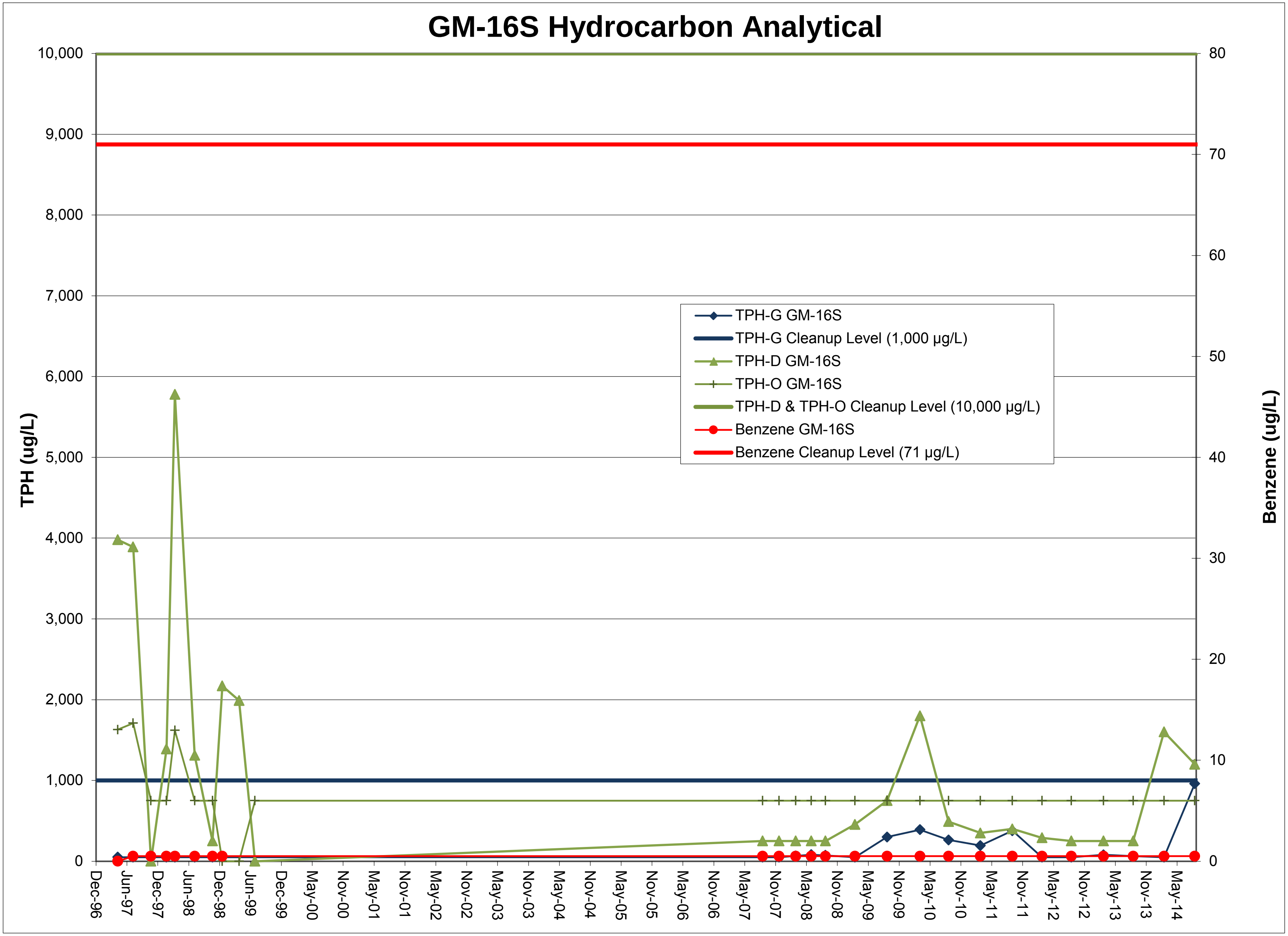
May-13
Nov-13
May-14


GM-16S Hydrocarbon Analytical
TPH (ug/L)
Benzene (ug/L)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
80
70
60
50
40
30
20
10
0
TPH-G GM-16S
TPH-G Cleanup Level (1,000 µg/L)
TPH-D GM-16S
TPH-O GM-16S
TPH-D & TPH-O Cleanup Level (10,000 µg/L)
Benzene GM-16S
Benzene Cleanup Level (71 µg/L)
Dec-96
Jun-97
Dec-97
Jun-98
Dec-98
Jun-99
Dec-99
May-00
Nov-00
May-01
Nov-01
May-02
Nov-02
May-03
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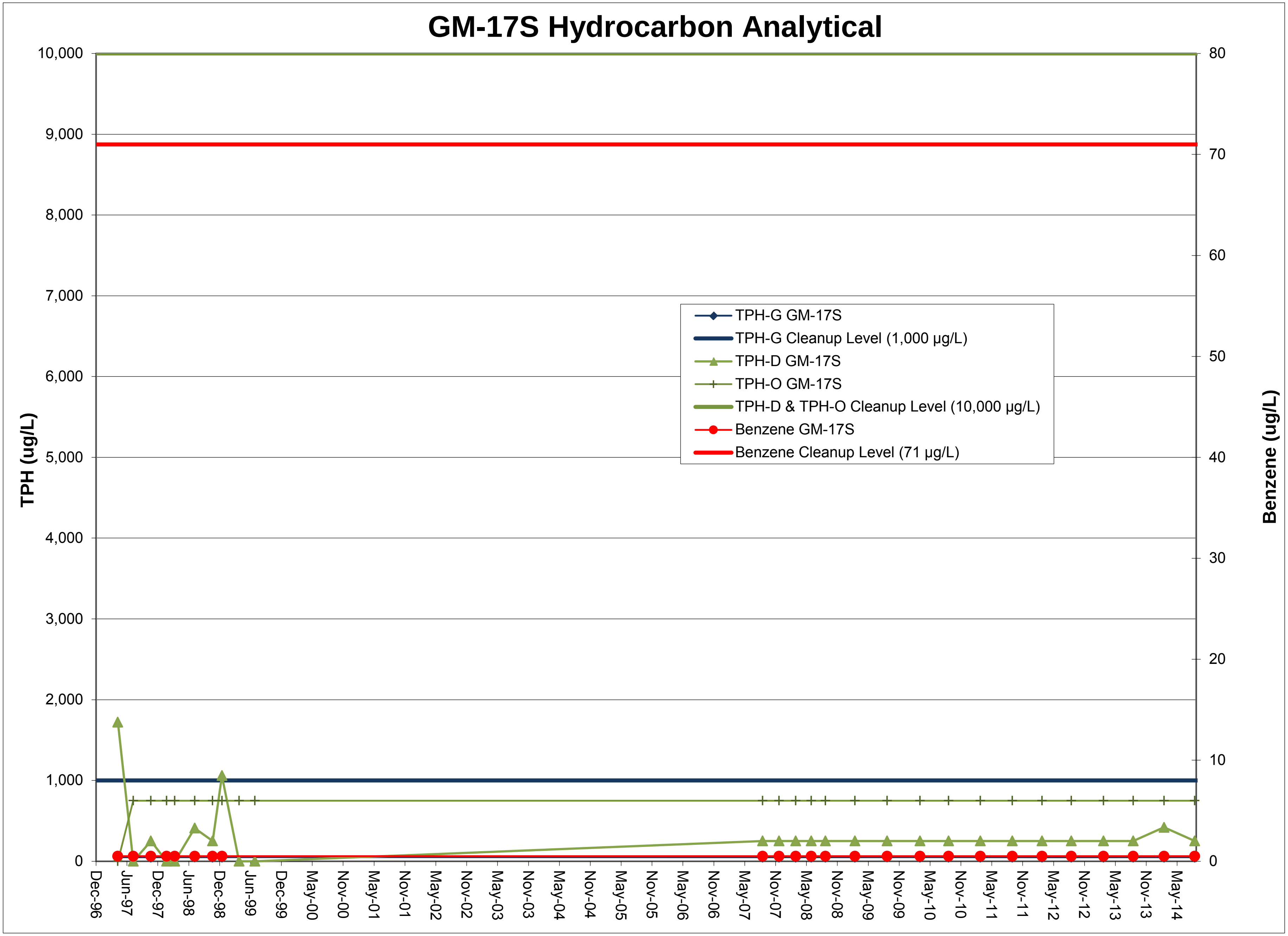
May-10
Nov-10
May-11
Nov-11
May-12
Nov-12
May-13
Nov-13
May-14



GM-17S Hydrocarbon Analytical
TPH (ug/L)
Benzene (ug/L)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
80
70
60
50
40
30
20
10
0
TPH-G GM-17S
TPH-G Cleanup Level (1,000 µg/L)
TPH-D GM-17S
TPH-O GM-17S
TPH-D & TPH-O Cleanup Level (10,000 µg/L)
Benzene GM-17S
Benzene Cleanup Level (71 µg/L)
Dec-96
Jun-97
Dec-97
Jun-98
Dec-98
Jun-99
Dec-99
May-00
Nov-00
May-01
Nov-01
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
May-05
Nov-05
May-06
Nov-06
May-07
Nov-07
May-08
Nov-08
May-09
Nov-09
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Nov-10
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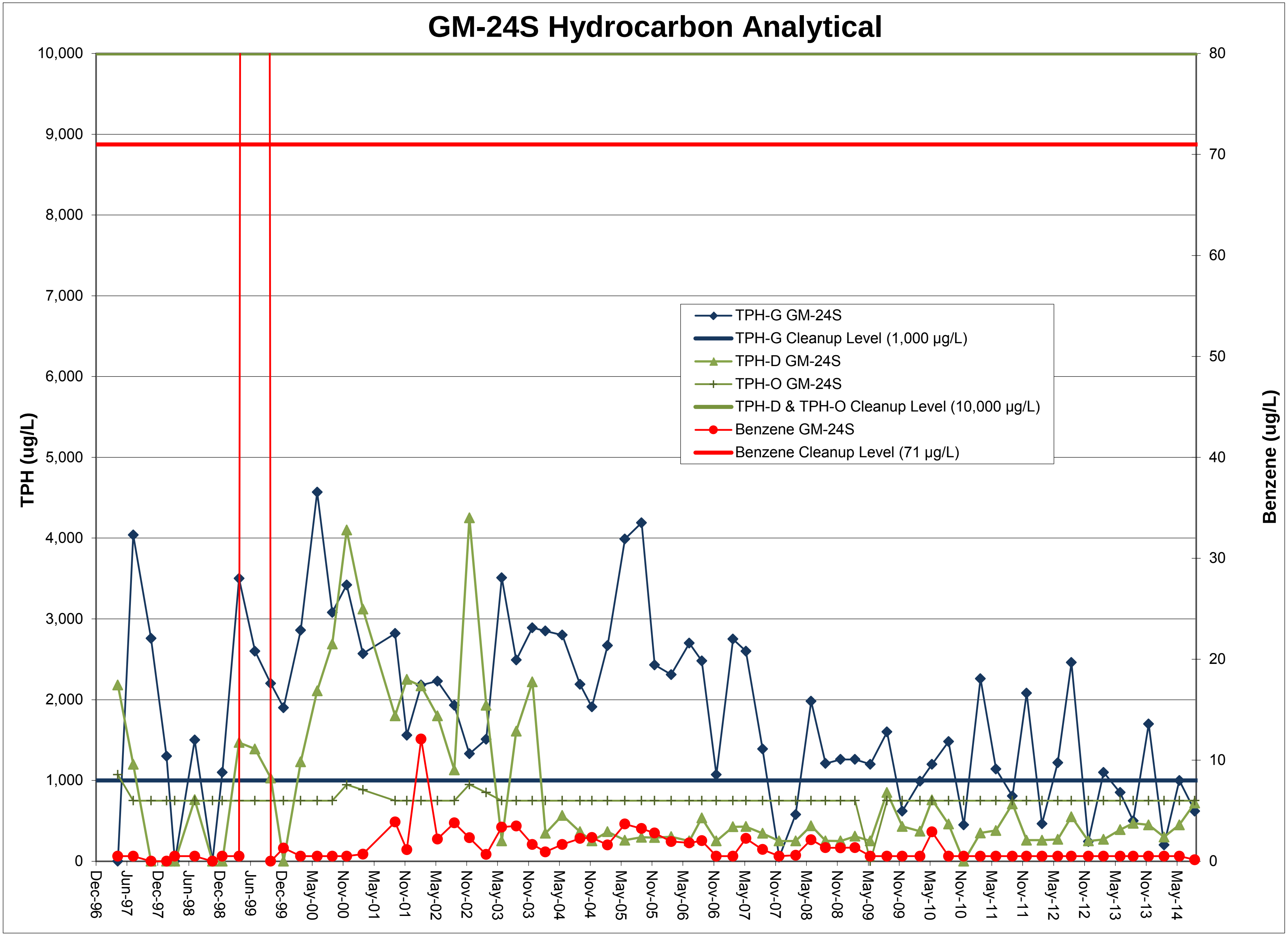
Nov-11
May-12
Nov-12
May-13
Nov-13
May-14


GM-24S Hydrocarbon Analytical
TPH (ug/L)
Benzene (ug/L)
TPH-G GM-24S
TPH-G Cleanup Level (1,000 µg/L)
TPH-D GM-24S
TPH-O GM-24S
TPH-D & TPH-O Cleanup Level (10,000 µg/L)
Benzene GM-24S
Benzene Cleanup Level (71 µg/L)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
80
70
60
50
40
30
20
10
0
Dec-96
Jun-97
Dec-97
Jun-98
Dec-98
Jun-99
Dec-99
May-00
Nov-00
May-01
Nov-01
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
May-05
Nov-05
May-06
Nov-06
May-07
Nov-07
May-08
Nov-08
May-09
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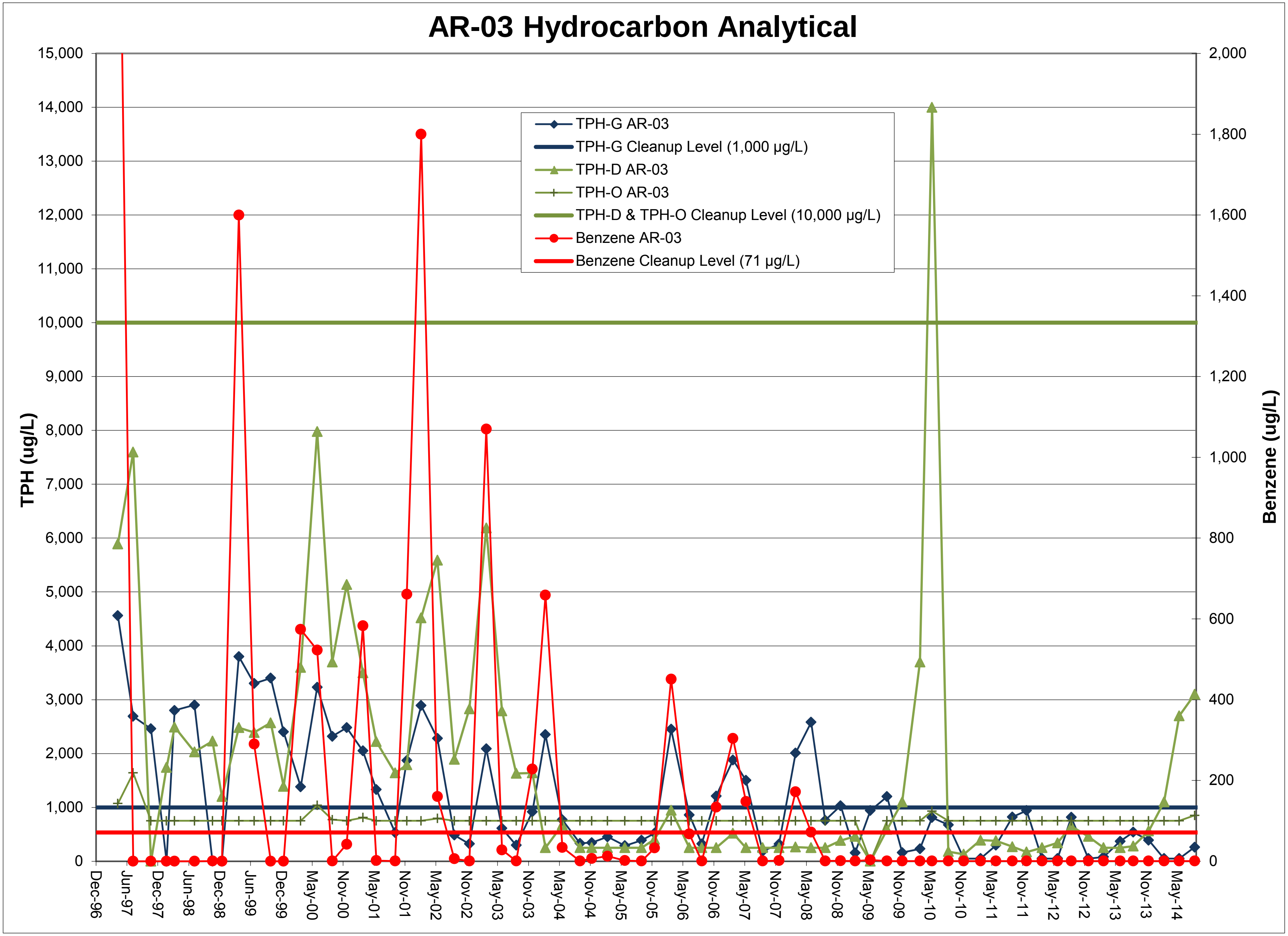
Nov-11
May-12
Nov-12
May-13
Nov-13
May-14


AR-03 Hydrocarbon Analytical
TPH (ug/L)
Benzene (ug/L)
TPH-G AR-03
TPH-G Cleanup Level (1,000 µg/L)
TPH-D AR-03
TPH-O AR-03
TPH-D & TPH-O Cleanup Level (10,000 µg/L)
Benzene AR-03
Benzene Cleanup Level (71 µg/L)
15,000
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
2,000
1,800
1,600
1,400
1,200
1,000
800
600
400
200
0
Dec-96
Jun-97
Dec-97
Jun-98
Dec-98
Jun-99
Dec-99
May-00
Nov-00
May-01
Nov-01
May-02
Nov-02
May-03
Nov-03
May-04
Nov-04
May-05
Nov-05
May-06
Nov-06
May-07
Nov-07
May-08
Nov-08
May-09
Nov-09
May-10
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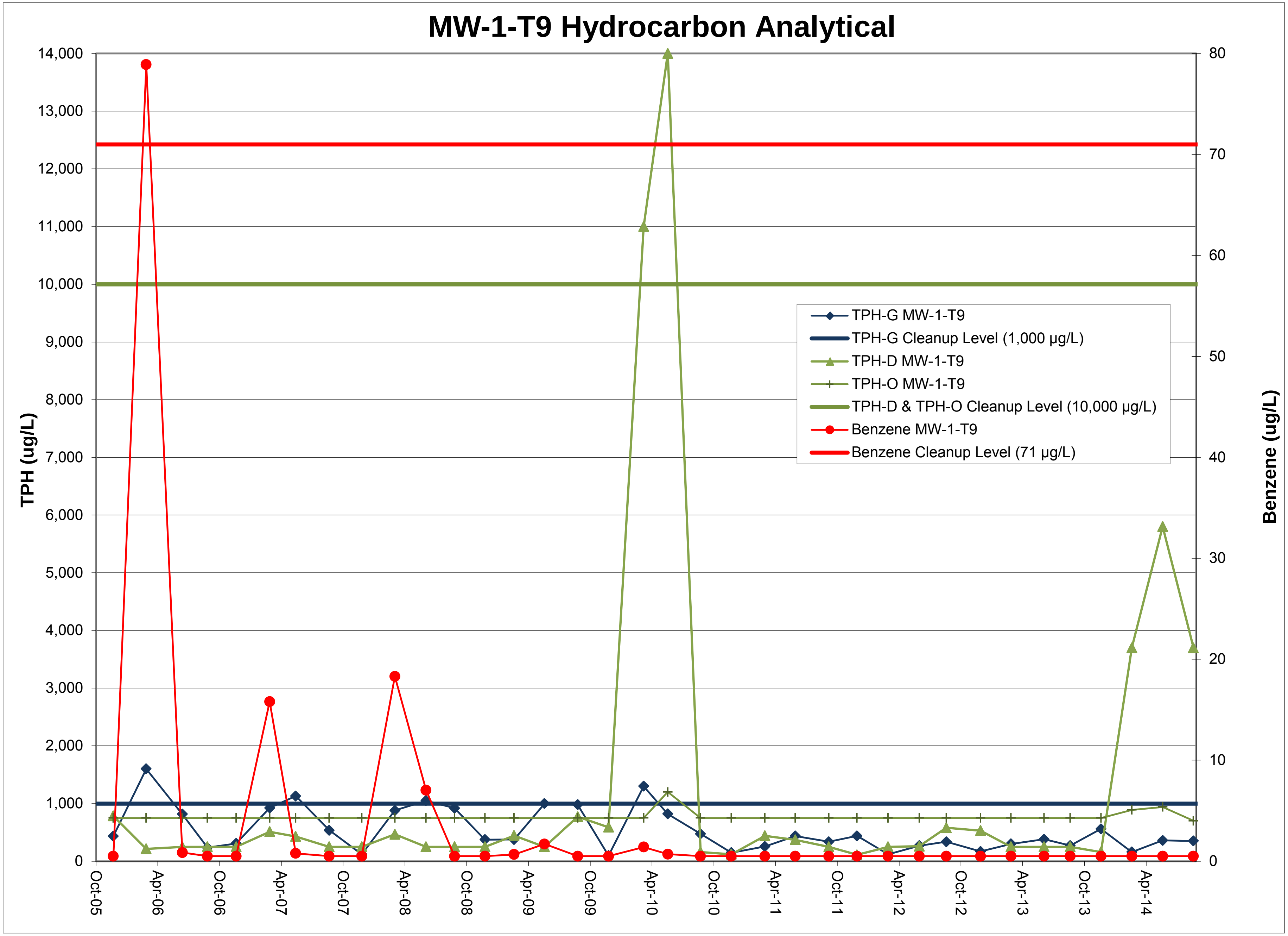
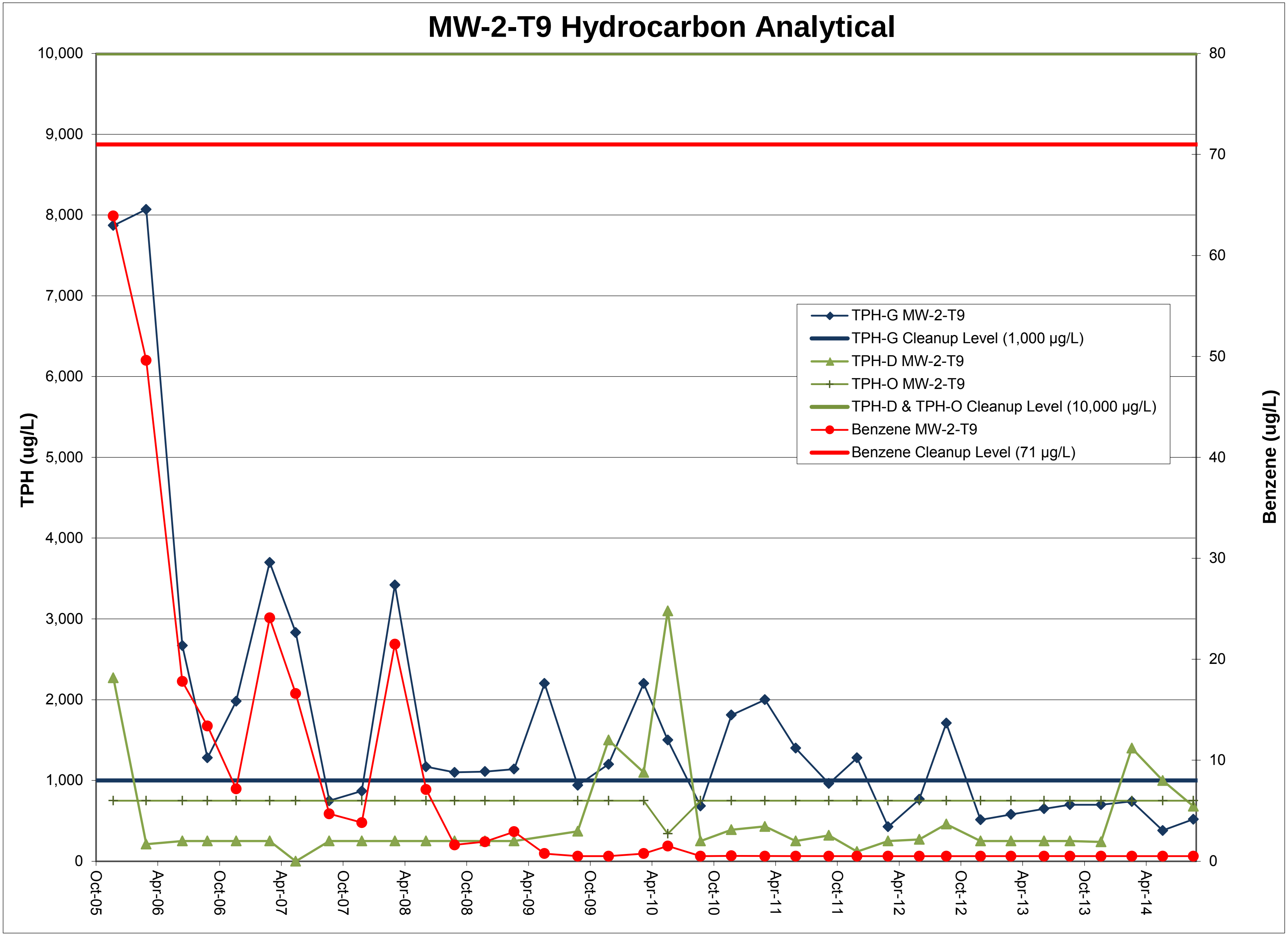
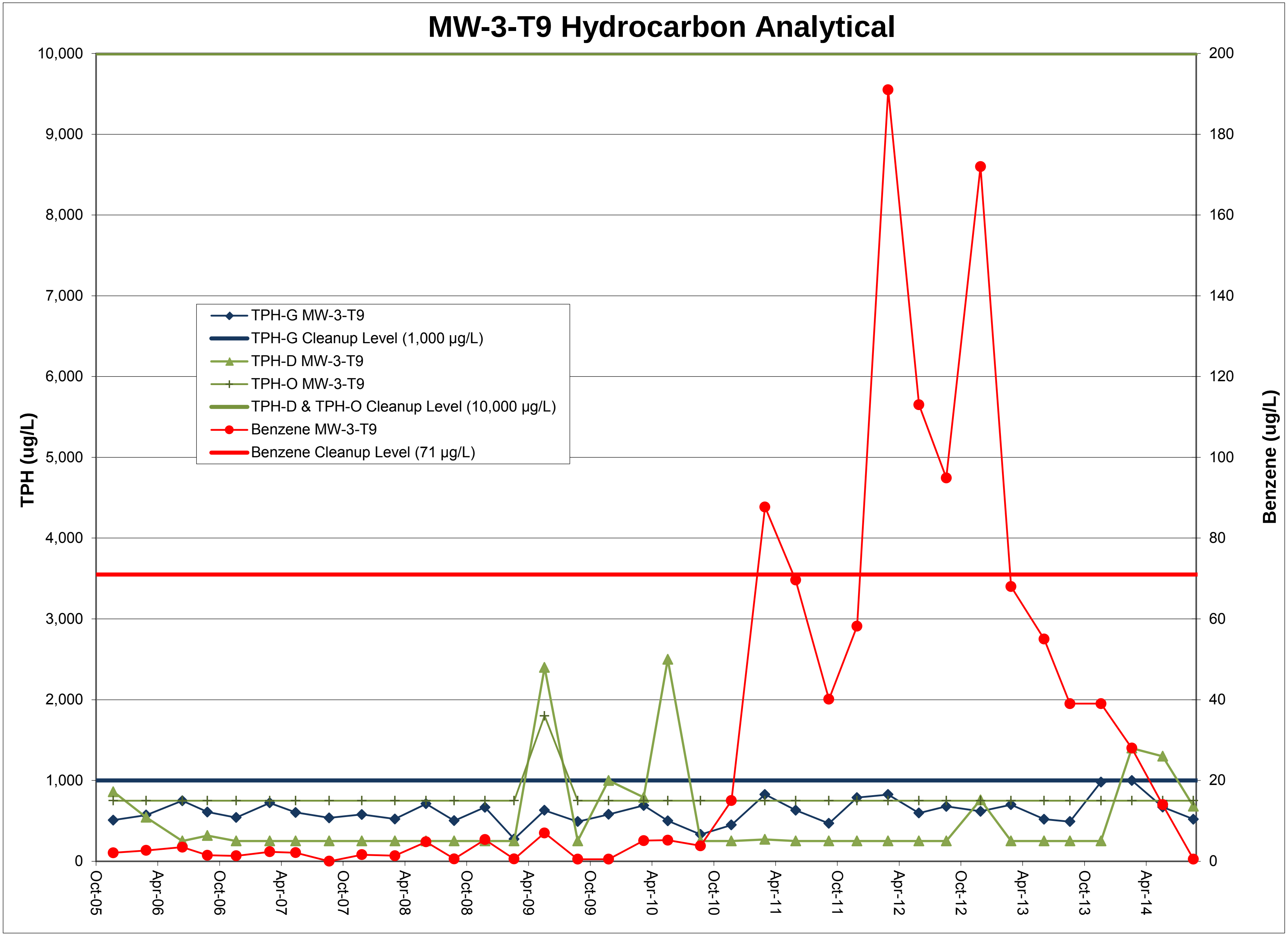
Nov-11
May-12
Nov-12
May-13
Nov-13
May-14

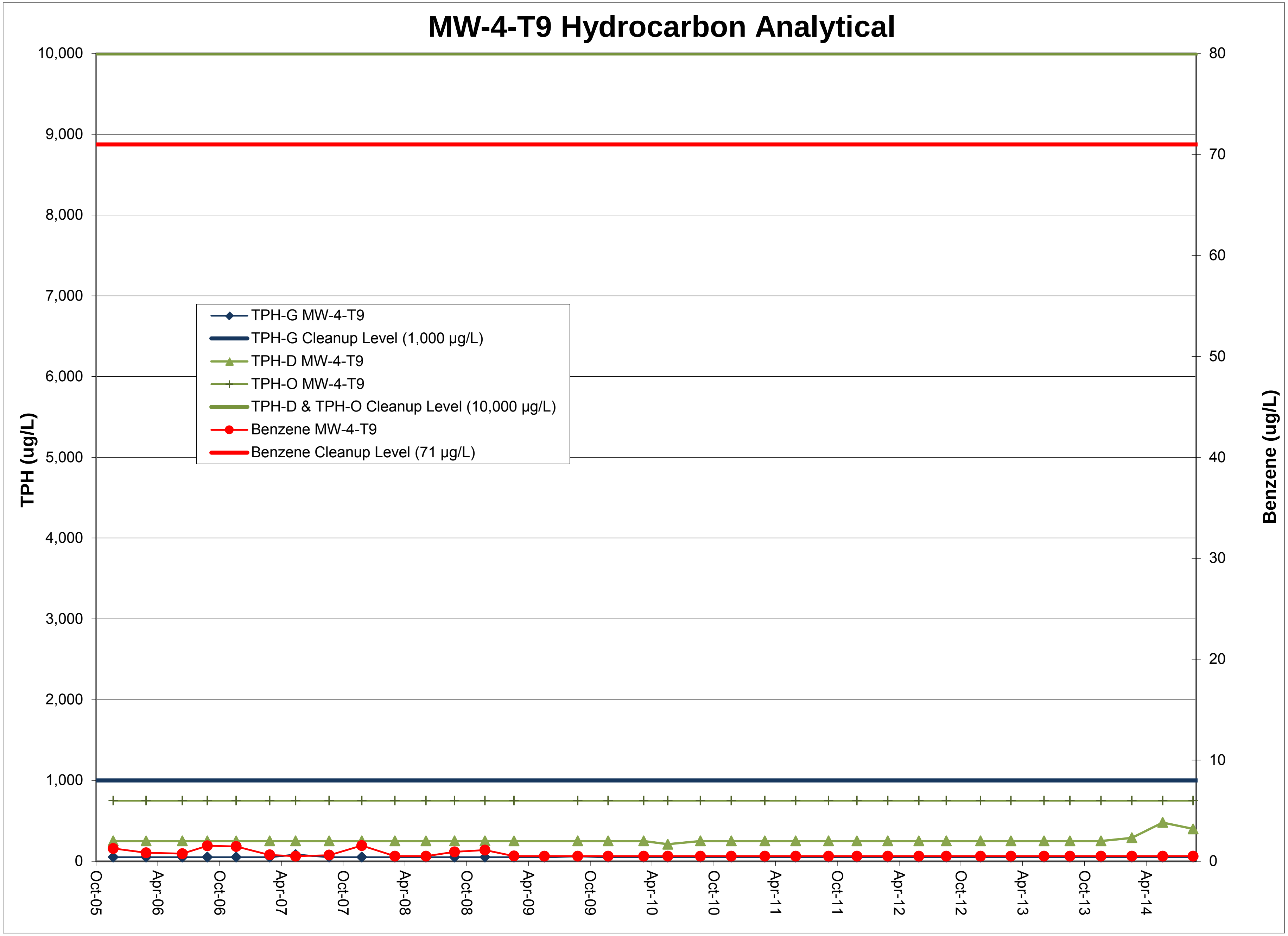

MW-1-T9 Hydrocarbon Analytical
TPH (ug/L)
Benzene (ug/L)
14,000
13,000
12,000
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
80
70
60
50
40
30
20
10
0
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
TPH-G MW-1-T9
TPH-G Cleanup Level (1,000 µg/L)
TPH-D MW-1-T9
TPH-O MW-1-T9
TPH-D & TPH-O Cleanup Level (10,000 µg/L)
Benzene MW-1-T9
Benzene Cleanup Level (71 µg/L)



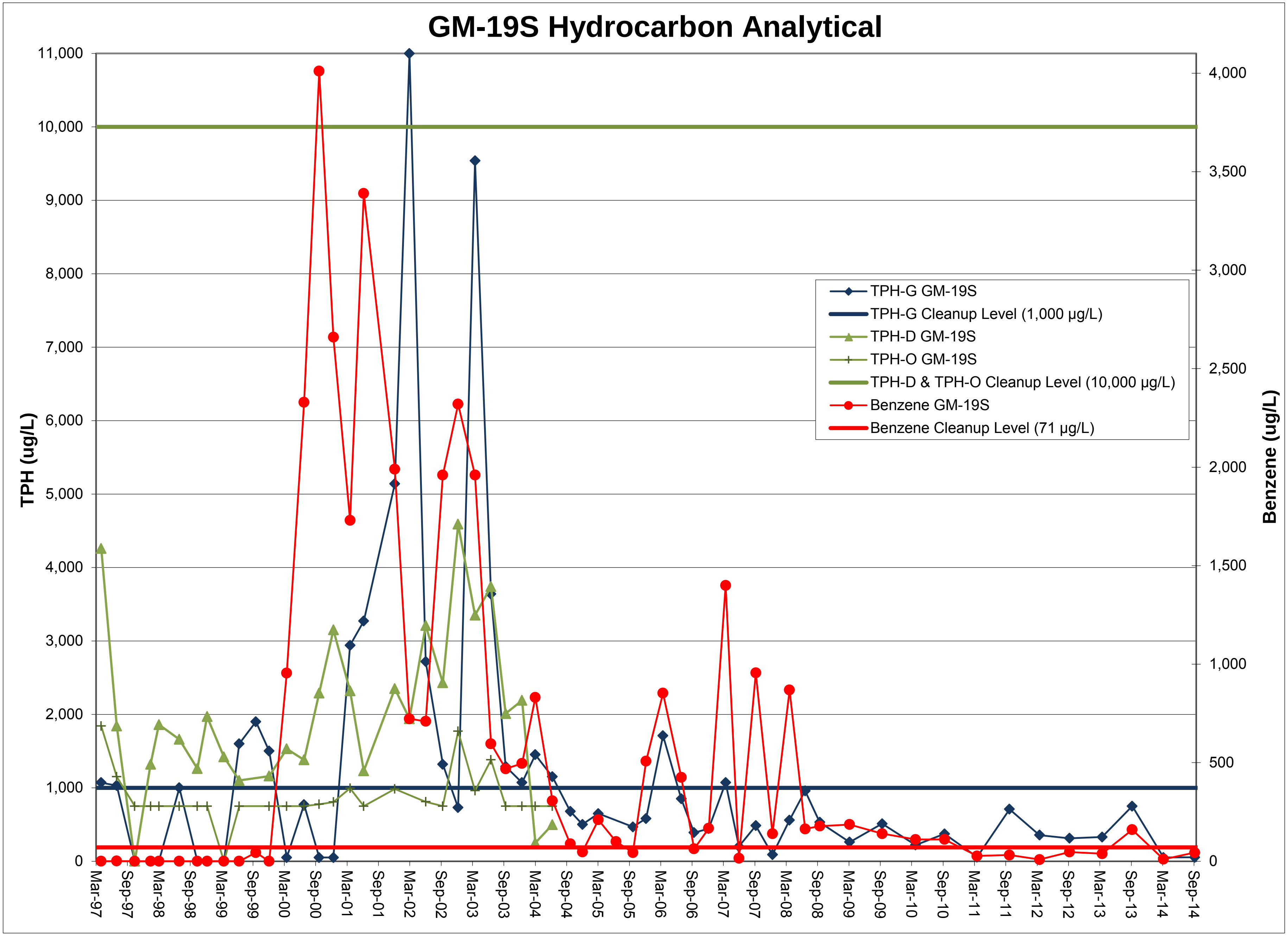
MW-2-T9 Hydrocarbon Analytical
TPH (ug/L)
Benzene (ug/L)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
80
70
60
50
40
30
20
10
0
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
TPH-G MW-2-T9
TPH-G Cleanup Level (1,000 µg/L)
TPH-D MW-2-T9
TPH-O MW-2-T9
TPH-D & TPH-O Cleanup Level (10,000 µg/L)
Benzene MW-2-T9
Benzene Cleanup Level (71 µg/L)



MW-3-T9 Hydrocarbon Analytical
TPH (ug/L)
Benzene (ug/L)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
200
180
160
140
120
100
80
60
40
20
0
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
TPH-G MW-3-T9
TPH-G Cleanup Level (1,000 µg/L)
TPH-D MW-3-T9
TPH-O MW-3-T9
TPH-D & TPH-O Cleanup Level (10,000 µg/L)
Benzene MW-3-T9
Benzene Cleanup Level (71 µg/L)



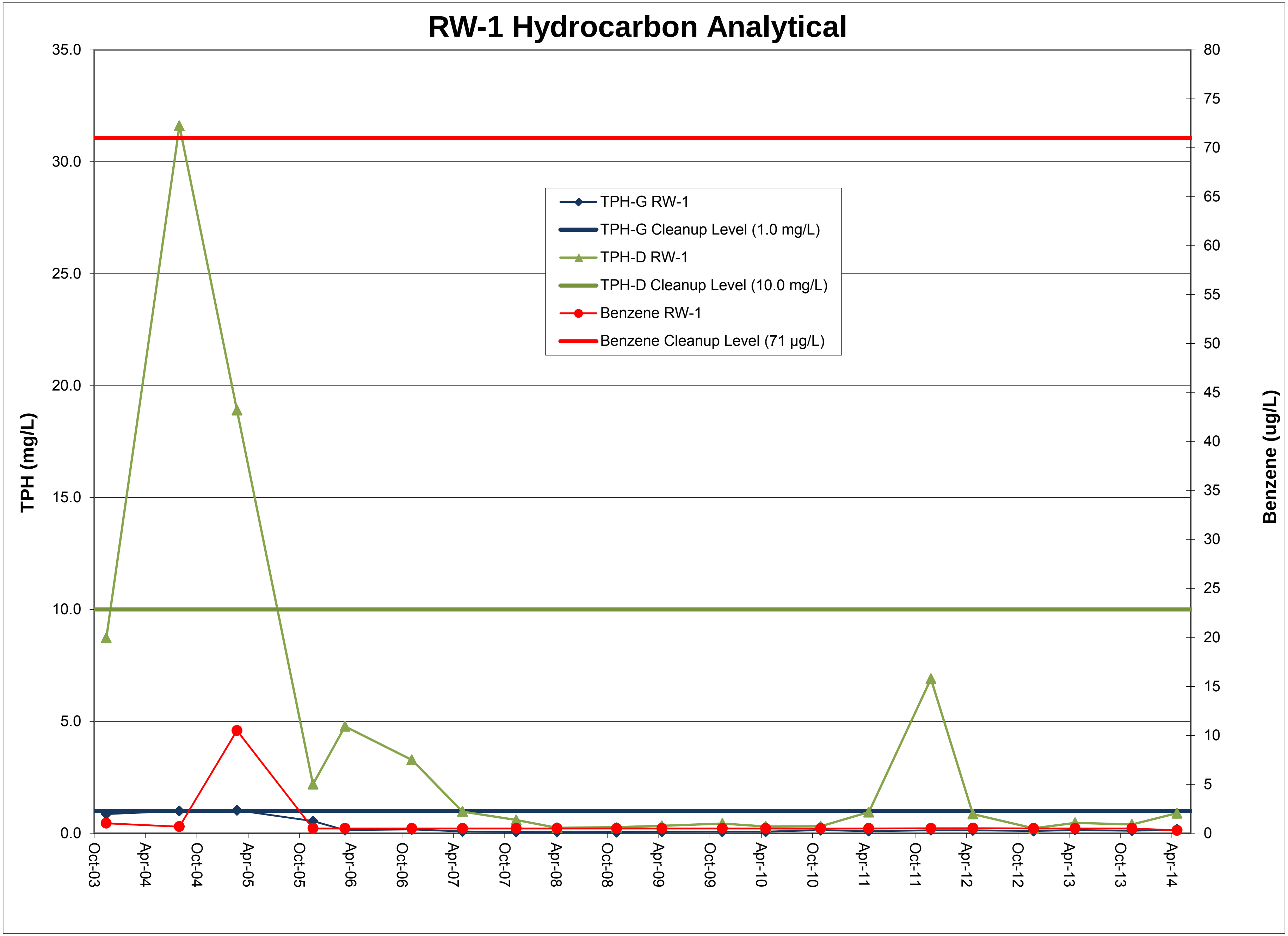
MW-4-T9 Hydrocarbon Analytical
TPH (ug/L)
Benzene (ug/L)
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
80
70
60
50
40
30
20
10
0
TPH-G MW-4-T9
TPH-G Cleanup Level (1,000 µg/L)
TPH-D MW-4-T9
TPH-O MW-4-T9
TPH-D & TPH-O Cleanup Level (10,000 µg/L)
Benzene MW-4-T9
Benzene Cleanup Level (71 µg/L)
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14

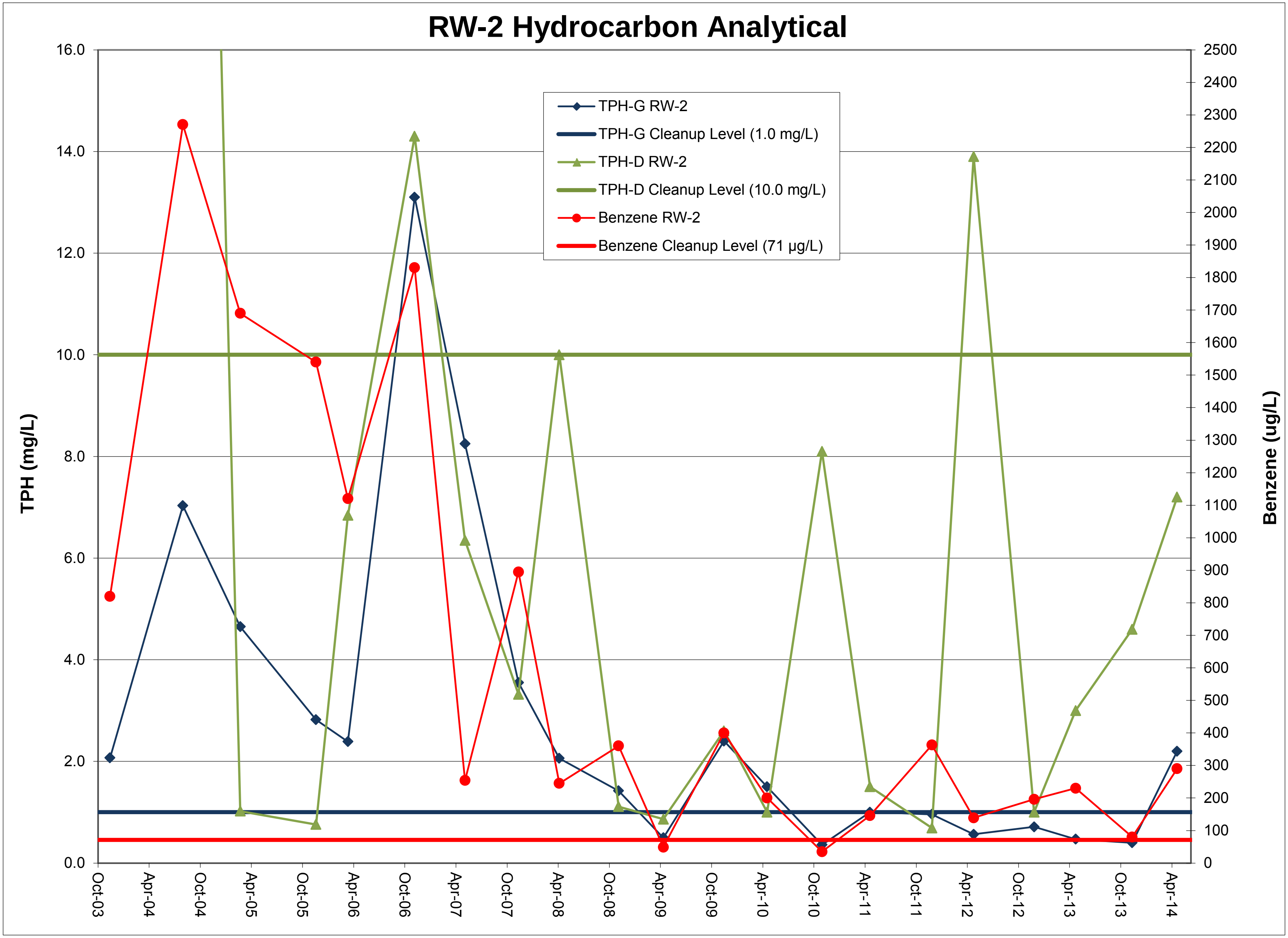

GM-19S Hydrocarbon Analytical
TPH (ug/L)
Benzene (ug/L)
11,000
10,000
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
4,000
3,500
3,000
2,500
2,000
1,500
1,000
500
0
TPH-G GM-19S
TPH-G Cleanup Level (1,000 µg/L)
TPH-D GM-19S
TPH-O GM-19S
TPH-D & TPH-O Cleanup Level (10,000 µg/L)
Benzene GM-19S
Benzene Cleanup Level (71 µg/L)
Mar-97
Sep-97
Mar-98
Sep-98
Mar-99
Sep-99
Mar-00
Sep-00
Mar-01
Sep-01
Mar-02
Sep-02
Mar-03
Sep-03
Mar-04
Sep-04
Mar-05
Sep-05
Mar-06
Sep-06
Mar-07
Sep-07
Mar-08
Sep-08
Mar-09
Sep-09
Mar-10
Sep-10
Mar-11
Sep-11
Mar-12
Sep-12
Mar-13
Sep-13
Mar-14
Sep-14

Appendix D.

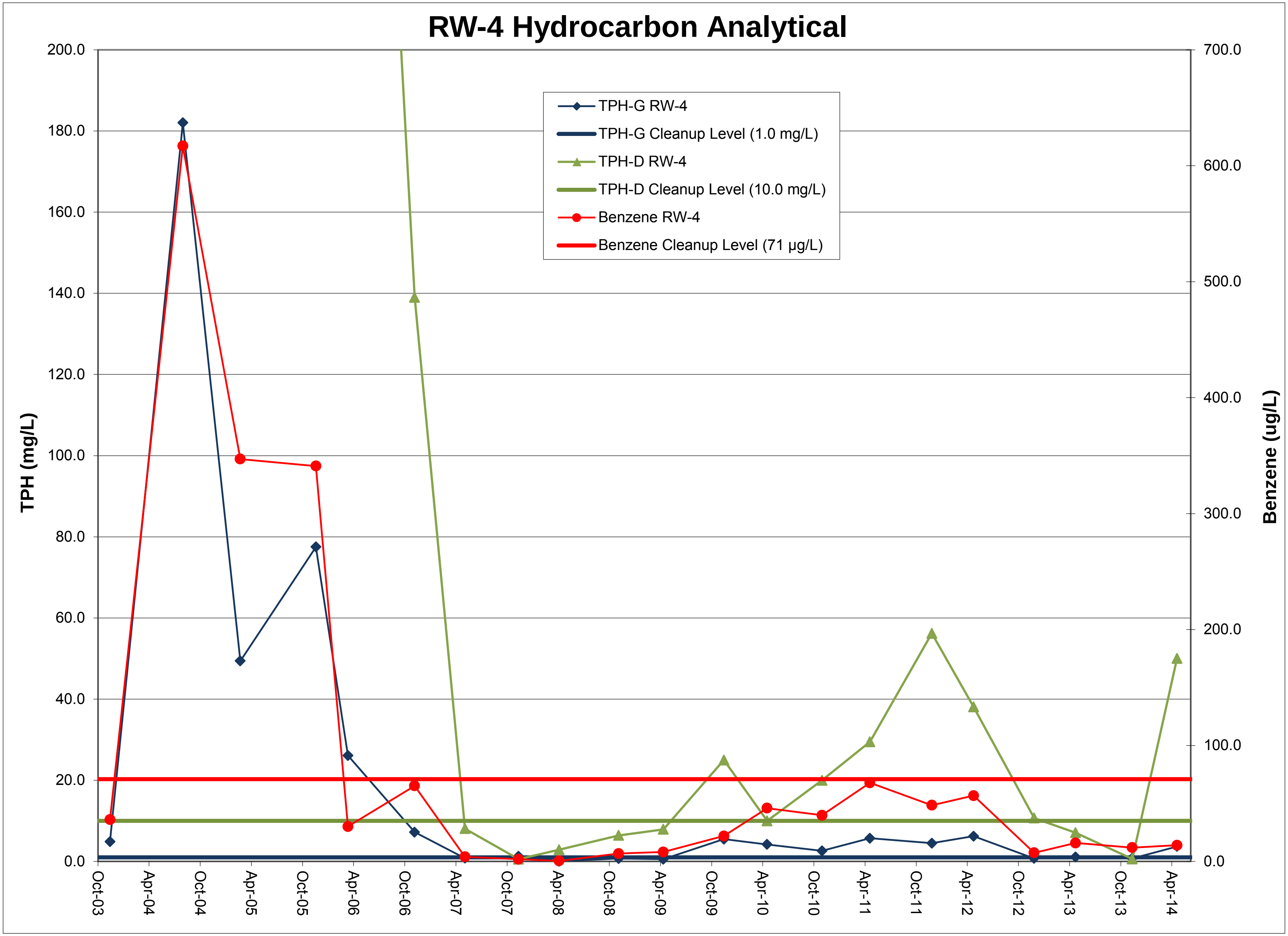
Recovery Well Hydrocarbon Analytical Line Charts

RW-1 Hydrocarbon Analytical
RW-2 Hydrocarbon Analytical
RW-4 Hydrocarbon Analytical
RW-5 Hydrocarbon Analytical
RW-6 Hydrocarbon Analytical
RW-7 Hydrocarbon Analytical
RW-8 Hydrocarbon Analytical
RW-9 Hydrocarbon Analytical
RW-10 Hydrocarbon Analytical
GM-11S Hydrocarbon Analytical

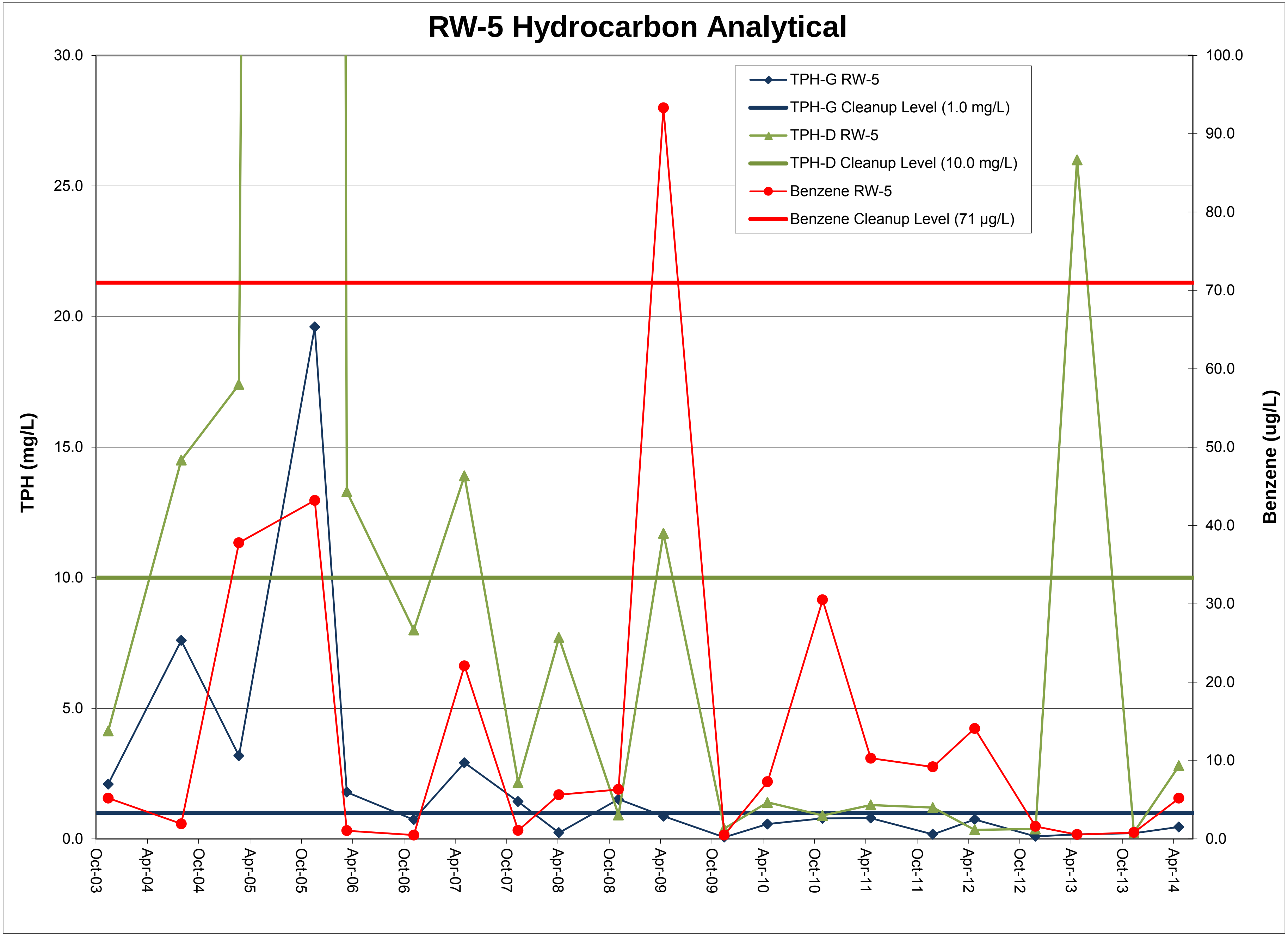

RW-1 Hydrocarbon Analytical
TPH (mg/L)
Benzene (ug/L)
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
TPH-G RW-1
TPH-G Cleanup Level (1.0 mg/L)
TPH-D RW-1
TPH-D Cleanup Level (10.0 mg/L)
Benzene RW-1
Benzene Cleanup Level (71 µg/L)
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14



RW-2 Hydrocarbon Analytical
TPH (mg/L)
Benzene (ug/L)
TPH-G RW-2
TPH-G Cleanup Level (1.0 mg/L)
TPH-D RW-2
TPH-D Cleanup Level (10.0 mg/L)
Benzene RW-2
Benzene Cleanup Level (71 µg/L)
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14



RW-4 Hydrocarbon Analytical
TPH (mg/L)
Benzene (ug/L)
TPH-G RW-4
TPH-G Cleanup Level (1.0 mg/L)
TPH-D RW-4
TPH-D Cleanup Level (10.0 mg/L)
Benzene RW-4
Benzene Cleanup Level (71 µg/L)
200.0
180.0
160.0
140.0
120.0
100.0
80.0
60.0
40.0
20.0
0.0
700.0
600.0
500.0
400.0
300.0
200.0
100.0
0.0
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14



RW-5 Hydrocarbon Analytical
TPH (mg/L)
Benzene (ug/L)
TPH-G RW-5
TPH-G Cleanup Level (1.0 mg/L)
TPH-D RW-5
TPH-D Cleanup Level (10.0 mg/L)
Benzene RW-5
Benzene Cleanup Level (71 µg/L)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
80.0
90.0
100.0
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
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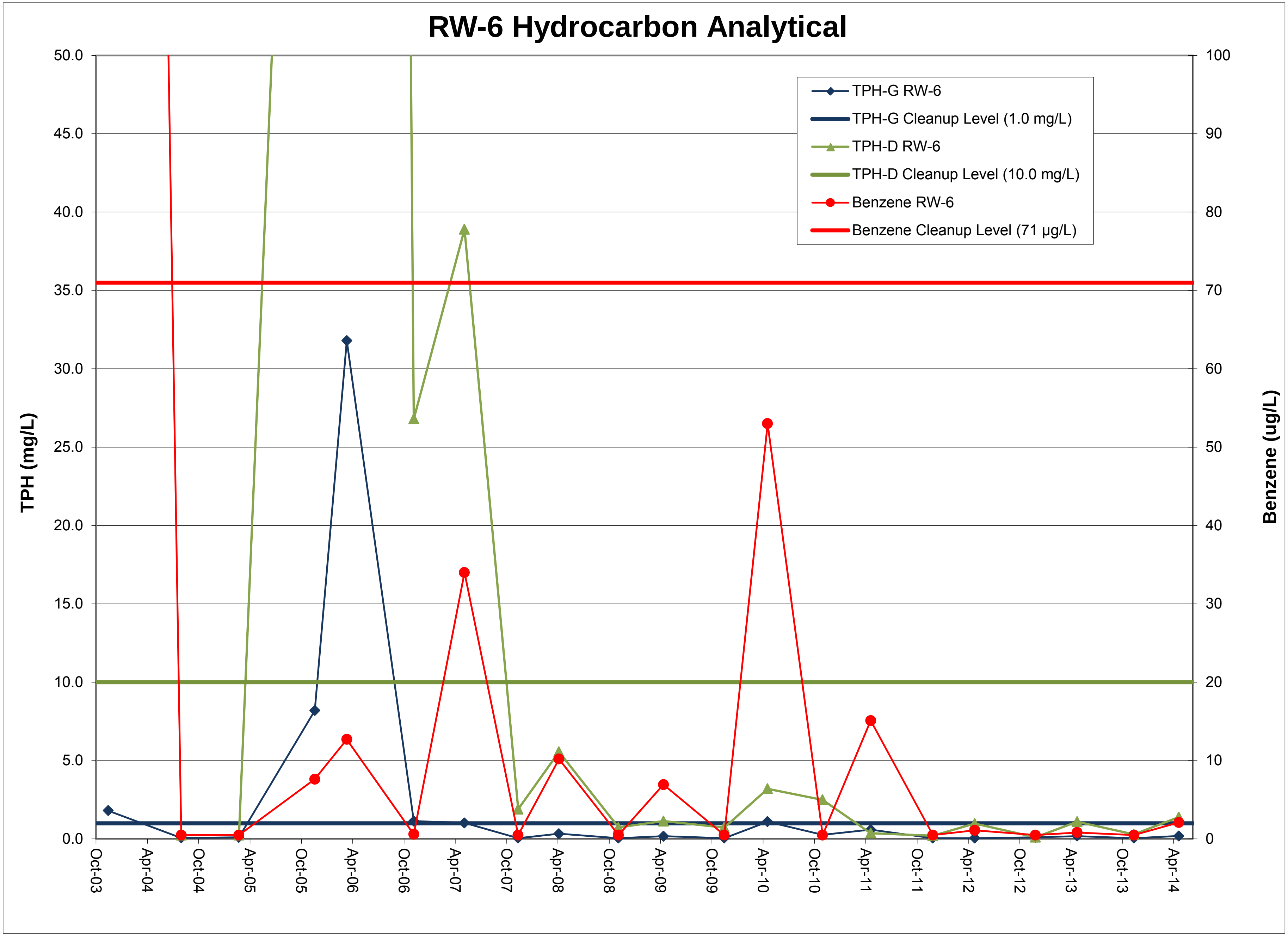
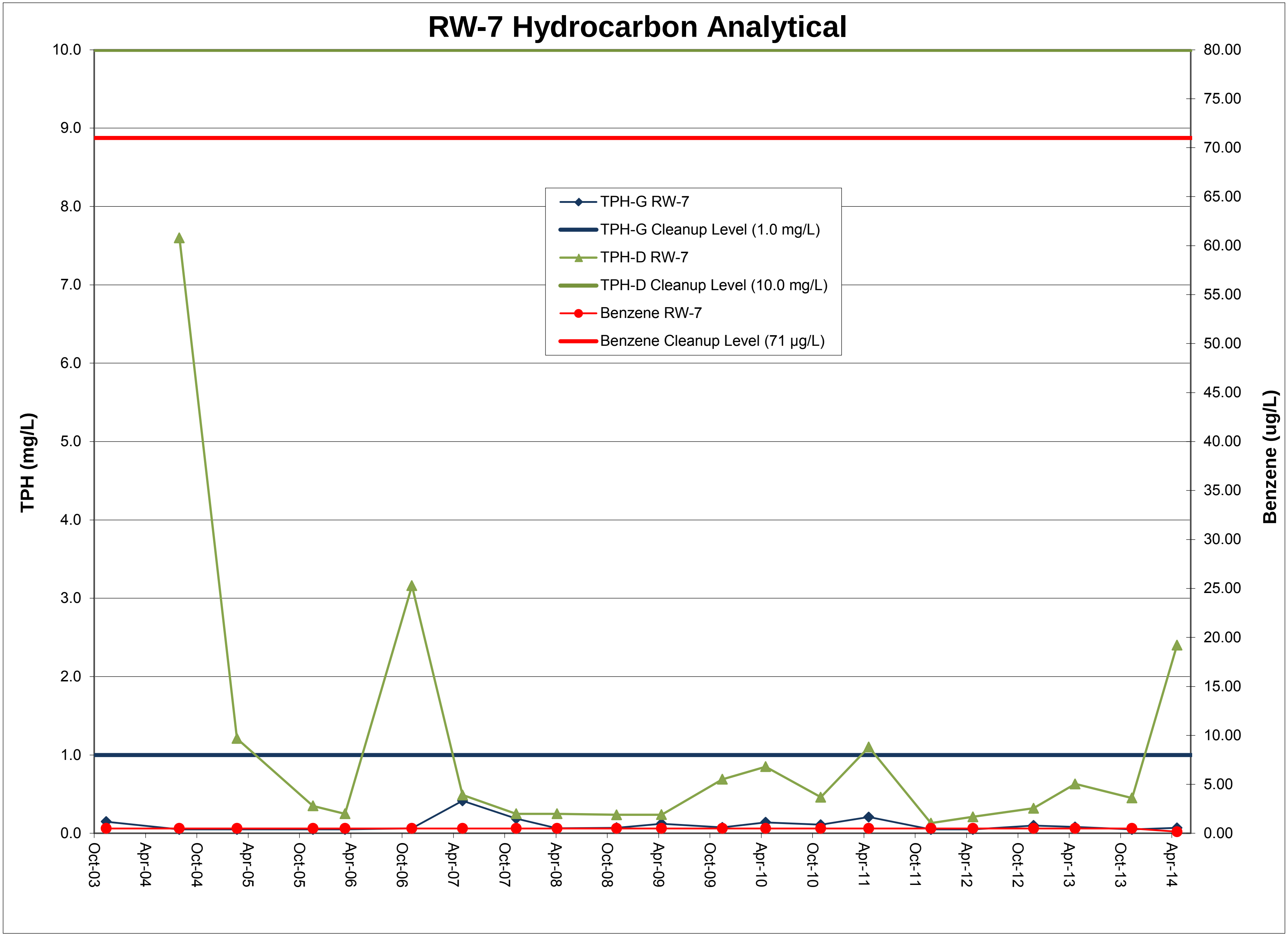
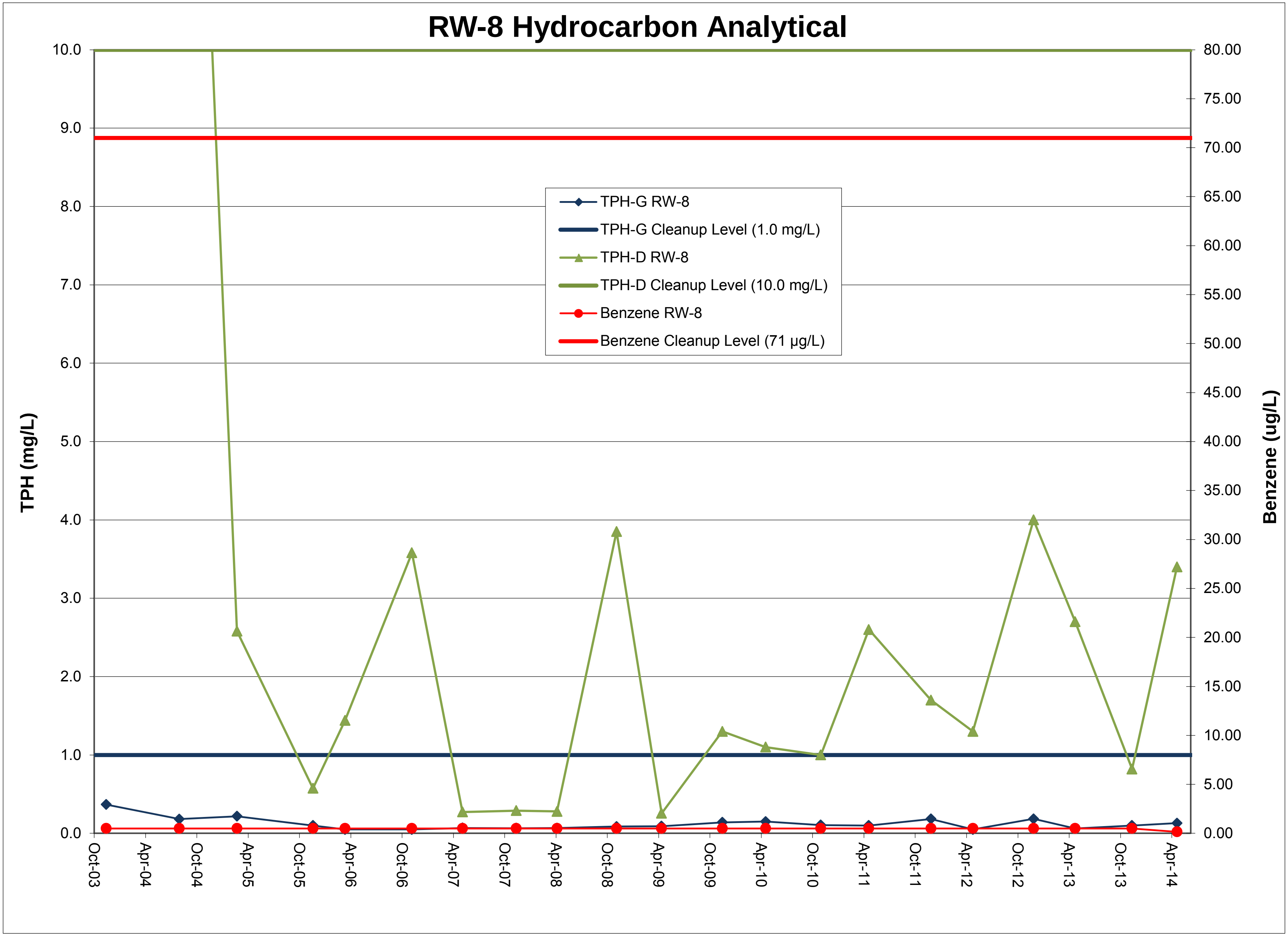
Apr-13
Oct-13
Apr-14



RW-6 Hydrocarbon Analytical
TPH (mg/L)
Benzene (ug/L)
50.0
45.0
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
100
90
80
70
60
50
40
30
20
10
0
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
TPH-G RW-6
TPH-G Cleanup Level (1.0 mg/L)
TPH-D RW-6
TPH-D Cleanup Level (10.0 mg/L)
Benzene RW-6
Benzene Cleanup Level (71 µg/L)


RW-7 Hydrocarbon Analytical
TPH (mg/L)
Benzene (ug/L)
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
80.00
75.00
70.00
65.00
60.00
55.00
50.00
45.00
40.00
35.00
30.00
25.00
20.00
15.00
10.00
5.00
0.00
TPH-G RW-7
TPH-G Cleanup Level (1.0 mg/L)
TPH-D RW-7
TPH-D Cleanup Level (10.0 mg/L)
Benzene RW-7
Benzene Cleanup Level (71 µg/L)
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14


RW-8 Hydrocarbon Analytical
TPH (mg/L)
Benzene (ug/L)
TPH-G RW-8
TPH-G Cleanup Level (1.0 mg/L)
TPH-D RW-8
TPH-D Cleanup Level (10.0 mg/L)
Benzene RW-8
Benzene Cleanup Level (71 µg/L)
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
0.00
5.00
10.00
15.00
20.00
25.00
30.00
35.00
40.00
45.00
50.00
55.00
60.00
65.00
70.00
75.00
80.00
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
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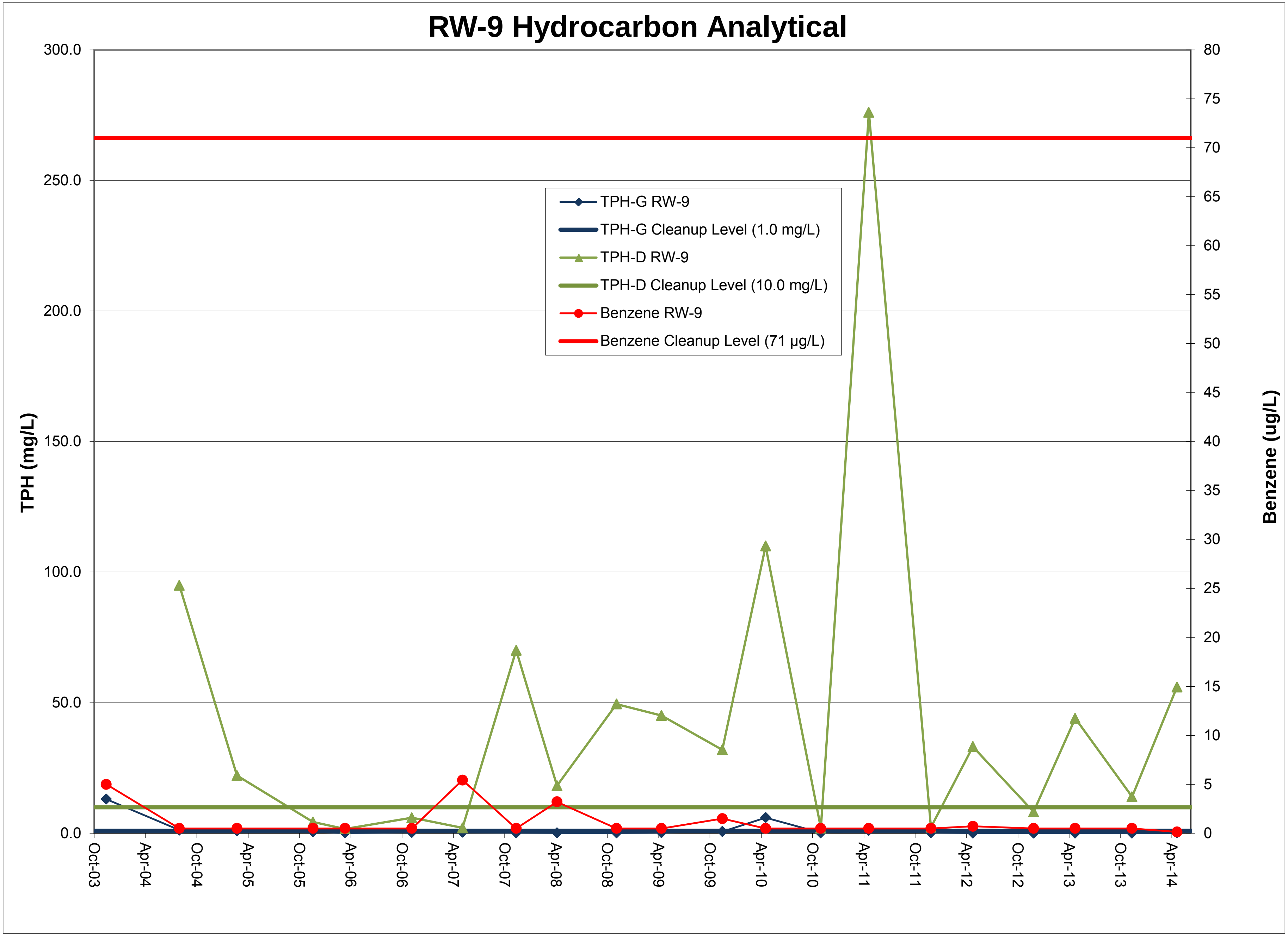
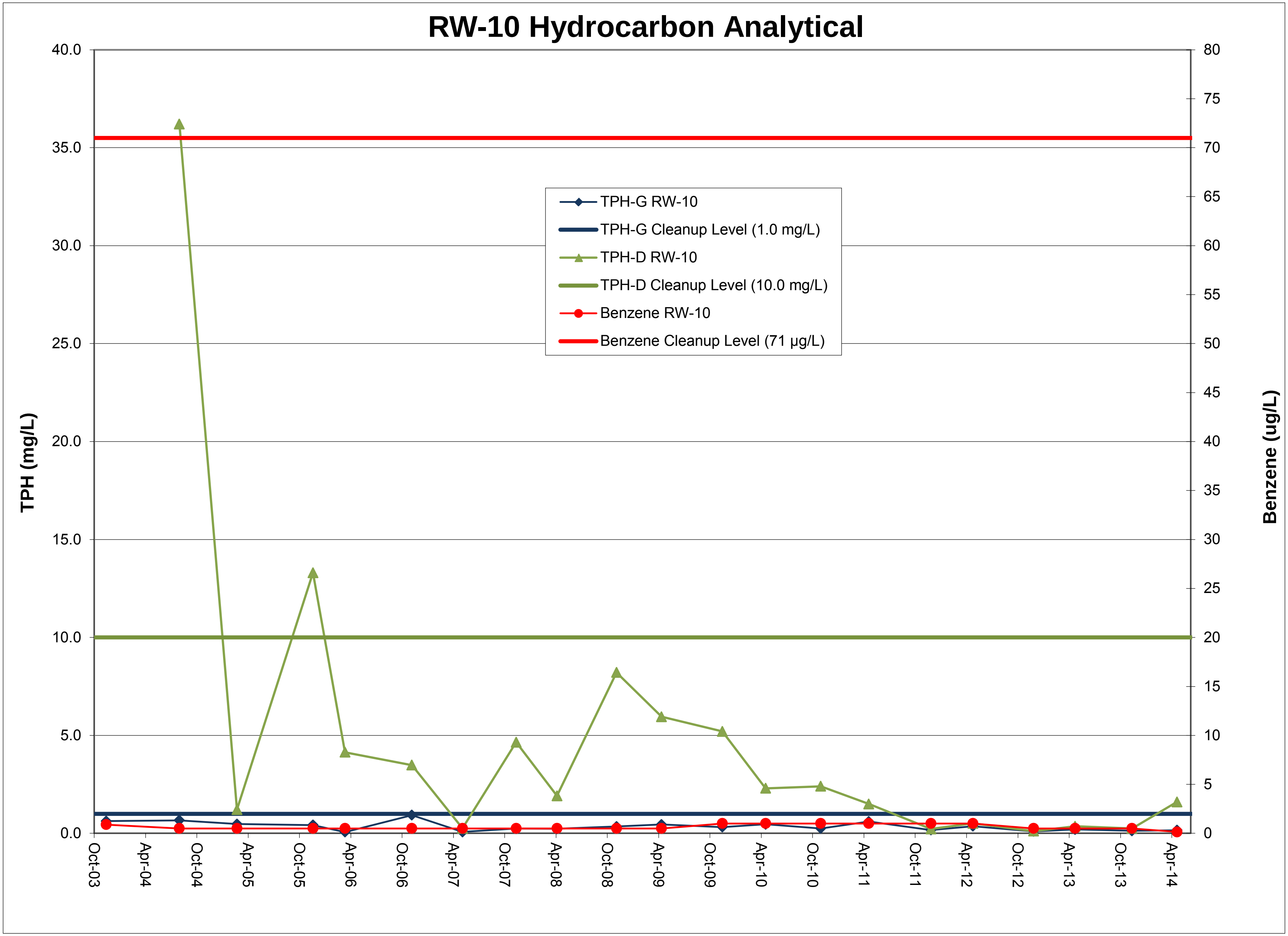
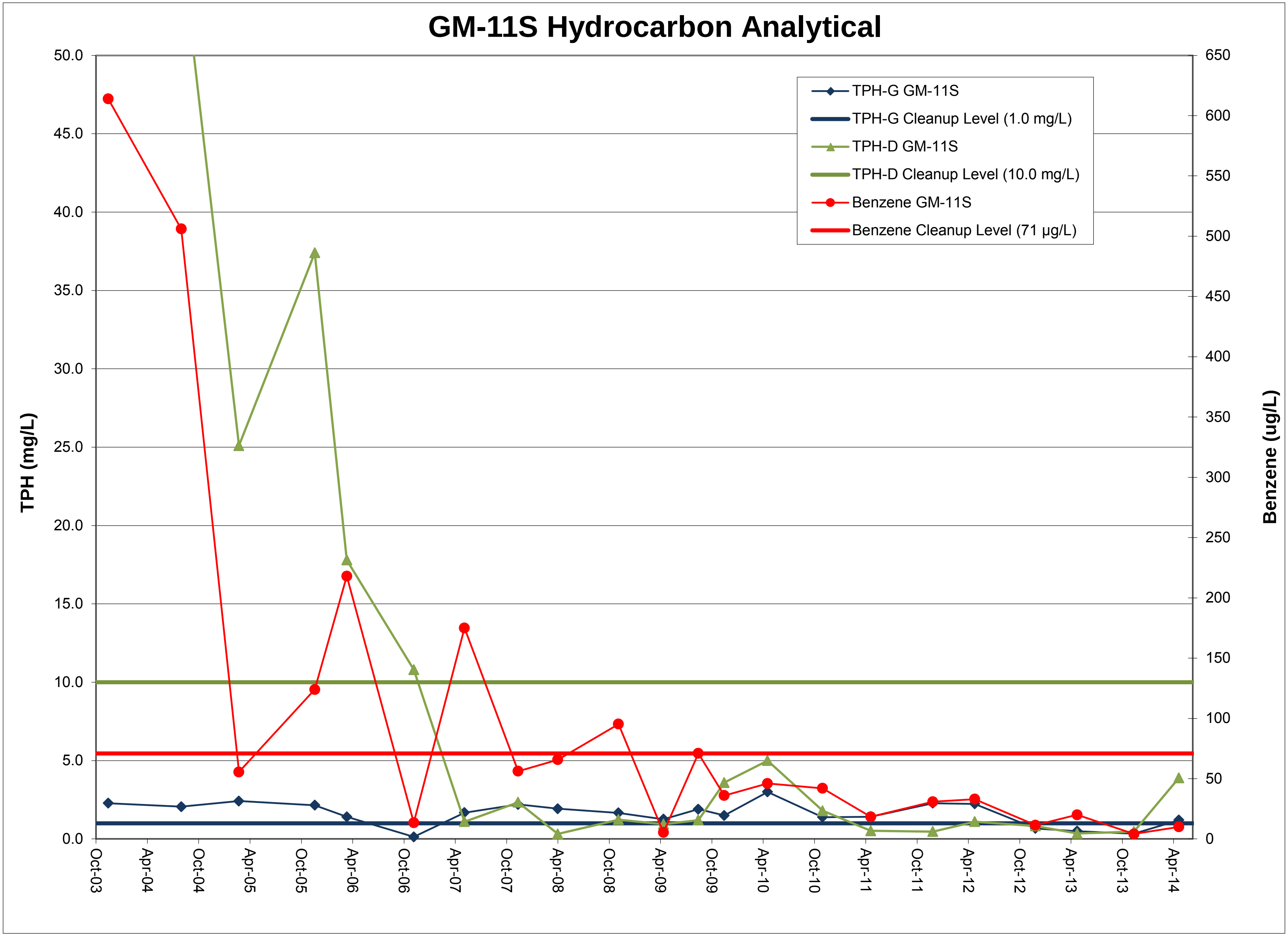
Apr-13
Oct-13
Apr-14


RW-9 Hydrocarbon Analytical
TPH (mg/L)
Benzene (ug/L)
300.0
250.0
200.0
150.0
100.0
50.0
0.0
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
TPH-G RW-9
TPH-G Cleanup Level (1.0 mg/L)
TPH-D RW-9
TPH-D Cleanup Level (10.0 mg/L)
Benzene RW-9
Benzene Cleanup Level (71 µg/L)
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14



RW-10 Hydrocarbon Analytical
TPH (mg/L)
Benzene (ug/L)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
5.0
0.0
80
75
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14
TPH-G RW-10
TPH-G Cleanup Level (1.0 mg/L)
TPH-D RW-10
TPH-D Cleanup Level (10.0 mg/L)
Benzene RW-10
Benzene Cleanup Level (71 µg/L)



GM-11S Hydrocarbon Analytical
TPH (mg/L)
Benzene (ug/L)
TPH-G GM-11S
TPH-G Cleanup Level (1.0 mg/L)
TPH-D GM-11S
TPH-D Cleanup Level (10.0 mg/L)
Benzene GM-11S
Benzene Cleanup Level (71 µg/L)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
0
50
100
150
200
250
300
350
400
450
500
550
600
650
Oct-03
Apr-04
Oct-04
Apr-05
Oct-05
Apr-06
Oct-06
Apr-07
Oct-07
Apr-08
Oct-08
Apr-09
Oct-09
Apr-10
Oct-10
Apr-11
Oct-11
Apr-12
Oct-12
Apr-13
Oct-13
Apr-14

Appendix E.

Summary of Recovered LNAPL

BP West Coast Products Terminal 21T, Harbor Island, Seattle Washington

Total Gallonage of Recovered LNAPL

Date	Monthly LNAPL Recovery	Dissolved LNAPL Recovery*	Cumulative LNAPL Recovery	Monthly SVE Recovery	Cumulative SVE Recovery	Total Recovery
9-Aug-92	0.0			NA	NA	0
10-Aug-92	1.2		1	NA	NA	1
11-Aug-92	27.4		29	NA	NA	29
19-Aug-92	43.6		72	NA	NA	72
25-Aug-92	7.3		80	NA	NA	80
26-Aug-92	19.0		99	NA	NA	99
27-Aug-92	19.4		118	NA	NA	118
11-Sep-92	5.4		123	NA	NA	123
13-Sep-92	31.8		155	NA	NA	155
18-Dec-92	17.8		173	NA	NA	173
4-Jan-93	45.0		218	NA	NA	218
3-Feb-93	120.3		338	NA	NA	338
4-Feb-93	11.1		349	NA	NA	349
5-Feb-93	14.8		364	NA	NA	364
8-Feb-93	38.9		403	NA	NA	403
16-Feb-93	72.7		476	NA	NA	476
18-Feb-93	23.5		499	NA	NA	499
1-Mar-93	89.4		589	NA	NA	589
15-Mar-93	253.8		842	NA	NA	842
16-Mar-93	20.2		863	NA	NA	863
25-Mar-93	98.0		961	NA	NA	961
31-Mar-93	52.1		1,013	NA	NA	1,013
8-Apr-93	108.6		1,121	NA	NA	1,121
12-Apr-93	86.5		1,208	NA	NA	1,208
14-Apr-93	37.5		1,245	NA	NA	1,245
15-Apr-93	21.8		1,267	NA	NA	1,267
29-Apr-93	114.0		1,381	NA	NA	1,381
5-May-93	57.9		1,439	NA	NA	1,439
10-May-93	128.9		1,568	NA	NA	1,568
14-May-93	175.4		1,743	NA	NA	1,743
19-May-93	236.7		1,980	NA	NA	1,980
28-May-93	279.7		2,260	NA	NA	2,260
3-Jun-93	2.4		2,262	NA	NA	2,262
4-Jun-93	78.0		2,340	NA	NA	2,340
11-Jun-93	40.5		2,380	NA	NA	2,380
25-Jun-93	216.6		2,597	NA	NA	2,597
6-Jul-93	167.9		2,765	NA	NA	2,765
9-Jul-93	15.1		2,780	NA	NA	2,780
16-Jul-93	3.3		2,783	NA	NA	2,783
29-Jul-93	9.2		2,792	NA	NA	2,792
30-Oct-93	1007.6		3,800	NA	NA	3,800
15-Mar-94	900.0		4,700	NA	NA	4,700
30-Jun-94	900.0		5,600	NA	NA	5,600
28-Sep-94	300.0		5,900	NA	NA	5,900
27-Dec-94	300.0		6,200	NA	NA	6,200
27-Mar-95	300.0		6,500	NA	NA	6,500
25-Jun-95	300.0		6,800	NA	NA	6,800

Note: NA - The Soil Vapor Extraction system was not brought online until January 1996.
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Total Gallonage of Recovered LNAPL

Date	Monthly LNAPL Recovery	Dissolved LNAPL Recovery*	Cumulative LNAPL Recovery	Monthly SVE Recovery	Cumulative SVE Recovery	Total Recovery
23-Sep-95	100.0		6,900	NA	NA	6,900
22-Dec-95	98.0		6,998	NA	NA	6,998
1-Jan-96	103.0		7,101	36	36	7,137
28-Feb-96	140.0		7,241	72	108	7,349
28-Mar-96	229.0		7,470	244	352	7,822
24-Apr-96	60.5		7,531	191	544	8,074
31-May-96	56.0		7,586	205	749	8,335
26-Jun-96	61.0		7,648	201	949	8,597
17-Jul-96	201.9		7,849	221	1170	9,020
16-Aug-96	312.9		8,162	328	1498	9,660
18-Sep-96	216.2		8,379	99	1596	9,975
16-Oct-96	120.5		8,499	321	1918	10,417
20-Nov-96	99.3		8,598	186	2104	10,702
12-Dec-96	17.2		8,615	88	2192	10,807
16-Jan-97	38.9		8,654	84	2276	10,930
14-Feb-97	2.3		8,657	60	2336	10,993
13-Mar-97	23.1		8,680	50	2386	11,066
14-Apr-97	86.6		8,766	31	2417	11,183
15-May-97	164.9		8,931	60	2477	11,408
24-Jun-97	70.2		9,001	0	2477	11,478
24-Jul-97	41.1		9,043	17	2493	11,536
24-Aug-97	0.0		9,043	11	2505	11,547
30-Sep-97	6.26		9,049	14	2518	11,567
31-Oct-97	23.68		9,072	0	2518	11,591
30-Nov-97	9.04		9,081	0	2518	11,600
15-Dec-97	7.19		9,089	3	2521	11,610
14-Jan-98	10.29		9,099	6	2527	11,626
13-Feb-98	6.5		9,105	21	2548	11,654
16-Mar-98	5.72		9,111	15	2563	11,674
14-Apr-98	0.01		9,111	25	2588	11,699
19-May-98	0.0		9,111	31	2619	11,730
15-Jun-98	0.0		9,111	4	2622	11,734
15-Jul-98	0.0		9,111	0	2622	11,734
15-Aug-98	0.0		9,111	0	2622	11,734
15-Sep-98	0.0		9,111	0	2622	11,734
15-Oct-98	7.7		9,119	16	2638	11,757
18-Nov-98	0.33		9,119	29	2667	11,787
13-Dec-98	0.0		9,119	22	2689	11,808
14-Jan-99	0.08		9,119	20	2709	11,828
17-Feb-99	0.0		9,119	28	2737	11,857
15-Mar-99	0.0		9,119	23	2761	11,880
15-Apr-99	0.0		9,119	25	2785	11,905
13-May-99	0.0		9,119	24	2809	11,929
15-Jun-99	0.0		9,119	24	2833	11,952
15-Jul-99	0.0		9,119	25	2858	11,978
17-Aug-99	0.0		9,119	25	2883	12,002
16-Sep-99	0.0		9,119	24	2907	12,026

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Total Gallonage of Recovered LNAPL

Date	Monthly LNAPL Recovery	Dissolved LNAPL Recovery*	Cumulative LNAPL Recovery	Monthly SVE Recovery	Cumulative SVE Recovery	Total Recovery
20-Oct-99	0.0		9,119	25	2932	12,051
19-Nov-99	0.0		9,119	22	2954	12,073
21-Dec-99	0.0		9,119	23	2977	12,096
21-Jan-00	0.0		9,119	22	2998	12,118
16-Feb-00	0.0		9,119	20	3018	12,137
21-Mar-00	0.0		9,119	27	3045	12,164
14-Apr-00	0.0		9,119	28	3073	12,192
15-May-00	0.0		9,119	16	3089	12,208
15-Jun-00	0.1		9,119	25	3114	12,234
19-Jul-00	0.0		9,119	24	3138	12,258
18-Aug-00	0.1		9,119	9	3148	12,267
20-Sep-00	7.3		9,127	17	3165	12,291
12-Oct-00	0.0		9,127	15	3179	12,306
14-Nov-00	32.9		9,160	18	3197	12,357
14-Dec-00	20.1		9,180	16	3213	12,393
11-Jan-01	0.9		9,181	15	3228	12,409
15-Feb-01	0.0		9,181	3	3231	12,412
15-Mar-01	0.2		9,181	0	3231	12,412
20-Apr-01	0.0		9,181	0	3231	12,412
18-May-01	0.0		9,181	42	3273	12,454
11-Jun-01	0.8		9,182	66	3339	12,520
24-Jul-01	0.1		9,182	268	3607	12,789
21-Aug-01	0.3		9,182	0	3607	12,789
6-Sep-01	0.1		9,182	0	3607	12,789
19-Oct-01	0.0		9,182	83	3690	12,872
15-Nov-01	106.9		9,289	206	3896	13,185
10-Dec-01	17.5		9,306	0	3896	13,202
16-Jan-02	5.6		9,312	212	4107	13,419
21-Feb-02	0.0		9,312	242	4349	13,661
15-Mar-02	0.0		9,312	0	4349	13,661
15-Apr-02	0.0		9,312	0	4349	13,661
15-May-02	0.0		9,312	0	4349	13,661
15-Jun-02	0.0		9,312	0	4349	13,661
15-Jul-02	0.0		9,312	0	4349	13,661
15-Aug-02	0.0		9,312	0	4349	13,661
24-Sep-02	0.0		9,312	0	4349	13,661
15-Oct-02	0.0	0.00	9,312	323	4672	13,984
26-Nov-02	0.0	1.22	9,313	663	5335	14,648
26-Dec-02	0.0	2.67	9,316	577	5912	15,227
16-Jan-03	19.6	2.61	9,338	501	6413	15,751
20-Feb-03	0.0	3.69	9,342	354	6766	16,108
11-Mar-03	0.0	4.55	9,346	356	7122	16,468
15-Apr-03	6.9	3.86	9,357	438	7560	16,918
15-May-03	2.5	2.81	9,362	365	7925	17,288
17-Jun-03	0.0	1.77	9,364	372	8297	17,661
15-Jul-03	2.0	1.33	9,367	323	8620	17,987
13-Aug-03	0.0	2.38	9,370	344	8964	18,334

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Total Gallonage of Recovered LNAPL

Date	Monthly LNAPL Recovery	Dissolved LNAPL Recovery*	Cumulative LNAPL Recovery	Monthly SVE Recovery	Cumulative SVE Recovery	Total Recovery
16-Sep-03	0.0	2.65	9,373	391	9355	18,727
14-Oct-03	0.0	2.51	9,375	339	9694	19,069
19-Nov-03	0.0	3.18	9,378	441	10135	19,514
17-Dec-03	20.0	6.41	9,405	329	10465	19,869
13-Jan-04	25.0	31.35	9,461	296	10761	20,222
10-Feb-04	0.0	19.69	9,481	190	10951	20,431
17-Mar-04	0.0	1.53	9,482	302	11253	20,735
15-Apr-04	0.0	0.76	9,483	209	11462	20,945
25-May-04	0.0	2.97	9,486	397	11859	21,345
17-Jun-04	35.0	2.75	9,524	160	12019	21,543
13-Jul-04	0.0	8.18	9,532	325	12344	21,876
13-Aug-04	50.0	11.94	9,594	255	12599	22,193
16-Sep-04	8.0	6.26	9,608	180	12779	22,387
13-Oct-04	0.0	1.83	9,610	180	12959	22,569
19-Nov-04	10.0	3.14	9,623	275	13234	22,857
15-Dec-04	3.5	2.01	9,629	209	13443	23,072
13-Jan-05	0.0	3.71	9,632	171	13614	23,246
15-Feb-05	35.0	5.33	9,673	211	13825	23,498
15-Mar-05	0.0	2.68	9,675	285	14110	23,785
15-Apr-05	0.0	6.16	9,681	307	14417	24,098
20-May-05	0.0	13.64	9,695	240	14656	24,352
16-Jun-05	0.0	13.56	9,709	168	14825	24,533
15-Jul-05	110.0	15.91	9,835	254	15079	24,913
12-Aug-05	0.0	7.93	9,842	242	15321	25,164
15-Sep-05	0.0	10.22	9,853	242	15564	25,416
14-Oct-05	0.0	7.72	9,860	246	15809	25,670
17-Nov-05	0.0	5.82	9,866	281	16090	25,957
19-Dec-05	0.0	7.84	9,874	153	16244	26,118
25-Jan-06	0.0	76.98	9,951	237	16480	26,431
14-Feb-06	5.0	35.47	9,992	114	16595	26,586
15-Mar-06	2.0	3.08	9,997	172	16766	26,763
14-Apr-06	0.0	3.96	10,001	163	16930	26,930
17-May-06	0.0	4.90	10,005	170	17100	27,105
14-Jun-06	0.0	1.12	10,007	114	17214	27,220
12-Jul-06	0.0	0.23	10,007	90	17304	27,311
08-Aug-06	0.0	0.000	10,007	38	17342	27,349
16-Aug-06	0.0	0.21	10,007	23	17365	27,372
13-Sep-06	0.0	0.74	10,008	77	17442	27,450
12-Oct-06	0.0	0.53	10,008	77	17519	27,527
17-Nov-06	0.0	0.59	10,009	103	17622	27,631
19-Dec-06	30.0	1.10	10,040	98	17720	27,760
19-Jan-07	0.0	1.24	10,041	93	17813	27,854
16-Feb-07	0.0	0.67	10,042	83	17896	27,938
16-Mar-07	0.0	0.46	10,042	91	17987	28,029
19-Apr-07	0.0	0.84	10,043	127	18113	28,157
03-May-07	0.0	0.71	10,044	54	18168	28,211
17-May-07	0.0	0.36	10,044	50	18217	28,262

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Total Gallonage of Recovered LNAPL

Date	Monthly LNAPL Recovery	Dissolved LNAPL Recovery*	Cumulative LNAPL Recovery	Monthly SVE Recovery	Cumulative SVE Recovery	Total Recovery
14-Jun-07	0.0	0.000	10,044	104	18321	28,366
13-Jul-07	0.0	0.25	10,044	115	18436	28,481
16-Aug-07	0.0	0.16	10,045	145	18581	28,626
10-Sep-07	0.0	0.14	10,045	121	18703	28,747
17-Oct-07	0.0	0.09	10,045	167	18869	28,914
16-Nov-07	0.0	0.16	10,045	118	18987	29,032
14-Dec-07	0.0	0.15	10,045	116	19103	29,148
22-Jan-08	0.0	0.38	10,046	165	19268	29,313
14-Feb-08	0.0	0.42	10,046	89	19357	29,403
14-Mar-08	30.0	0.31	10,076	91	19448	29,525
18-Apr-08	0.0	0.16	10,076	117	19565	29,642
16-May-08	0.0	0.14	10,077	92	19657	29,734
18-Jun-08	0.0	0.15	10,077	0	19657	29,734
16-Jul-08	0.0	0.23	10,077	0	19657	29,734
18-Aug-08	0.0	0.20	10,077	0	19657	29,735
16-Sep-08	0.0	0.14	10,077	0	19657	29,735
15-Oct-08	0.0	0.14	10,077	0	19657	29,735
14-Nov-08	0.0	0.20	10,078	0	19657	29,735
11-Dec-08	0.0	0.12	10,078	0	19657	29,735
14-Jan-09	0.0	0.24	10,078	0	19657	29,735
18-Feb-09	0.0	0.12	10,078	0	19657	29,736
17-Mar-09	0.0	0.08	10,078	0	19657	29,736
16-Apr-09	0.0	0.11	10,078	0	19657	29,736
14-May-09	0.0	0.09	10,078	0	19657	29,736
16-Jun-09	0.0	0.13	10,079	0	19657	29,736
22-Jul-09	0.0	0.26	10,079	0	19657	29,736
17-Aug-09	0.0	0.42	10,079	0	19657	29,737
14-Sep-09	0.0	0.31	10,080	0	19657	29,737
20-Oct-09	0.0	0.24	10,080	0	19657	29,737
18-Nov-09	0.0	0.62	10,080	0	19657	29,738
15-Dec-09	0.0	0.26	10,081	0	19657	29,738
21-Jan-10	0.0	1.67	10,082	0	19657	29,740
17-Feb-10	0.0	0.75	10,083	0	19657	29,740
16-Mar-10	0.0	0.44	10,084	0	19657	29,741
15-Apr-10	0.0	0.27	10,084	0	19657	29,741
19-May-10	0.0	0.25	10,084	0	19657	29,741
16-Jun-10	0.0	0.11	10,084	0	19657	29,742
28-Jul-10	0.0	0.114	10,084	0	19657	29,742
18-Aug-10	0.0	0.048	10,084	0	19657	29,742
21-Sep-10	0.0	0.063	10,084	0	19657	29,742
19-Oct-10	0.0	0.083	10,084	0	19657	29,742
29-Nov-10	0.0	0.133	10,085	0	19657	29,742
22-Dec-10	0.0	0.724	10,085	0	19657	29,743
19-Jan-11	0.0	1.222	10,087	0	19657	29,744
15-Feb-11	0.0	0.511	10,087	0	19657	29,744
29-Mar-11	0.0	0.462	10,088	0	19657	29,745
21-Apr-11	0.0	0.165	10,088	0	19657	29,745

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BP West Coast Products Terminal 21T, Harbor Island, Seattle Washington

Total Gallonage of Recovered LNAPL

Date	Monthly LNAPL Recovery	Dissolved LNAPL Recovery*	Cumulative LNAPL Recovery	Monthly SVE Recovery	Cumulative SVE Recovery	Total Recovery
18-May-11	0.0	0.494	10,088	0	19657	29,746
15-Jun-11	0.0	0.294	10,088	0	19657	29,746
20-Jul-11	0.0	0.085	10,089	0	19657	29,746
17-Aug-11	0.0	0.049	10,089	0	19657	29,746
14-Sep-11	0.0	0.030	10,089	0	19657	29,746
11-Oct-11	0.0	0.087	10,089	0	19657	29,746
22-Nov-11	0.0	0.273	10,089	0	19657	29,746
13-Dec-11	0.0	0.139	10,089	0	19657	29,747
23-Jan-12	0.0	1.765	10,091	0.0	19657	29,748
14-Feb-12	0.0	0.939	10,092	0.0	19657	29,749
13-Mar-12	0.0	0.172	10,092	0.0	19657	29,749
16-Apr-12	0.0	0.813	10,093	0.0	19657	29,750
16-May-12	0.0	0.504	10,093	0.0	19657	29,751
13-Jun-12	0.0	0.081	10,093	0.0	19657	29,751
20-Jul-12	0.0	0.059	10,093	0.0	19657	29,751
23-Aug-12	0.0	0.168	10,094	0.0	19657	29,751
5-Sep-12	0.0	0.058	10,094	0.0	19657	29,751
24-Oct-12	0.0	0.247	10,094	0.0	19657	29,751
18-Dec-12	0.0	0.007	10,094	0.0	19657	29,751
23-Jan-13	0.0	0.501	10,094	0.0	19657	29,752
21-Feb-13	0.0	0.112	10,095	0.0	19657	29,752
13-Mar-13	0.0	0.118	10,095	0.0	19657	29,752
17-Apr-13	0.0	0.157	10,095	0.0	19657	29,752
22-May-13	0.0	0.103	10,095	0.0	19657	29,752
12-Jun-13	0.0	0.091	10,095	0.0	19657	29,752
24-Jul-13	0.0	0.252	10,095	0.0	19657	29,753
20-Aug-13	0.0	0.215	10,095	0.0	19657	29,753
24-Sep-13	0.0	0.136	10,096	0.0	19657	29,753
15-Oct-13	0.0	0.021	10,096	0.0	19657	29,753
20-Nov-13	0.0	0.157	10,096	0.0	19657	29,753
18-Dec-13	0.0	0.213	10,096	0.0	19657	29,753
14-Jan-14	0.0	0.145	10,096	0.0	19657	29,754
11-Feb-14	0.0	0.123	10,096	0.0	19657	29,754
20-Mar-14	0.0	0.281	10,097	0.0	19657	29,754
16-Apr-14	0.0	0.199	10,097	0.0	19657	29,754
21-May-14	0.0	0.234	10,097	0.0	19657	29,754
19-Jun-14	0.0	0.092	10,097	0.0	19657	29,754
24-Jul-14	0.0	0.039	10,097	0.0	19657	29,755
13-Aug-14	0.0	0.128	10,097	0.0	19657	29,755
17-Sep-14	0.0	0.337	10,098	0.0	19657	29,755
TOTALS	9,706	391	10,098	19,657	19,657	29,755

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Appendix F.

Site Photographs

with EPA Five-Year Interview Report

Five-Year Review Interview Record			
Site:	*BP West Coast Products Terminal*	**EPA ID No:**	*WAD009590779*

Interview Type: *Site Visit*
Location of Visit: *BP West Coast Products Terminal. 1652 SW Lander Street, Seattle, Washington*
Date: *December 4, 2014*
Time: *13:30-15:00*

Interviewers

Name	Title	Organization
Maura S. O'Brien	*Professional Geologist / Hydrogeologist*	*Toxics Cleanup Program - NWRO Department of Ecology*

Interviewees

Name	Organization	Title	Telephone	Email
Scott Larsen	*TechSolve, Environmental, Inc.*	*Project Manager*	*425-402-8277*	*slarsen@techsolveinc.com*
Matt Roberts	*TechSolve, Environmental, Inc.*	*Staff Scientist*	*425-402-8277*	*mroberts@techsolveinc.com*
Paul Supple	*BP*	*Environmental Business Manager*	*925-275-3801*	*paul.supple@bp.com*

Summary of Conversation

1) What is your overall impression of the project?
The cleanup actions completed at the Site appear to be protective of human health and the environment.

2) Is the remedy functioning as expected?. How well is the remedy performing?
The remedy appears to be functioning as expected and performing as desired based upon review of monitoring and system performance data. Cleanup objectives in most areas of the Site have been met. Data from areas of the Site with remaining contamination show contaminant levels to be stable and decreasing.

3) What does the monitoring data show? Are there any trends that show contaminant levels are decreasing?
Groundwater monitoring data shows contaminant levels mainly below cleanup levels in most wells at the Site. Historically, Waterfront Compliance Monitoring Wells AMW-01 and AMW-02 at Plant 1 were routinely above the benzene cleanup level. However, over the past 5-years benzene concentrations in these wells have decreased markedly and are now mainly below cleanup levels.

An inland gasoline plume along the southern property boundary at Plant 1 historically impacted shallow groundwater. An Inland SVE System has operated since 2008 and has improved groundwater quality in this area of the Site. Gasoline and benzene concentrations are mainly below cleanup levels along the southern property boundary.

4) Is there a continuous O&M presence? If so, please describe staff and activities. If there is not a continuous on-site presence, describe staff and frequency of Site inspections and activities.
There is a continued O&M presence at the Site for a Groundwater/LNAPL recovery system located along the waterfront at Plant 1 and for the Inland SVE System located along the southern property boundary at Plant 1. The Site is continually manned and O&M activities are conducted on both systems weekly at a minimum. Monitoring activities are conducted to ensure continued operation of systems and compliance with associated PSCAA air discharge authorizations and with a KCDNR sanitary sewer discharge permit

5) Have there been any significant changes in the O&M requirements, maintenance schedules, or sampling routines in the last five years? If so, do they affect protectiveness of the remedy? Please describe changes and impacts.
There have been no significant changes in the last five years.

6) What are the annual operating costs for your organization's involvement with the Site?
Total annual O&M, monitoring, reporting, and project management costs are around $500K for the Site.

7) Have there been unexpected O&M difficulties or costs at the Site in the last five years? If so, please give details.
The waterfront Groundwater/LNAPL Recovery System was designed to operate for 5 years, but has operated continuously for over 12 years. Due to the extended system life, materials and equipment have needed to be replaced to keep the system operational. Additionally, the brackish nature of the groundwater is prone to bioufouling, which has required additional O&M to clean and treat wells, pumps, piping, and system treatment components.

The Inland SVE System along the southern property boundary utilizes shallow horizontal wells to recovery vapors. During wetter periods of the year (typically winter and spring) these well screens can become partially to fully submerged by rising groundwater.

The rising groundwater can increase system fouling and/or prevent vapor capture. The system is turned off during these periods and system operation is resumed once groundwater elevations have fallen to a safe level to resume system operation.

8) Have there been opportunities to optimize O&M or sampling efforts? Please describe changes and resultant or desired cost savings or improved efficiency.
Waterfront SVE and air sparging operations were discontinued in 2008 as they were not longer providing hydrocarbon capture or affecting biodegradation.

The Inland SVE System, currently in operation, appears to no longer capture measurable concentrations of hydrocarbons and may no longer be affecting biodegradation. BP may propose discontinuing operation of the Inland SVE system based upon the decreasing benefits provided by continued system operation.

Waterfront Groundwater/LNAPL Recovery System operation will be reevaluated after portions of the seawall have been upgraded. BP is voluntarily upgrading portions of the waterfront seawall at Plant 1 to increase the seismic stability of the Site. Portions of the seawall date to island construction in the early 1900s and have been identified as being seismically vulnerable. BP plans to upgrade the northern seawall in 2015 and may upgrade the southern seawall in a subsequent year. These seawall upgrades will likely change Site hydrology and BP has agreed to perform evaluations following seawall install to determine if modifications to system operations and monitoring are necessary.

9) Are you aware of any changes in Federal/State/County/Local laws and regulations that may impact the protectiveness of the remedy?
No.

10) Do you have any comments, suggestions, or recommendations regarding the project?
Based on this periodic review, the Department of Ecology has determined that the requirements of the Restrictive Covenant continue to be met. No additional cleanup actions are required by the property owner. It is the property owner's responsibility to continue to inspect the Site to assure that the integrity of the remedy is maintained.

Additional Site-Specific Questions
[If needed]

Photo 1. BP Terminal Harbor Island illustrating one petroleum fuels loading rack looking northwest.

Photo 2. BP Terminal seawall parallel to loading rack on right, green boom to capture any sheen or floating product on West Waterway is a safety measure. Foreground is piping for on-loading and off-loading petroleum from barges or ships at West Waterway. Left is barge and ship dock with Elliott Bay is in background.

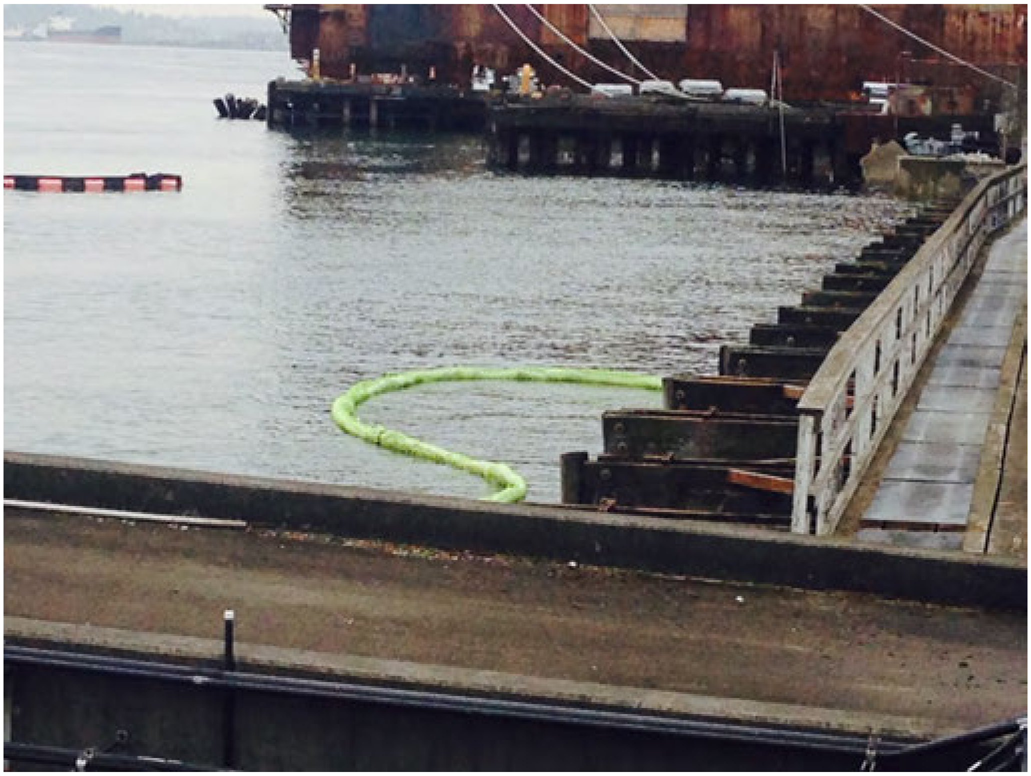


Photo 3. BP Terminal seawall and green boom to capture any sheen or floating product on West Waterway as a safety measure, and photo looking NNW at West Waterway and Elliott Bay in the background.

Photo 4. BP Terminal continuation of photo 2 showing on-loading and off-loading petroleum fuels piping and dock at West Waterway looking westward in distance is the north edge of West Seattle.

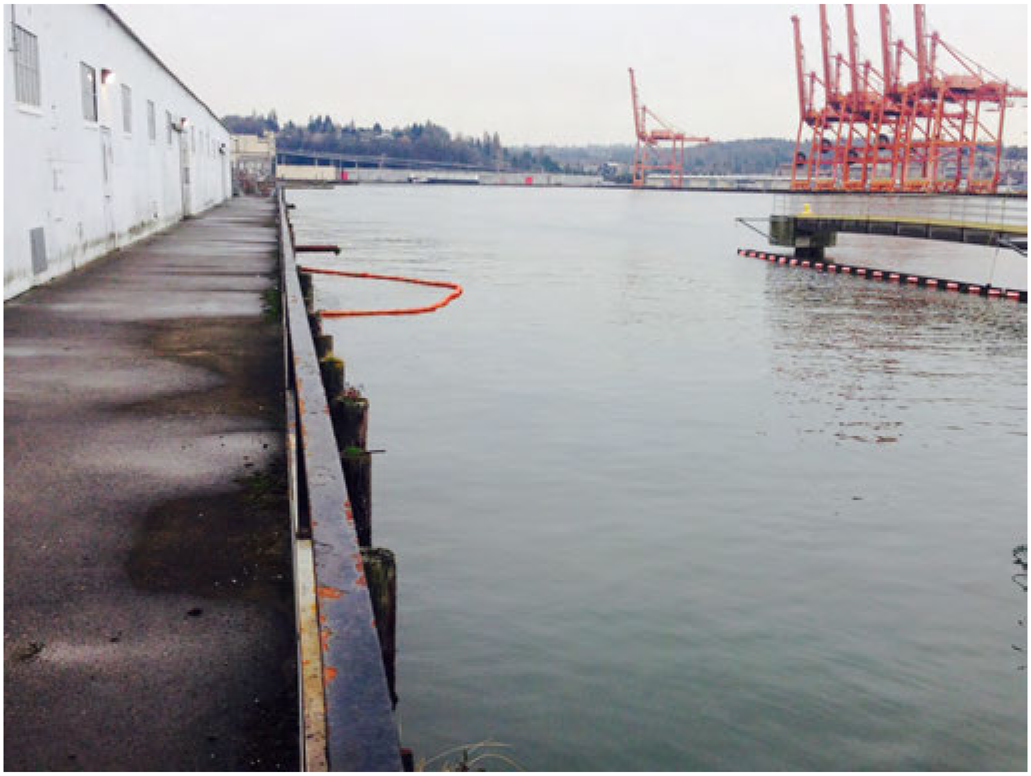


Photo 5. BP Terminal looking south along the seawall and West Waterway with orange boom to capture any sheen or floating product on waterway as a safety measure. Along this walkway are near shore compliance monitoring wells to evaluate current conditions and protect waterway. Well heads not easily visible.

Photo 6. BP Terminal showing Compliance Monitoring Well AMW-01 to the left and behind the yellow bollard. Additionally, Recovery Well RW-10 is located directly behind AMW-01. Recovery Well RW-10 is an active pumping well utilized as part of the Groundwater/LNAPL Recovery System. Well heads are flush mounted to ground surface.

Photo7. BP Terminal Soil Vapor Extraction Remediation System equipment is shown with pumping station, vapor removal and stripping system and six individual well piping with control valves. This system is removing petroleum vapors from soil and groundwater for subsurface cleanup action.

Photo 8. BP Terminal detail for the Soil Vapor Extraction Remediation System showing 11 individual well control valves and piping. Blue airlines to right were installed as a contingency in case additional remedial technologies, such as air sparging, would be needed to meet site cleanup objectives. This system is removing petroleum vapors from soil and groundwater for subsurface cleanup action.

Photo 9. BP Terminal Plant 1 at south wall looking east where above ground storage tank (AST) No. 8 with monitoring well GM-16S is located in distance at the southeast corner of Plant 1.

Photo 10. BP Terminal outside south wall for Plant 1 where new materials for new seawall are temporarily stored and waiting permit approval to replace West Waterway seawall and AST No. 9 and 13 in background.

Appendix G.

Containment Boom Sheen Monitoring Table & Charts

Containment Boom Sheen Monitoring Table
Sheen Observation Charts:
2014 Sheen Observations: Warehouse
2014 Sheen Observations: Loading Rack
2013 Sheen Observations: Warehouse
2013 Sheen Observations: Loading Rack
2012 Sheen Observations: Warehouse
2012 Sheen Observations: Loading Rack
2011 Sheen Observations: Warehouse
2011 Sheen Observations: Loading Rack
2010 Sheen Observations: Warehouse
2010 Sheen Observations: Loading Rack
2009 Sheen Observations: Warehouse
2009 Sheen Observations: Loading Rack
2008 Sheen Observations: Warehouse
2008 Sheen Observations: Loading Rack
2007 Sheen Observations: Warehouse
2007 Sheen Observations: Loading Rack
2006 Sheen Observations: Warehouse
2006 Sheen Observations: Loading Rack
2005 Sheen Observations: Warehouse & Loading Rack
2004 Sheen Observations: Warehouse & Loading Rack
2003 Sheen Observations: Warehouse & Loading Rack
2002 Sheen Observations: Warehouse & Loading Rack
2001 Sheen Observations: Warehouse & Loading Rack
2000Sheen Observations: Warehouse & Loading Rack

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
1/11/2000	medium	1	no	0.0	**yes**	1.0
1/21/2000	high	2	no	0.0	no	0.0
2/16/2000	medium	1	no	0.0	no	0.0
2/22/2000	high	2	no	0.0	no	0.0
2/23/2000	medium	1	no	0.0	no	0.0
2/24/2000	low	0	no	0.0	no	0.0
3/15/2000	medium	1	no	0.0	no	0.0
3/16/2000	medium	1	no	0.0	no	0.0
3/21/2000	low	0	no	0.0	**yes**	**1.0**
4/14/2000	medium	1	no	0.0	**yes**	**1.0**
6/15/2000	low	0	no	0.0	no	0.0
6/28/2000	low	0	**yes**	**1.0**	no	0.0
6/29/2000	low	0	no	0.0	no	0.0
7/11/2000	high	2	no	0.0	no	0.0
7/19/2000	low	0	no	0.0	no	0.0
8/15/2000	low	0	no	0.0	no	0.0
10/12/2000	low	0	no	0.0	no	0.0
11/14/2000	medium	1	no	0.0	no	0.0
12/14/2000	high	2	no	0.0	no	0.0
1/11/2001	medium	1	no	0.0	no	0.0
2/15/2001	medium	1	no	0.0	no	0.0
4/12/2001	medium	1	**yes**	**1.0**	no	0.0
4/13/2001	medium	1	no	0.0	no	0.0
5/16/2001	low	0	no	0.0	no	0.0
5/17/2001	low	0	no	0.0	no	0.0
5/18/2001	low	0	no	0.0	no	0.0
5/21/2001	low	0	no	0.0	no	0.0
5/23/2001	low	0	no	0.0	no	0.0
5/29/2001	low	0	no	0.0	no	0.0
6/11/2001	medium	1	no	0.0	no	0.0
7/23/2001	low	0	no	0.0	no	0.0
8/21/2001	medium	1	no	0.0	no	0.0
9/6/2001	high	2	no	0.0	no	0.0
10/16/2001	low	0	no	0.0	no	0.0
11/15/2001	medium	1	no	0.0	no	0.0
12/10/2001	medium	1	no	0.0	no	0.0
1/4/2002	high	2	no	0.0	no	0.0
1/9/2002	medium	1	no	0.0	**yes**	**1.0**
1/11/2002	medium	1	no	0.0	**yes**	**1.0**
1/16/2002	high	2	no	0.0	**yes**	**1.0**

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
1/22/2002	medium	1	no	0.0	**yes**	**1.0**
1/23/2002	low	0	no	0.0	**yes**	**1.0**
2/4/2002	high	2	no	0.0	no	0.0
2/18/2002	medium	1	**yes**	**1.0**	no	0.0
2/21/2002	medium	1	no	0.0	**yes**	**2.0**
3/21/2002	medium	1	no	0.0	**yes**	**1.0**
3/25/2002	medium	1	no	0.0	no	0.0
3/26/2002	medium	1	no	0.0	no	0.0
3/27/2002	medium	1	no	0.0	**yes**	2.0
4/4/2002	high	2	no	0.0	no	0.0
5/3/2002	low	0	no	0.0	no	0.0
5/7/2002	medium	1	**yes**	**1.0**	no	0.0
5/21/2002	medium	1	**yes**	**1.0**	**yes**	**1.0**
6/6/2002	medium	1	**yes**	**1.0**	no	0.0
6/18/2002	low	0	no	0.0	no	0.0
6/27/2002	high	2	**yes**	**1.0**	**yes**	**1.0**
7/10/2002	medium	1	**yes**	**1.0**	**yes**	**1.0**
7/29/2002	medium	1	**yes**	**1.0**	no	0.0
8/21/2002	low	0	no	0.0	no	0.0
9/9/2002	high	2	**yes**	**1.0**	**yes**	**1.0**
9/20/2002	medium	1	**yes**	**1.0**	no	0.0
10/9/2002	high	2	no	0.0	no	0.0
11/25/2002	high	2	no	0.0	no	0.0
11/27/2002	high	2	no	0.0	no	0.0
12/19/2002	medium	1	no	0.0	no	0.0
12/20/2002	high	2	no	0.0	no	0.0
1/16/2003	medium	1	no	0.0	no	0.0
2/3/2003	medium	1	no	0.0	no	0.0
2/10/2003	medium	1	no	0.0	no	0.0
2/10/2003	low	0	no	0.0	no	0.0
2/11/2003	medium	1	no	0.0	no	0.0
2/11/2003	high	2	no	0.0	no	0.0
2/11/2003	low	0	no	0.0	no	0.0
2/12/2003	medium	1	no	0.0	no	0.0
2/13/2003	high	2	no	0.0	no	0.0
2/13/2003	medium	1	no	0.0	no	0.0
2/14/2003	high	2	no	0.0	no	0.0
2/20/2003	high	2	no	0.0	no	0.0
2/20/2003	medium	1	no	0.0	no	0.0
2/20/2003	low	0	no	0.0	no	0.0
2/21/2003	high	2	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
2/21/2003	medium	1	no	0.0	no	0.0
3/3/2003	medium	1	no	0.0	no	0.0
3/10/2003	medium	1	no	0.0	no	0.0
3/11/2003	high	2	no	0.0	no	0.0
3/18/2003	medium	1	no	0.0	no	0.0
4/1/2003	low	0	no	0.0	no	0.0
4/8/2003	high	2	no	0.0	**yes**	**2.0**
4/15/2003	low	0	no	0.0	**yes**	**2.0**
4/21/2003	high	2	no	0.0	no	0.0
5/15/2003	low	0	no	0.0	no	0.0
5/20/2003	medium	1	no	0.0	no	0.0
5/21/2003	medium	1	no	0.0	no	0.0
5/27/2003	low	0	no	0.0	no	0.0
6/3/2003	medium	1	no	0.0	no	0.0
6/17/2003	medium	1	no	0.0	no	0.0
7/15/2003	medium	1	no	0.0	no	0.0
7/21/2003	low	0	no	0.0	no	0.0
8/7/2003	low	0	no	0.0	no	0.0
8/13/2003	medium	1	no	0.0	no	0.0
9/15/2003	high	2	no	0.0	no	0.0
9/16/2003	high	2	no	0.0	no	0.0
9/17/2003	medium	1	no	0.0	no	0.0
9/19/2003	medium	1	no	0.0	no	0.0
10/9/2003	medium	1	**yes**	**1.0**	no	0.0
10/14/2003	high	2	no	0.0	no	0.0
11/12/2003	high	2	no	0.0	no	0.0
11/19/2003	high	2	no	0.0	no	0.0
12/17/2003	medium	1	no	0.0	no	0.0
12/23/2003	medium	1	no	0.0	no	0.0
1/13/2004	medium	1	no	0.0	**yes**	**1.0**
1/24/2004	high	2	no	0.0	no	0.0
2/10/2004	medium	1	no	0.0	**yes**	**1.0**
2/23/2004	medium	1	**yes**	**1.0**	no	0.0
3/17/2004	medium	1	no	0.0	no	0.0
3/19/2004	medium	1	no	0.0	no	0.0
4/15/2004	medium	1	**yes**	**1.0**	no	0.0
4/19/2004	medium	1	no	0.0	no	0.0
4/22/2004	medium	1	no	0.0	no	0.0
5/24/2004	medium	1	no	0.0	no	0.0
5/25/2004	medium	1	no	0.0	no	0.0
6/14/2004	medium	1	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
6/15/2004	low	0	no	0.0	no	0.0
6/23/2004	high	2	no	0.0	no	0.0
6/28/2004	low	0	no	0.0	no	0.0
6/29/2004	medium	1	no	0.0	no	0.0
6/30/2004	medium	1	no	0.0	no	0.0
7/12/2004	low	0	no	0.0	no	0.0
7/13/2004	low	0	no	0.0	no	0.0
8/11/2004	high	2	no	0.0	no	0.0
8/12/2004	low	0	no	0.0	no	0.0
8/24/2004	medium	1	no	0.0	no	0.0
9/2/2004	high	2	no	0.0	no	0.0
9/3/2004	high	2	no	0.0	no	0.0
9/7/2004	medium	1	no	0.0	no	0.0
9/10/2004	low	0	no	0.0	no	0.0
9/16/2004	high	2	no	0.0	no	0.0
9/21/2004	medium	1	no	0.0	no	0.0
9/22/2004	medium	1	no	0.0	no	0.0
9/23/2004	medium	1	no	0.0	no	0.0
10/5/2004	medium	1	no	0.0	no	0.0
10/13/2004	medium	1	**yes**	**1.0**	no	0.0
10/15/2004	high	2	no	0.0	no	0.0
10/18/2004	high	2	no	0.0	no	0.0
10/25/2004	low	0	no	0.0	no	0.0
11/4/2004	medium	1	no	0.0	no	0.0
11/18/2004	high	2	no	0.0	no	0.0
11/23/2004	medium	1	no	0.0	no	0.0
12/3/2004	low	0	no	0.0	no	0.0
12/15/2004	high	2	no	0.0	no	0.0
12/23/2004	medium	1	no	0.0	no	0.0
1/4/2005	high	2	no	0.0	no	0.0
1/13/2005	high	2	no	0.0	no	0.0
1/21/2005	low	0	no	0.0	no	0.0
2/1/2005	high	**2**	**no**	**0.0**	**yes**	**1.0**
2/2/2005	high	**2**	**no**	**0.0**	**yes**	**2.0**
2/3/2005	medium	**1**	**no**	**0.0**	**yes**	**1.0**
2/4/2005	medium	**1**	**no**	**0.0**	**yes**	**1.0**
2/7/2005	low	**0**	**no**	**0.0**	**yes**	**1.0**
2/8/2005	low	0	no	0.0	no	0.0
2/15/2005	high	2	no	0.0	no	0.0
2/25/2005	high	2	no	0.0	no	0.0
3/2/2005	high	2	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
3/8/2005	low	0	no	0.0	no	0.0
3/15/2005	high	2	no	0.0	no	0.0
4/4/2005	low	0	no	0.0	no	0.0
4/11/2015	high	**2**	**no**	**0.0**	**yes**	**1.0**
4/13/2005	medium	**1**	**no**	**0.0**	**yes**	**2.0**
4/14/2005	high	**2**	**no**	**0.0**	**yes**	**1.0**
4/15/2005	medium	**1**	**no**	**0.0**	**yes**	**2.0**
4/18/2005	low	0	no	0.0	no	0.0
4/25/2005	medium	1	no	0.0	no	0.0
5/2/2005	low	0	no	0.0	no	0.0
5/9/2005	medium	1	no	0.0	no	0.0
5/16/2005	low	0	no	0.0	no	0.0
5/20/2005	low	0	no	0.0	no	0.0
5/23/2005	medium	1	no	0.0	no	0.0
5/30/2005	medium	1	no	0.0	no	0.0
6/6/2005	medium	1	no	0.0	no	0.0
6/10/2005	medium	1	no	0.0	no	0.0
6/13/2005	high	2	no	0.0	no	0.0
6/20/2005	low	0	no	0.0	no	0.0
6/27/2005	high	2	no	0.0	no	0.0
7/4/2005	medium	1	no	0.0	no	0.0
7/11/2005	high	**2**	no	0.0	**yes**	**1.0**
7/15/2005	medium	1	no	0.0	no	0.0
7/18/2005	low	0	no	0.0	no	0.0
7/25/2005	high	2	no	0.0	no	0.0
8/1/2005	low	0	no	0.0	no	0.0
8/8/2005	high	2	no	0.0	no	0.0
8/12/2005	medium	1	no	0.0	no	0.0
8/15/2005	low	0	no	0.0	no	0.0
8/22/2005	medium	1	no	0.0	no	0.0
8/29/2005	low	0	no	0.0	no	0.0
9/5/2005	medium	1	no	0.0	no	0.0
9/12/2005	medium	1	no	0.0	no	0.0
9/14/2005	low	0	no	0.0	no	0.0
9/19/2005	medium	1	no	0.0	no	0.0
9/26/2005	low	0	no	0.0	no	0.0
10/3/2005	medium	1	no	0.0	no	0.0
10/10/2005	medium	1	no	0.0	no	0.0
10/14/2005	low	0	no	0.0	no	0.0
10/17/2005	medium	1	no	0.0	no	0.0
10/24/2005	medium	1	no	0.0	no	0.0
10/31/2005	low	0	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
11/7/2005	high	2	no	0.0	no	0.0
11/14/2005	low	0	no	0.0	no	0.0
11/21/2005	high	2	no	0.0	no	0.0
11/23/2005	medium	1	no	0.0	no	0.0
11/28/2005	low	0	no	0.0	no	0.0
11/29/2005	medium	1	no	0.0	no	0.0
11/30/2005	medium	1	no	0.0	no	0.0
12/1/2005	high	2	no	0.0	no	0.0
12/2/2005	high	2	no	0.0	no	0.0
12/5/2005	high	2	no	0.0	no	0.0
12/6/2005	medium	1	no	0.0	no	0.0
12/7/2005	high	2	no	0.0	no	0.0
12/9/2005	high	2	no	0.0	no	0.0
12/15/2005	high	**2**	no	0.0	**yes**	**1.0**
12/19/2005	high	**2**	no	0.0	**yes**	**1.0**
1/25/2006	low	0	**yes**	**2.0**	**yes**	**2.0**
2/8/2006			no	0.0	**yes**	**1.0**
2/9/2006			no	0.0	**yes**	**1.0**
2/10/2006			no	0.0	**yes**	**1.0**
2/13/2006	medium	1	no	0.0	**yes**	**1.0**
2/14/2006	medium	1	no	0.0	**yes**	**1.0**
3/15/2006	low	0	no	0.0	no	0.0
3/17/2006	low	0	no	0.0	no	0.0
3/21/2006	high	2	no	0.0	no	0.0
3/27/2006	low	0	no	0.0	no	0.0
4/3/2006	high	2	no	0.0	no	0.0
4/11/2006	medium	1	no	0.0	no	0.0
4/14/2006	medium	1	no	0.0	no	0.0
4/17/2006	high	2	no	0.0	no	0.0
4/24/2006	low	0	no	0.0	no	0.0
4/25/2006	medium	1	no	0.0	no	0.0
4/26/2006	medium	1	no	0.0	no	0.0
4/27/2006	medium	1	no	0.0	no	0.0
4/28/2006	medium	1	no	0.0	no	0.0
5/1/2006	medium	1	no	0.0	no	0.0
5/9/2006	low	0	no	0.0	no	0.0
5/17/2006	high	2	no	0.0	no	0.0
5/18/2006	high	2	no	0.0	no	0.0
5/22/2006	low	0	no	0.0	no	0.0
5/30/2006	medium	1	no	0.0	no	0.0
5/31/2006	high	2	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
6/1/2006	high	2	no	0.0	no	0.0
6/5/2006	medium	1	**yes**	**0.5**	no	0.0
6/12/2006	low	0	no	0.0	no	0.0
6/14/2006	medium	1	no	0.0	no	0.0
7/12/2006	low	0	no	0.0	no	0.0
7/19/2006	medium	1	**yes**	**1.0**	no	0.0
7/24/2006	high	2	no	0.0	no	0.0
7/25/2006	low	0	**yes**	**1.0**	no	0.0
7/31/2006	high	2	no	0.0	**yes**	**1.0**
8/2/2006	high	2	no	0.0	no	0.0
8/8/2006	high	2	no	0.0	no	0.0
8/14/2006	high	2	**yes**	**1.0**	**yes**	**1.0**
8/16/2006	medium	1	**yes**	**2.0**	**yes**	**1.0**
8/21/2006	low	0	no	0.0	no	0.0
8/25/2006	high	2	**yes**	**0.5**	**yes**	**0.5**
8/28/2006	high	2	**yes**	**0.5**	no	0.0
8/29/2006	high	2	no	0.0	no	0.0
9/1/2006	medium	1	no	0.0	no	0.0
9/5/2006	low	0	no	0.0	no	0.0
9/6/2006	low	0	no	0.0	no	0.0
9/11/2006	high	2	no	0.0	no	0.0
9/13/2006	high	2	**yes**	**1.0**	**yes**	**1.0**
9/18/2006	low	0	no	0.0	**yes**	**1.0**
9/19/2006	low	0	**yes**	**2.0**	no	0.0
9/22/2006	high	2	no	0.0	no	0.0
9/25/2006	high	2	no	0.0	**yes**	**1.0**
9/27/2006	high	2	no	0.0	no	0.0
10/2/2006	medium	1	no	0.0	no	0.0
10/5/2006	low	0	no	0.0	no	0.0
10/6/2006	high	2	no	0.0	no	0.0
10/9/2006	high	2	no	0.0	no	0.0
10/12/2006	high	2	no	0.0	no	0.0
10/16/2006	medium	1	no	0.0	no	0.0
10/17/2006	high	2	**yes**	**1.0**	no	0.0
10/23/2006	high	2	no	0.0	no	0.0
10/25/2006	high	2	no	0.0	no	0.0
10/30/2006	high	2	no	0.0	no	0.0
10/31/2006	high	2	**yes**	**1.0**	no	0.0
11/1/2006	medium	1	no	0.0	no	0.0
11/6/2006	high	2	no	0.0	no	0.0
11/7/2006	high	2	no	0.0	no	0.0
11/8/2006	high	2	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
11/9/2006	high	2	no	0.0	no	0.0
11/13/2006	high	2	no	0.0	**yes**	**1.0**
11/17/2006	medium	1	no	0.0	no	0.0
11/20/2006	high	2	no	0.0	no	0.0
11/27/2006	high	2	no	0.0	no	0.0
11/30/2006	high	2	no	0.0	no	0.0
12/4/2006	medium	1	no	0.0	**yes**	**1.0**
12/5/2006	high	2	**yes**	**1.0**	no	0.0
12/11/2006	high	2	no	0.0	no	0.0
12/12/2006	medium	1	no	0.0	no	0.0
12/13/2006	high	2	no	0.0	no	0.0
12/14/2006	high	2	no	0.0	no	0.0
12/15/2006	medium	1	**yes**	**1.0**	no	0.0
12/16/2006	medium	1	no	0.0	no	0.0
12/18/2006	medium	1	no	0.0	no	0.0
12/19/2006	high	2	no	0.0	**yes**	**1.0**
12/21/2006	high	2	no	0.0	no	0.0
12/22/2006	high	2	no	0.0	no	0.0
1/2/2007	high	2	no	0.0	no	0.0
1/5/2007	high	2	no	0.0	no	0.0
1/8/2007	high	2	no	0.0	no	0.0
1/9/2007	high	2	no	0.0	no	0.0
1/10/2007	high	2	no	0.0	no	0.0
1/15/2007	high	2	no	0.0	no	0.0
1/19/2007	high	2	no	0.0	**yes**	**1.0**
1/22/2007	high	2	no	0.0	**yes**	**0.5**
1/29/2007	high	2	no	0.0	**yes**	**1.0**
1/31/2007	high	2	**yes**	**1.0**	no	0.0
2/2/2007	high	2	no	0.0	no	0.0
2/5/2007	high	2	no	0.0	no	0.0
2/6/2007	high	2	no	0.0	no	0.0
2/7/2007	high	2	no	0.0	no	0.0
2/12/2007	high	2	no	0.0	no	0.0
2/14/2007	high	2	no	0.0	no	0.0
2/16/2007	high	2	no	0.0	no	0.0
2/20/2007	high	2	no	0.0	no	0.0
2/26/2007	high	2	no	0.0	no	0.0
3/5/2007	medium	1	no	0.0	no	0.0
3/7/2007	medium	1	no	0.0	no	0.0
3/13/2007	high	2	no	0.0	no	0.0
3/16/2007	medium	1	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
3/19/2007	low	0	no	0.0	no	0.0
3/20/2007	medium	1	no	0.0	no	0.0
3/21/2007	high	2	no	0.0	no	0.0
3/22/2007	high	2	no	0.0	no	0.0
3/26/2007	high	2	no	0.0	no	0.0
3/30/2007	medium	1	no	0.0	no	0.0
4/2/2007	high	2	no	0.0	no	0.0
4/6/2007	high	2	**yes**	**1.0**	no	0.0
4/9/2007	high	2	no	0.0	no	0.0
4/12/2007	high	2	no	0.0	no	0.0
4/13/2007	medium	1	no	0.0	no	0.0
4/16/2007	low	0	no	0.0	no	0.0
4/19/2007	medium	1	no	0.0	no	0.0
4/23/2007	high	2	no	0.0	no	0.0
4/24/2007	high	2	**yes**	**1.0**	no	0.0
4/26/2007	medium	1	no	0.0	no	0.0
4/27/2007	high	2	no	0.0	no	0.0
4/30/2007	low	0	no	0.0	no	0.0
5/3/2007	medium	1	no	0.0	no	0.0
5/8/2007	high	2	no	0.0	no	0.0
5/9/2007	high	2	no	0.0	no	0.0
5/14/2007	low	0	no	0.0	no	0.0
5/17/2007	medium	1	no	0.0	no	0.0
5/21/2007	high	2	no	0.0	no	0.0
5/23/2007	medium	1	no	0.0	no	0.0
6/1/2007	medium	1	no	0.0	no	0.0
6/4/2007	high	2	**yes**	**1.0**	**yes**	**1.0**
6/6/2007	high	2	no	0.0	no	0.0
6/7/2007	medium	1	**yes**	**1.0**	no	0.0
6/11/2007	low	0	no	0.0	no	0.0
6/13/2007	low	0	no	0.0	no	0.0
6/14/2007	low	0	no	0.0	no	0.0
6/18/2007	medium	1	no	0.0	no	0.0
6/19/2007	high	2	no	0.0	no	0.0
6/25/2007	low	0	no	0.0	no	0.0
7/2/2007	high	2	**yes**	**2.0**	no	0.0
7/9/2007	low	0	no	0.0	no	0.0
7/13/2007	low	0	no	0.0	no	0.0
7/16/2007	low	0	no	0.0	no	0.0
7/23/2007	low	0	no	0.0	no	0.0
7/30/2007	medium	1	no	0.0	no	0.0
7/31/2007	high	2	**yes**	**1.0**	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
8/6/2007	medium	1	no	0.0	no	0.0
8/8/2007	low	0	no	0.0	no	0.0
8/13/2007	medium	1	no	0.0	no	0.0
8/16/2007	high	2	no	0.0	no	0.0
8/20/2007	high	2	no	0.0	no	0.0
8/22/2007	medium	1	no	0.0	no	0.0
8/23/2007	medium	1	no	0.0	no	0.0
8/24/2007	low	0	no	0.0	no	0.0
8/27/2007	low	0	no	0.0	no	0.0
8/30/2007	low	0	no	0.0	no	0.0
9/4/2007	medium	1	no	0.0	no	0.0
9/10/2007	medium	1	no	0.0	no	0.0
9/13/2007	medium	1	no	0.0	no	0.0
9/14/2007	high	2	no	0.0	no	0.0
9/17/2007	high	2	no	0.0	no	0.0
9/18/2007	high	2	no	0.0	no	0.0
9/19/2007	high	2	no	0.0	no	0.0
9/20/2007	medium	1	no	0.0	no	0.0
9/24/2007	low	0	no	0.0	no	0.0
10/1/2007	high	2	no	0.0	no	0.0
10/2/2007	high	2	no	0.0	no	0.0
10/3/2007	medium	1	no	0.0	no	0.0
10/5/2007	low	0	no	0.0	no	0.0
10/8/2007	medium	1	no	0.0	no	0.0
10/9/2007	high	2	no	0.0	no	0.0
10/11/2007	high	2	no	0.0	no	0.0
10/15/2007	high	2	no	0.0	no	0.0
10/17/2007	medium	1	no	0.0	no	0.0
10/22/2007	low	0	no	0.0	no	0.0
10/24/2007	medium	1	no	0.0	no	0.0
10/25/2007	high	2	no	0.0	no	0.0
10/29/2007	high	2	no	0.0	no	0.0
10/31/2007	low	0	no	0.0	no	0.0
11/1/2007	low	0	no	0.0	no	0.0
11/2/2007	low	0	no	0.0	no	0.0
11/5/2007	low	0	no	0.0	no	0.0
11/6/2007	low	0	no	0.0	no	0.0
11/12/2007	high	2	no	0.0	no	0.0
11/13/2007	high	2	no	0.0	no	0.0
11/15/2007	high	2	no	0.0	no	0.0
11/16/2007	high	2	no	0.0	no	0.0
11/19/2007	medium	1	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
11/26/2007	high	2	no	0.0	no	0.0
11/27/2007	high	2	**yes**	**0.5**	no	0.0
12/3/2007	high	2	no	0.0	no	0.0
12/10/2007	high	2	no	0.0	no	0.0
12/11/2007	high	2	no	0.0	no	0.0
12/14/2007	high	2	no	0.0	no	0.0
12/17/2007	high	2	no	0.0	no	0.0
12/19/2007	high	2	no	0.0	no	0.0
12/20/2007	high	2	no	0.0	no	0.0
12/24/2007	medium	1	no	0.0	no	0.0
1/2/2008	high	2	no	0.0	yes	1.0
1/7/2008	high	2	no	0.0	no	0.0
1/11/2008	high	2	no	0.0	no	0.0
1/14/2008	high	2	no	0.0	no	0.0
1/21/2008	high	2	no	0.0	no	0.0
1/22/2008	high	2	no	0.0	no	0.0
1/28/2008	high	2	no	0.0	no	0.0
1/29/2008	high	2	no	0.0	no	0.0
2/4/2008	high	2	**yes**	**0.5**	no	0.0
2/11/2008	medium	1	no	0.0	no	0.0
2/12/2008	high	2	no	0.0	no	0.0
2/14/2008	high	2	no	0.0	no	0.0
2/19/2008	high	2	no	0.0	no	0.0
2/20/2008	high	2	no	0.0	no	0.0
2/25/2008	high	2	no	0.0	no	0.0
2/28/2008	high	2	no	0.0	no	0.0
3/3/2008	medium	1	no	0.0	no	0.0
3/4/2008	medium	1	no	0.0	no	0.0
3/10/2008	high	2	no	0.0	no	0.0
3/11/2008	high	2	no	0.0	no	0.0
3/12/2008	high	2	no	0.0	no	0.0
3/14/2008	high	2	no	0.0	no	0.0
3/17/2008	medium	1	no	0.0	no	0.0
3/24/2008	high	2	no	0.0	no	0.0
3/26/2008	high	2	no	0.0	no	0.0
3/31/2008	medium	1	no	0.0	no	0.0
4/1/2008	medium	1	no	0.0	no	0.0
4/7/2008	high	2	no	0.0	no	0.0
4/10/2008	medium	1	**yes**	**0.5**	no	0.0
4/11/2008	medium	1	no	0.0	no	0.0
4/15/2008	medium	1	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
4/16/2008	low	0	no	0.0	no	0.0
4/18/2008	low	0	no	0.0	no	0.0
4/21/2008	medium	1	no	0.0	no	0.0
4/22/2008	medium	1	no	0.0	no	0.0
4/28/2008	medium	1	no	0.0	no	0.0
5/2/2008	low	0	no	0.0	no	0.0
5/5/2008	medium	1	no	0.0	no	0.0
5/12/2008	medium	1	no	0.0	no	0.0
5/16/2008	medium	1	no	0.0	no	0.0
5/19/2008	low	0	no	0.0	no	0.0
5/21/2008	low	0	no	0.0	no	0.0
5/23/2008	high	2	no	0.0	no	0.0
5/27/2008	medium	1	**yes**	**0.5**	no	0.0
5/29/2008	medium	1	no	0.0	no	0.0
6/2/2008	low	0	no	0.0	no	0.0
6/9/2008	medium	1	no	0.0	no	0.0
6/12/2008	medium	1	no	0.0	no	0.0
6/17/2008	low	0	no	0.0	no	0.0
6/18/2008	low	0	no	0.0	no	0.0
6/19/2008	medium	1	no	0.0	no	0.0
6/23/2008	high	2	yes	1.0	no	0.0
6/25/2008	medium	1	no	0.0	no	0.0
6/26/2008	medium	1	no	0.0	no	0.0
6/27/2008	low	0	no	0.0	no	0.0
6/30/2008	low	0	no	0.0	no	0.0
7/7/2008	high	2	no	0.0	no	0.0
7/8/2008	high	2	no	0.0	no	0.0
7/14/2008	low	0	no	0.0	no	0.0
7/16/2008	medium	1	**yes**	**1.0**	**yes**	**1.0**
7/21/2008	high	2	no	0.0	no	0.0
7/22/2008	high	2	no	0.0	no	0.0
7/23/2008	high	2	no	0.0	no	0.0
7/28/2008	low	0	no	0.0	no	0.0
7/30/2008	low	0	no	0.0	no	0.0
7/31/2008	low	0	no	0.0	no	0.0
8/4/2008	high	2	no	0.0	no	0.0
8/5/2008	high	2	no	0.0	no	0.0
8/6/2008	high	2	no	0.0	no	0.0
8/7/2008	high	2	no	0.0	no	0.0
8/8/2008	medium	1	no	0.0	no	0.0
8/11/2008	low	0	no	0.0	no	0.0
8/12/2008	low	0	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
8/13/2008	low	0	no	0.0	no	0.0
8/18/2008	medium	1	no	0.0	no	0.0
8/19/2008	high	2	yes	1.0	no	0.0
8/20/2008	high	2	no	0.0	no	0.0
8/21/2008	high	2	no	0.0	no	0.0
8/25/2008	medium	1	no	0.0	no	0.0
8/27/2008	low	0	no	0.0	no	0.0
9/2/2008	medium	1	no	0.0	no	0.0
9/8/2008	medium	1	no	0.0	no	0.0
9/16/2008	medium	1	no	0.0	no	0.0
9/17/2008	high	2	no	0.0	no	0.0
9/18/2008	high	2	no	0.0	no	0.0
9/19/2008	high	2	no	0.0	no	0.0
9/22/2008	high	2	no	0.0	no	0.0
9/23/2008	medium	1	no	0.0	no	0.0
9/24/2008	low	0	no	0.0	no	0.0
9/29/2008	high	2	no	0.0	no	0.0
9/30/2008	high	2	no	0.0	no	0.0
10/1/2008	high	2	no	0.0	no	0.0
10/2/2008	high	2	no	0.0	no	0.0
10/6/2008	high	2	no	0.0	no	0.0
10/13/2008	medium	1	no	0.0	no	0.0
10/15/2008	medium	1	no	0.0	no	0.0
10/17/2008	high	2	no	0.0	no	0.0
10/20/2008	high	2	no	0.0	no	0.0
10/21/2008	high	2	no	0.0	no	0.0
10/24/2008	low	0	no	0.0	no	0.0
10/25/2008	medium	1	no	0.0	no	0.0
10/27/2008	high	2	no	0.0	no	0.0
11/3/2008	high	2	no	0.0	no	0.0
11/6/2008	high	2	no	0.0	no	0.0
11/10/2008	medium	1	no	0.0	no	0.0
11/14/2008	high	2	no	0.0	no	0.0
11/17/2008	high	2	no	0.0	no	0.0
11/18/2008	high	2	no	0.0	no	0.0
11/21/2008	medium	1	no	0.0	no	0.0
11/24/2008	medium	1	no	0.0	no	0.0
11/25/2008	high	2	no	0.0	no	0.0
12/1/2008	high	2	no	0.0	no	0.0
12/2/2008	high	2	no	0.0	no	0.0
12/3/2008	high	2	no	0.0	no	0.0
12/8/2008	high	2	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
12/11/2008	high	2	no	0.0	no	0.0
12/12/2008	high	2	no	0.0	no	0.0
12/15/2008	high	2	no	0.0	no	0.0
12/16/2008	high	2	no	0.0	no	0.0
12/17/2008	high	2	no	0.0	no	0.0
12/23/2008	high	2	no	0.0	no	0.0
12/29/2008	high	2	no	0.0	no	0.0
1/5/2009	high	2	no	0.0	no	0.0
1/12/2009	high	2	no	0.0	no	0.0
1/14/2009	high	2	no	0.0	no	0.0
1/15/2009	high	2	no	0.0	no	0.0
1/16/2009	high	2	no	0.0	no	0.0
1/20/2009	high	2	no	0.0	no	0.0
1/22/2009	high	2	no	0.0	no	0.0
1/26/2009	medium	1	no	0.0	no	0.0
1/27/2009	high	2	no	0.0	no	0.0
1/28/2009	medium	1	no	0.0	no	0.0
1/29/2009	medium	1	no	0.0	no	0.0
1/30/2009	medium	1	no	0.0	no	0.0
2/2/2009	high	2	no	0.0	no	0.0
2/5/2009	high	2	no	0.0	**yes**	**0.5**
2/9/2009	high	2	no	0.0	no	0.0
2/11/2009	medium	1	no	0.0	no	0.0
2/17/2009	high	2	**yes**	**0.5**	no	0.0
2/18/2009	high	2	no	0.0	no	0.0
2/23/2009	high	2	no	0.0	no	0.0
2/26/2009	medium	1	no	0.0	no	0.0
3/3/2009	high	2	no	0.0	no	0.0
3/9/2009	medium	1	no	0.0	no	0.0
3/11/2009	medium	1	no	0.0	no	0.0
3/16/2009	medium	1	no	0.0	no	0.0
3/17/2009	high	2	no	0.0	no	0.0
3/18/2009	high	2	no	0.0	no	0.0
3/23/2009	medium	1	no	0.0	no	0.0
3/30/2009	high	2	no	0.0	no	0.0
3/31/2009	high	2	no	0.0	no	0.0
4/6/2009	medium	1	no	0.0	no	0.0
4/7/2009	medium	1	no	0.0	no	0.0
4/13/2009	high	2	no	0.0	no	0.0
4/15/2009	high	2	no	0.0	no	0.0
4/16/2009	low	0	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
4/21/2009	low	0	no	0.0	no	0.0
4/27/2009	medium	1	no	0.0	no	0.0
4/28/2009	high	2	no	0.0	no	0.0
4/29/2009	high	2	no	0.0	no	0.0
5/4/2009	low	0	no	0.0	no	0.0
5/11/2009	medium	1	no	0.0	no	0.0
5/14/0009	high	2	no	0.0	no	0.0
5/15/2009	high	2	no	0.0	no	0.0
5/18/2009	medium	1	no	0.0	no	0.0
5/26/2009	medium	1	no	0.0	no	0.0
5/27/2009	medium	1	no	0.0	no	0.0
6/1/2009	medium	1	no	0.0	no	0.0
6/2/2009	medium	1	no	0.0	no	0.0
6/4/2009	low	0	no	0.0	no	0.0
6/8/2009	medium	1	no	0.0	no	0.0
6/10/2009	high	2	no	0.0	no	0.0
6/11/2009	medium	1	no	0.0	no	0.0
6/15/2009	high	2	no	0.0	no	0.0
6/16/2009	medium	1	no	0.0	no	0.0
6/19/2009	high	2	no	0.0	no	0.0
6/22/2009	low	0	no	0.0	no	0.0
6/25/2009	high	2	no	0.0	no	0.0
6/29/2009	high	2	no	0.0	no	0.0
7/6/2009	low	0	no	0.0	no	0.0
7/13/2009	high	2	no	0.0	no	0.0
7/15/2009	high	2	no	0.0	no	0.0
7/16/2009	low	0	no	0.0	no	0.0
7/20/2009	low	0	no	0.0	no	0.0
7/22/2009	low	0	no	0.0	no	0.0
7/27/2009	high	2	no	0.0	no	0.0
8/3/2009	low	0	no	0.0	no	0.0
8/10/2009	high	2	**yes**	**0.5**	no	0.0
8/14/2009	low	0	no	0.0	no	0.0
8/17/2009	low	0	no	0.0	no	0.0
8/18/2009	low	0	no	0.0	no	0.0
8/24/2009	high	2	no	0.0	no	0.0
8/31/2009	low	0	no	0.0	no	0.0
9/1/2009	medium	1	no	0.0	no	0.0
9/8/2009	high	2	no	0.0	no	0.0
9/11/2009	high	2	no	0.0	no	0.0
9/14/2009	medium	1	no	0.0	no	0.0
9/16/2009	medium	1	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
9/17/2009	medium	1	no	0.0	no	0.0
9/18/2009	high	2	no	0.0	no	0.0
9/21/2009	high	2	no	0.0	no	0.0
9/28/2009	low	0	no	0.0	no	0.0
10/1/2009	medium	1	no	0.0	no	0.0
10/7/2009	high	2	no	0.0	no	0.0
10/12/2009	medium	1	no	0.0	no	0.0
10/20/2009	high	2	**yes**	**0.5**	no	0.0
10/21/2009	high	2	no	0.0	no	0.0
10/26/2009	medium	1	no	0.0	no	0.0
10/27/2009	medium	1	no	0.0	no	0.0
11/2/2009	medium	1	no	0.0	no	0.0
11/3/2009	high	2	no	0.0	no	0.0
11/10/2009	medium	1	no	0.0	no	0.0
11/16/2009	high	2	no	0.0	no	0.0
11/17/2009	high	2	no	0.0	no	0.0
11/18/2009	high	2	no	0.0	no	0.0
11/23/2009	high	2	no	0.0	no	0.0
11/24/2009	high	2	no	0.0	no	0.0
11/30/2009	high	2	no	0.0	no	0.0
12/3/2009	high	2	no	0.0	no	0.0
12/4/2009	high	2	no	0.0	no	0.0
12/7/2009	high	2	no	0.0	no	0.0
12/8/2009	high	2	no	0.0	no	0.0
12/9/2009	high	2	no	0.0	no	0.0
12/10/2009	medium	1	no	0.0	no	0.0
12/11/2009	high	2	no	0.0	no	0.0
12/14/2009	high	2	**yes**	**1.0**	no	0.0
12/15/2009	high	2	no	0.0	no	0.0
12/16/2009	high	2	no	0.0	no	0.0
12/17/2009	high	2	no	0.0	no	0.0
12/21/2009	high	2	no	0.0	no	0.0
12/28/2009	high	2	no	0.0	no	0.0
1/4/2010	high	2	no	0.0	no	0.0
1/5/2010	high	2	no	0.0	no	0.0
1/6/2010	high	2	no	0.0	no	0.0
1/7/2010	high	2	no	0.0	no	0.0
1/11/2010	high	2	no	0.0	no	0.0
1/14/2010	high	2	no	0.0	no	0.0
1/19/2010	high	2	no	0.0	no	0.0
1/20/2010	high	2	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
1/21/2010	high	2	no	0.0	no	0.0
1/25/2010	high	2	no	0.0	no	0.0
1/27/2010	high	2	no	0.0	no	0.0
2/1/2010	high	2	no	0.0	no	0.0
2/2/2010	high	2	no	0.0	no	0.0
2/8/2010	high	2	no	0.0	no	0.0
2/9/2010	high	2	no	0.0	no	0.0
2/16/2010	high	2	no	0.0	no	0.0
2/17/2010	high	2	no	0.0	no	0.0
2/18/2010	high	2	no	0.0	no	0.0
2/19/2010	high	2	no	0.0	no	0.0
2/22/2010	high	2	no	0.0	no	0.0
3/1/2010	high	2	**yes**	**1.0**	no	0.0
3/8/2010	high	2	no	0.0	no	0.0
3/12/2010	high	2	no	0.0	no	0.0
3/16/2010	high	2	no	0.0	no	0.0
3/17/2010	medium	1	no	0.0	no	0.0
3/19/2010	high	2	no	0.0	no	0.0
3/22/2010	high	2	no	0.0	no	0.0
3/25/2010	high	2	no	0.0	no	0.0
3/30/2010	high	2	no	0.0	no	0.0
3/31/2010	high	2	no	0.0	no	0.0
4/1/2010	high	2	no	0.0	no	0.0
4/2/2010	high	2	no	0.0	no	0.0
4/5/2010	high	2	no	0.0	no	0.0
4/6/2010	high	2	no	0.0	no	0.0
4/9/2010	medium	1	no	0.0	no	0.0
4/12/2010	medium	1	no	0.0	no	0.0
4/14/2010	medium	1	no	0.0	no	0.0
4/15/2010	medium	1	no	0.0	no	0.0
4/16/2010	medium	1	no	0.0	no	0.0
4/19/2010	high	2	no	0.0	no	0.0
4/20/2010	high	2	no	0.0	no	0.0
4/27/2010	high	2	no	0.0	no	0.0
4/28/2010	high	2	no	0.0	no	0.0
4/29/2010	high	2	no	0.0	no	0.0
5/3/2010	high	2	no	0.0	no	0.0
5/5/2010	medium	1	no	0.0	no	0.0
5/6/2010	medium	1	no	0.0	no	0.0
5/7/2010	medium	1	no	0.0	no	0.0
5/10/2010	medium	1	no	0.0	no	0.0
5/17/2010	high	2	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
5/18/2010	high	2	no	0.0	no	0.0
5/24/2010	low	0	no	0.0	no	0.0
6/1/2010	medium	1	no	0.0	no	0.0
6/7/2010	low	0	no	0.0	no	0.0
6/9/2010	low	0	no	0.0	no	0.0
6/10/2010	low	0	no	0.0	no	0.0
6/14/2010	high	2	no	0.0	no	0.0
6/16/2010	high	2	no	0.0	no	0.0
6/17/2010	medium	1	no	0.0	no	0.0
6/21/2010	low	0	no	0.0	no	0.0
6/24/2010	low	0	no	0.0	no	0.0
6/28/2010	high	2	no	0.0	no	0.0
7/6/2010	low	0	no	0.0	no	0.0
7/8/2010	low	0	no	0.0	no	0.0
7/12/2010	medium	1	no	0.0	no	0.0
7/13/2010	medium	1	no	0.0	no	0.0
7/14/2010	medium	1	no	0.0	no	0.0
7/15/2010	high	2	no	0.0	no	0.0
7/16/2010	high	2	no	0.0	no	0.0
7/19/2010	low	0	**yes**	**1.0**	no	0.0
7/20/2010	medium	1	**yes**	**1.0**	no	0.0
7/21/2010	low	0	no	0.0	no	0.0
7/22/2010	low	0	no	0.0	no	0.0
7/26/2010	high	1	no	0.0	no	0.0
7/28/2010	medium	1	no	0.0	no	0.0
7/29/2010	medium	1	no	0.0	no	0.0
8/2/2010	medium	1	no	0.0	no	0.0
8/3/2010	low	0	no	0.0	no	0.0
8/9/2010	medium	1	no	0.0	no	0.0
8/11/2010	high	2	no	0.0	no	0.0
8/16/2010	medium	1	no	0.0	no	0.0
8/18/2010	low	0	no	0.0	no	0.0
8/19/2010	low	0	no	0.0	no	0.0
8/23/2010	medium	1	no	0.0	no	0.0
8/24/2010	high	2	no	0.0	no	0.0
8/30/2010	high	2	no	0.0	no	0.0
8/31/2010	high	2	no	0.0	no	0.0
9/1/2010	high	2	no	0.0	no	0.0
9/2/2010	low	0	no	0.0	no	0.0
9/3/2010	low	0	no	0.0	no	0.0
9/7/2010	low	0	no	0.0	no	0.0
9/14/2010	medium	1	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
9/15/2010	low	0	no	0.0	no	0.0
9/16/2010	low	0	no	0.0	no	0.0
9/20/2010	medium	1	no	0.0	no	0.0
9/21/2010	medium	1	no	0.0	no	0.0
9/22/2010	medium	1	no	0.0	no	0.0
9/27/2010	high	2	no	0.0	no	0.0
9/30/2010	high	2	no	0.0	no	0.0
10/4/2010	low	0	no	0.0	no	0.0
10/7/2010	medium	1	no	0.0	no	0.0
10/11/2010	high	2	no	0.0	no	0.0
10/14/2010	medium	1	no	0.0	no	0.0
10/18/2010	medium	1	no	0.0	no	0.0
10/19/2010	medium	1	no	0.0	no	0.0
10/20/2010	medium	1	no	0.0	no	0.0
10/21/2010	medium	1	no	0.0	no	0.0
10/25/2010	high	2	no	0.0	no	0.0
10/29/2010	high	2	no	0.0	no	0.0
11/1/2010	low	0	no	0.0	no	0.0
11/2/2010	medium	1	no	0.0	no	0.0
11/8/2010	high	2	no	0.0	no	0.0
11/11/2010	high	2	no	0.0	no	0.0
11/15/2010	medium	1	no	0.0	no	0.0
11/16/2010	medium	1	no	0.0	no	0.0
11/17/2010	medium	1	no	0.0	no	0.0
11/18/2010	medium	1	no	0.0	no	0.0
11/22/2010	high	2	no	0.0	no	0.0
11/29/2010	high	2	no	0.0	no	0.0
11/30/2010	medium	1	no	0.0	no	0.0
12/1/2010	medium	1	no	0.0	no	0.0
12/2/2010	medium	1	no	0.0	no	0.0
12/3/2010	medium	1	no	0.0	no	0.0
12/6/2010	high	2	no	0.0	no	0.0
12/7/2010	high	2	no	0.0	no	0.0
12/8/2010	high	2	no	0.0	no	0.0
12/13/2010	high	2	no	0.0	no	0.0
12/14/2010	high	2	no	0.0	no	0.0
12/15/2010	high	2	no	0.0	no	0.0
12/16/2010	high	2	no	0.0	no	0.0
12/20/2010	high	2	no	0.0	no	0.0
12/22/2010	high	2	no	0.0	no	0.0
12/23/2010	high	2	no	0.0	no	0.0
12/24/2010	high	2	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
12/27/2010	high	2	no	0.0	no	0.0
1/3/2011	high	2	no	0.0	no	0.0
1/10/2011	high	2	no	0.0	no	0.0
1/17/2011	high	2	no	0.0	no	0.0
1/18/2011	high	2	no	0.0	no	0.0
1/19/2011	high	2	no	0.0	no	0.0
1/24/2011	high	2	no	0.0	no	0.0
1/27/2011	high	2	no	0.0	no	0.0
1/31/2011	high	2	no	0.0	no	0.0
2/4/2011	high	2	no	0.0	no	0.0
2/7/2011	high	2	no	0.0	no	0.0
2/8/2011	high	2	no	0.0	no	0.0
2/14/2011	high	2	no	0.0	no	0.0
2/15/2011	high	2	no	0.0	no	0.0
2/16/2011	high	2	no	0.0	no	0.0
2/22/2011	high	2	no	0.0	no	0.0
2/25/2011	high	2	no	0.0	no	0.0
2/28/2011	high	2	no	0.0	no	0.0
3/2/2011	high	2	no	0.0	no	0.0
3/9/2011	high	2	no	0.0	no	0.0
3/10/2011	high	2	no	0.0	no	0.0
3/11/2011	high	2	no	0.0	no	0.0
3/14/2011	high	2	no	0.0	no	0.0
3/21/2011	high	2	no	0.0	no	0.0
3/22/2011	high	2	no	0.0	no	0.0
3/23/2011	high	2	no	0.0	no	0.0
3/24/2011	high	2	no	0.0	no	0.0
3/28/2011	high	2	no	0.0	no	0.0
3/29/2011	high	2	no	0.0	no	0.0
4/4/2011	high	2	no	0.0	no	0.0
4/5/2011	high	2	no	0.0	no	0.0
4/11/2011	high	2	no	0.0	no	0.0
4/12/2011	high	2	no	0.0	no	0.0
4/13/2011	high	2	no	0.0	no	0.0
4/19/2011	high	2	no	0.0	no	0.0
4/20/2011	high	2	no	0.0	no	0.0
4/21/2011	high	2	no	0.0	no	0.0
4/22/2011	high	2	no	0.0	no	0.0
4/25/2011	medium	1	no	0.0	no	0.0
4/27/2011	medium	1	**yes**	**1.0**	no	0.0
5/2/2011	high	2	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
5/9/2011	high	2	no	0.0	no	0.0
5/16/2011	medium	1	no	0.0	no	0.0
5/18/2011	high	2	no	0.0	no	0.0
5/19/2011	high	2	no	0.0	no	0.0
5/23/2011	high	2	no	0.0	no	0.0
6/1/2011	medium	1	no	0.0	no	0.0
6/6/2011	high	2	no	0.0	no	0.0
6/10/2011	medium	1	**yes**	**1.0**	no	0.0
6/13/2011	low	0	no	0.0	no	0.0
6/14/2011	low	0	no	0.0	no	0.0
6/15/2011	low	0	no	0.0	no	0.0
6/20/2011	high	2	no	0.0	no	0.0
6/22/2011	medium	1	**yes**	**0.5**	no	0.0
6/23/2011	medium	1	no	0.0	no	0.0
6/27/2011	low	0	no	0.0	no	0.0
6/30/2011	medium	1	no	0.0	no	0.0
7/6/2011	high	2	no	0.0	no	0.0
7/11/2011	low	0	no	0.0	no	0.0
7/18/2011	high	2	no	0.0	no	0.0
7/19/2011	high	2	no	0.0	no	0.0
7/20/2011	high	2	no	0.0	no	0.0
7/25/2011	low	0	no	0.0	no	0.0
7/29/2011	medium	1	no	0.0	no	0.0
8/1/2011	high	2	no	0.0	no	0.0
8/8/2011	low	0	no	0.0	no	0.0
8/15/2011	high	2	no	0.0	no	0.0
8/16/2011	high	2	no	0.0	no	0.0
8/17/2011	high	2	no	0.0	no	0.0
8/22/2011	low	0	no	0.0	no	0.0
8/24/2011	high	2	no	0.0	no	0.0
8/29/2011	medium	1	no	0.0	no	0.0
8/31/2011	medium	1	no	0.0	no	0.0
9/6/2011	medium	1	no	0.0	no	0.0
9/12/2011	high	2	no	0.0	no	0.0
9/13/2011	high	2	no	0.0	no	0.0
9/14/2011	high	2	no	0.0	no	0.0
9/20/2011	medium	1	no	0.0	no	0.0
9/26/2011	medium	1	no	0.0	no	0.0
9/27/2011	high	2	no	0.0	no	0.0
9/28/2011	high	2	no	0.0	no	0.0
9/29/2011	high	2	no	0.0	no	0.0
10/3/2011	high	2	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
10/10/2011	high	2	no	0.0	no	0.0
10/11/2011	high	2	no	0.0	no	0.0
10/12/2011	high	2	no	0.0	no	0.0
10/17/2011	high	2	no	0.0	no	0.0
10/18/2011	high	2	no	0.0	no	0.0
10/19/2011	high	2	no	0.0	no	0.0
10/20/2011	high	2	no	0.0	no	0.0
10/24/2011	medium	1	no	0.0	no	0.0
10/31/2011	high	2	no	0.0	no	0.0
11/8/2011	medium	1	no	0.0	no	0.0
11/14/2011	high	2	no	0.0	no	0.0
11/21/2011	medium	1	no	0.0	no	0.0
11/22/2011	high	2	no	0.0	no	0.0
11/23/2011	high	2	no	0.0	no	0.0
11/28/2011	high	2	no	0.0	no	0.0
11/29/2011	high	2	no	0.0	no	0.0
12/5/2011	medium	1	no	0.0	no	0.0
12/12/2011	high	2	no	0.0	no	0.0
12/13/2011	high	2	no	0.0	no	0.0
12/14/2011	high	2	no	0.0	no	0.0
12/19/2011	high	2	no	0.0	no	0.0
12/20/2011	high	2	no	0.0	no	0.0
12/21/2011	high	2	no	0.0	no	0.0
12/27/2011	high	2	no	0.0	no	0.0
1/3/2012	high	2	no	0.0	no	0.0
1/9/2012	high	2	no	0.0	no	0.0
1/17/2012	high	2	no	0.0	no	0.0
1/23/2012	high	2	no	0.0	no	0.0
1/24/2012	high	2	no	0.0	no	0.0
1/25/2012	high	2	no	0.0	no	0.0
1/27/2012	high	2	no	0.0	no	0.0
1/30/2012	high	2	no	0.0	no	0.0
2/6/2012	high	2	no	0.0	no	0.0
2/13/2012	high	2	no	0.0	no	0.0
2/21/2012	medium	1	no	0.0	no	0.0
2/27/2012	high	2	no	0.0	no	0.0
2/24/2012	high	2	no	0.0	no	0.0
3/1/2012	medium	1	no	0.0	no	0.0
3/2/2012	high	2	no	0.0	no	0.0
3/5/2012	high	2	no	0.0	no	0.0
3/12/2012	high	2	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
3/13/2012	high	2	no	0.0	no	0.0
3/14/2012	medium	1	no	0.0	no	0.0
3/15/2012	high	2	no	0.0	no	0.0
3/19/2012	high	2	no	0.0	no	0.0
3/20/2012	high	2	no	0.0	no	0.0
.3/21/2012	high	2	no	0.0	no	0.0
3/22/2012	high	2	no	0.0	no	0.0
3/26/2012	high	2	no	0.0	no	0.0
3/28/2012	high	2	no	0.0	no	0.0
4/2/2012	medium	1	no	0.0	no	0.0
4/5/2012	medium	1	no	0.0	no	0.0
4/9/2012	high	2	no	0.0	no	0.0
4/16/2012	medium	1	no	0.0	no	0.0
4/17/2012	medium	1	no	0.0	no	0.0
4/18/2012	high	2	no	0.0	no	0.0
4/19/2012	medium	1	no	0.0	no	0.0
4/23/2012	medium	1	no	0.0	no	0.0
4/30/2012	medium	1	no	0.0	no	0.0
5/2/2012	medium	1	no	0.0	no	0.0
5/7/2012	high	2	no	0.0	no	0.0
5/8/2012	high	2	no	0.0	no	0.0
5/14/2012	medium	1	no	0.0	no	0.0
5/15/2012	low	0	no	0.0	no	0.0
5/16/2012	medium	1	no	0.0	no	0.0
5/21/2012	high	2	no	0.0	no	0.0
5/22/2012	high	2	no	0.0	no	0.0
5/23/2012	high	2	no	0.0	no	0.0
5/24/2012	high	2	no	0.0	no	0.0
5/29/2012	high	2	no	0.0	no	0.0
5/31/2012	low	0	no	0.0	no	0.0
6/4/2012	medium	1	no	0.0	no	0.0
6/11/2012	medium	1	no	0.0	no	0.0
6/12/2012	medium	1	no	0.0	no	0.0
6/13/2012	medium	1	no	0.0	no	0.0
6/20/2012	high	2	no	0.0	no	0.0
6/25/2012	medium	1	no	0.0	no	0.0
7/2/2012	low	0	no	0.0	no	0.0
7/9/2012	medium	1	**yes**	**0.5**	no	0.0
7/10/2012	high	2	no	0.0	no	0.0
7/11/2012	high	2	no	0.0	no	0.0
7/12/2012	high	2	**yes**	**0.5**	no	0.0
7/16/2012	low	0	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
7/17/2012	low	0	no	0.0	no	0.0
7/19/2012	low	0	no	0.0	no	0.0
7/20/2012	low	0	no	0.0	no	0.0
7/23/2012	high	2	no	0.0	no	0.0
7/30/2012	low	0	no	0.0	no	0.0
8/6/2012	high	2	no	0.0	no	0.0
8/7/2012	medium	1	no	0.0	no	0.0
8/10/2012	medium	1	no	0.0	no	0.0
8/13/2012	low	0	no	0.0	no	0.0
8/14/2012	low	0	no	0.0	no	0.0
8/15/2012	low	0	no	0.0	no	0.0
8/20/2012	high	2	no	0.0	no	0.0
8/23/2012	high	2	no	0.0	no	0.0
8/28/2012	low	0	no	0.0	no	0.0
8/29/2012	low	0	no	0.0	no	0.0
9/4/2012	high	2	no	0.0	no	0.0
9/5/2012	high	2	no	0.0	no	0.0
9/7/2012	high	2	no	0.0	no	0.0
9/10/2012	low	0	no	0.0	no	0.0
9/11/2012	low	0	no	0.0	no	0.0
9/17/2012	high	2	no	0.0	no	0.0
9/18/2012	high	2	no	0.0	no	0.0
9/19/2012	high	2	no	0.0	no	0.0
9/20/2012	high	2	no	0.0	no	0.0
9/21/2012	high	2	no	0.0	no	0.0
9/25/2102	low	0	no	0.0	no	0.0
9/26/2012	low	0	no	0.0	no	0.0
9/27/2012	low	0	no	0.0	no	0.0
10/1/2012	high	2	no	0.0	no	0.0
10/9/2012	low	0	no	0.0	no	0.0
10/15/2012	high	2	no	0.0	no	0.0
10/16/2012	high	2	no	0.0	no	0.0
10/22/2012	high	2	no	0.0	no	0.0
10/23/2012	high	2	no	0.0	no	0.0
10/24/2012	high	2	no	0.0	no	0.0
10/25/2012	high	2	no	0.0	no	0.0
10/26/2012	high	2	no	0.0	no	0.0
10/29/2012	high	2	no	0.0	no	0.0
11/7/2012	high	2	**yes**	**0.5**	no	0.0
11/12/2012	high	2	no	0.0	no	0.0
11/13/2012	medium	1	no	0.0	no	0.0
11/19/2012	high	2	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
11/27/2012	high	2	**yes**	**0.5**	no	0.0
11/28/2012	high	2	no	0.0	no	0.0
12/5/2012	high	2	no	0.0	no	0.0
12/6/2012	high	2	**yes**	**0.5**	no	0.0
12/7/2012	high	2	no	0.0	no	0.0
12/12/2012	medium	1	**yes**	**0.5**	no	0.0
12/13/2012	medium	1	no	0.0	no	0.0
12/14/2012	medium	1	no	0.0	no	0.0
12/17/2012	high	2	no	0.0	no	0.0
12/18/2012	high	2	no	0.0	no	0.0
12/19/2012	high	2	no	0.0	no	0.0
12/20/2012	high	2	no	0.0	no	0.0
12/24/2012	high	2	no	0.0	no	0.0
1/2/2013	high	2	no	0.0	no	0.0
1/3/2013	high	2	no	0.0	no	0.0
1/7/2013	high	2	no	0.0	no	0.0
1/14/2013	high	2	no	0.0	no	0.0
1/22/2013	high	2	no	0.0	no	0.0
1/23/2013	high	2	no	0.0	no	0.0
1/28/2013	high	2	no	0.0	no	0.0
1/30/2013	high	2	no	0.0	no	0.0
1/31/2013	high	2	no	0.0	no	0.0
2/1/2013	high	2	no	0.0	no	0.0
2/4/2013	high	2	no	0.0	no	0.0
2/11/2013	high	2	no	0.0	no	0.0
2/19/2013	high	2	no	0.0	no	0.0
2/20/2013	high	2	no	0.0	no	0.0
2/21/2013	high	2	no	0.0	no	0.0
2/25/2013	high	2	no	0.0	no	0.0
3/5/2013	high	2	no	0.0	no	0.0
3/6/2013	medium	1	no	0.0	no	0.0
3/11/2013	medium	1	no	0.0	no	0.0
3/12/2013	high	2	no	0.0	no	0.0
3/13/2013	high	2	no	0.0	no	0.0
3/18/2013	high	2	no	0.0	no	0.0
3/25/2013	high	2	no	0.0	no	0.0
4/1/2013	high	2	no	0.0	no	0.0
4/2/2013	high	2	no	0.0	no	0.0
4/8/2013	medium	1	no	0.0	no	0.0
4/9/2013	medium	1	no	0.0	no	0.0
4/10/2013	high	2	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
4/15/2013	high	2	no	0.0	no	0.0
4/16/2013	high	2	no	0.0	no	0.0
4/18/2013	high	2	no	0.0	no	0.0
4/22/2013	medium	1	no	0.0	no	0.0
4/23/2013	medium	1	no	0.0	no	0.0
4/24/2013	low	0	no	0.0	no	0.0
4/25/2013	medium	1	no	0.0	no	0.0
4/29/2013	high	2	no	0.0	no	0.0
4/30/2013	high	2	no	0.0	no	0.0
5/6/2013	low	0	no	0.0	no	0.0
5/7/2013	medium	1	no	0.0	no	0.0
5/13/2013	high	2	no	0.0	no	0.0
5/17/2013	medium	1	no	0.0	no	0.0
5/20/2013	medium	1	no	0.0	no	0.0
5/21/2013	medium	1	no	0.0	no	0.0
5/22/2013	medium	1	no	0.0	no	0.0
5/23/2013	medium	1	no	0.0	no	0.0
5/28/2013	high	2	no	0.0	no	0.0
6/3/2013	medium	1	no	0.0	no	0.0
6/5/2013	low	0	no	0.0	no	0.0
6/10/2013	high	2	no	0.0	no	0.0
6/11/2013	high	2	no	0.0	no	0.0
6/12/2013	high	2	no	0.0	no	0.0
6/17/2013	medium	1	no	0.0	no	0.0
6/18/2013	medium	1	no	0.0	no	0.0
6/19/2013	medium	1	no	0.0	no	0.0
6/24/2013	high	2	no	0.0	no	0.0
6/25/2013	high	2	no	0.0	no	0.0
6/26/2013	high	2	no	0.0	no	0.0
7/1/2013	medium	1	no	0.0	no	0.0
7/8/2013	medium	1	no	0.0	no	0.0
7/15/2013	medium	1	no	0.0	no	0.0
7/18/2013	high	2	no	0.0	no	0.0
7/22/2013	medium	1	no	0.0	no	0.0
7/23/2013	medium	1	no	0.0	no	0.0
7/24/2013	high	2	no	0.0	no	0.0
7/29/2013	medium	1	no	0.0	no	0.0
8/5/2013	medium	1	no	0.0	no	0.0
8/12/2013	high	2	no	0.0	no	0.0
8/19/2013	low	0	no	0.0	no	0.0
8/20/2013	medium	1	no	0.0	no	0.0
8/21/2013	high	2	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
8/26/2013	high	2	no	0.0	no	0.0
8/27/2013	medium	1	no	0.0	no	0.0
9/3/2013	medium	1	no	0.0	no	0.0
9/9/2013	high	2	no	0.0	no	0.0
9/10/2013	high	2	no	0.0	no	0.0
9/11/2013	medium	1	no	0.0	no	0.0
9/12/2013	medium	1	no	0.0	no	0.0
9/16/2013	low	0	no	0.0	no	0.0
9/17/2013	medium	1	no	0.0	no	0.0
9/23/2013	high	2	no	0.0	no	0.0
9/24/2013	high	2	**yes**	**0.5**	no	0.0
9/25/2013	high	2	no	0.0	no	0.0
9/27/2013	high	2	no	0.0	no	0.0
9/30/2013	medium	1	no	0.0	no	0.0
10/2/2013	medium	1	no	0.0	no	0.0
10/7/2013	high	2	no	0.0	no	0.0
10/9/2013	high	2	no	0.0	no	0.0
10/14/2013	low	0	no	0.0	no	0.0
10/15/2013	low	0	no	0.0	no	0.0
10/21/2013	high	2	no	0.0	no	0.0
10/28/2013	high	2	no	0.0	no	0.0
10/29/2013	medium	1	no	0.0	no	0.0
10/30/2013	medium	1	**yes**	**0.5**	no	0.0
10/31/2013	medium	1	no	0.0	no	0.0
11/4/2013	high	2	no	0.0	no	0.0
11/11/2013	high	2	no	0.0	no	0.0
11/13/2013	medium	1	**yes**	**0.5**	no	0.0
11/18/2013	medium	1	no	0.0	no	0.0
11/19/2013	high	2	no	0.0	no	0.0
11/20/2013	high	2	no	0.0	no	0.0
11/25/2013	high	2	no	0.0	no	0.0
12/2/2013	high	2	no	0.0	no	0.0
12/3/2013	high	2	no	0.0	no	0.0
12/9/2013	high	2	no	0.0	no	0.0
12/16/2013	high	2	no	0.0	no	0.0
12/17/2013	high	2	no	0.0	no	0.0
12/18/2013	high	2	no	0.0	no	0.0
12/23/2013	high	2	no	0.0	no	0.0
12/30/2013	medium	1	no	0.0	no	0.0

1/3/2014	high	2	no	0.0	no	0.0
1/6/2014	high	2	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
1/13/2014	high	2	no	0.0	no	0.0
1/14/2014	high	2	no	0.0	no	0.0
1/15/2014	high	2	no	0.0	no	0.0
1/21/2014	high	2	no	0.0	no	0.0
1/27/2014	high	2	no	0.0	no	0.0
1/28/2014	high	2	no	0.0	no	0.0
2/4/2014	high	2	no	0.0	no	0.0
2/10/2014	high	2	no	0.0	no	0.0
2/11/2014	high	2	no	0.0	no	0.0
2/12/2014	high	2	no	0.0	no	0.0
2/18/2014	high	2	no	0.0	no	0.0
2/21/2014	high	2	no	0.0	no	0.0
2/24/2014	high	2	no	0.0	no	0.0
3/3/2014	high	2	no	0.0	no	0.0
3/10/2014	high	2	no	0.0	no	0.0
3/11/2014	high	2	no	0.0	no	0.0
3/12/2014	high	2	no	0.0	no	0.0
3/17/2014	high	2	no	0.0	no	0.0
3/19/2014	high	2	no	0.0	no	0.0
3/20/2014	high	2	no	0.0	no	0.0
3/24/2014	high	2	no	0.0	no	0.0
3/26/2014	high	2	no	0.0	no	0.0
3/27/2014	high	2	no	0.0	no	0.0
3/31/2014	high	2	no	0.0	no	0.0
4/2/2014	high	2	no	0.0	no	0.0
4/7/2014	high	2	no	0.0	no	0.0
4/14/2014	medium	1	no	0.0	no	0.0
4/15/2014	medium	1	no	0.0	no	0.0
4/16/2014	high	2	no	0.0	no	0.0
4/17/2014	high	2	no	0.0	no	0.0
4/21/2014	high	2	no	0.0	no	0.0
4/22/2014	medium	1	no	0.0	no	0.0
4/23/2014	medium	1	no	0.0	no	0.0
4/28/2014	medium	1	no	0.0	no	0.0
4/29/2014	high	2	no	0.0	no	0.0
5/5/2014	high	2	**yes**	**0.5**	no	0.0
5/12/2014	medium	1	no	0.0	no	0.0
5/13/2014	medium	1	no	0.0	no	0.0
5/14/2014	medium	1	no	0.0	no	0.0
5/19/2014	high	2	no	0.0	no	0.0
5/20/2014	high	2	no	0.0	no	0.0
5/21/2014	medium	1	no	0.0	no	0.0

Date	Tide		Warehouse Area		Loading Rack Area	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)
5/27/2014	low	0	no	0.0	no	0.0
6/2/2014	high	2	no	0.0	no	0.0
6/9/2014	low	0	no	0.0	no	0.0
6/10/2014	medium	1	no	0.0	no	0.0
6/16/2014	high	2	no	0.0	no	0.0
6/17/2014	high	2	no	0.0	no	0.0
6/18/2014	high	2	no	0.0	no	0.0
6/23/2014	low	0	no	0.0	no	0.0
6/24/2014	low	0	**yes**	**1.0**	no	0.0
6/30/2014	high	2	no	0.0	no	0.0
7/72014	medium	1	no	0.0	no	0.0
7/8/2014	medium	1	no	0.0	no	0.0
7/14/2014	high	2	no	0.0	no	0.0
7/15/2014	high	2	no	0.0	no	0.0
7/21/2014	low	0	no	0.0	no	0.0
7/25/2014	medium	1	no	0.0	no	0.0
7/28/2014	high	2	no	0.0	no	0.0
7/30/2014	low	0	no	0.0	no	0.0
8/4/2014	medium	1	no	0.0	no	0.0
8/11/2014	medium	1	no	0.0	no	0.0
8/12/2014	high	2	no	0.0	no	0.0
8/13/2014	high	2	no	0.0	no	0.0
8/18/2014	low	0	no	0.0	no	0.0
8/20/2014	medium	1	no	0.0	no	0.0
8/25/2014	high	2	no	0.0	no	0.0
9/2/2014	low	0	no	0.0	no	0.0
9/8/2014	medium	1	no	0.0	no	0.0
9/9/2014	high	2	no	0.0	no	0.0
9/10/2014	high	2	no	0.0	no	0.0
9/16/2014	medium	1	no	0.0	no	0.0
9/17/2014	medium	1	no	0.0	no	0.0
9/22/2014	medium	1	no	0.0	no	0.0
9/29/2014	high	2	no	0.0	no	0.0
10/6/2014	medium	1	no	0.0	no	0.0
10/9/2014	high	2	no	0.0	no	0.0
10/14/2014	high	2	no	0.0	no	0.0
10/15/2014	high	2	no	0.0	no	0.0

Date	**Tide**		**Warehouse Area**		**Loading Rack Area**	
	Status (low, Medium, high, ebb, flood)	Measurement	Sheen (yes or No)	Appearance of Sheen (See Note)	Sheen (yes or No)	Appearance of Sheen (See Note)

Notes:
* Sheen Appearance is rated from 0.0 to 3.0 using criteria below;
0.0 No sheen present
1.0 Light sheen visible in one location
2.0 Sheen visible in several locations and is brightly colored
3.0 Sheen covers large areas of boom and is outside boom and/or is thick dark liquid floating on surface

** Tide Level is rated from 0.0 to 4.0 using the criteria below;
0.0 Low Tide
1.0 Medium Tide
2.0 High Tide
3.0 Ebb Tide
4.0 Flood Stage

on* North of warehouse wells were not operational

Figure 11. **2013 Sheen Observations - Warehouse**
BP West Coast Products Terminal 21T, Harbor Island, Seattle

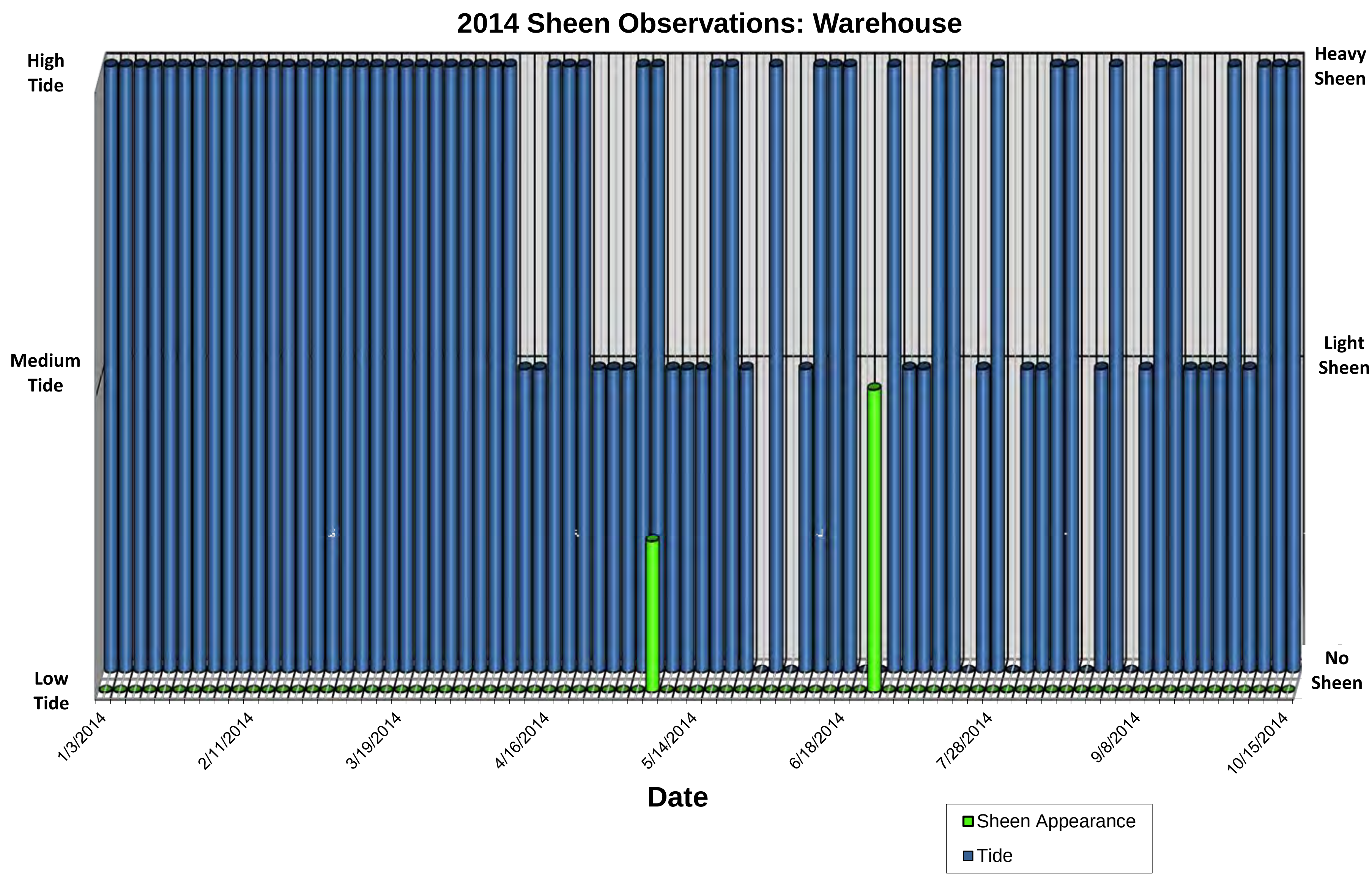


Figure 10. **2013 Sheen Observations - Loading Rack**
BP West Coast Products Terminal 21T, Harbor Island, Seattle

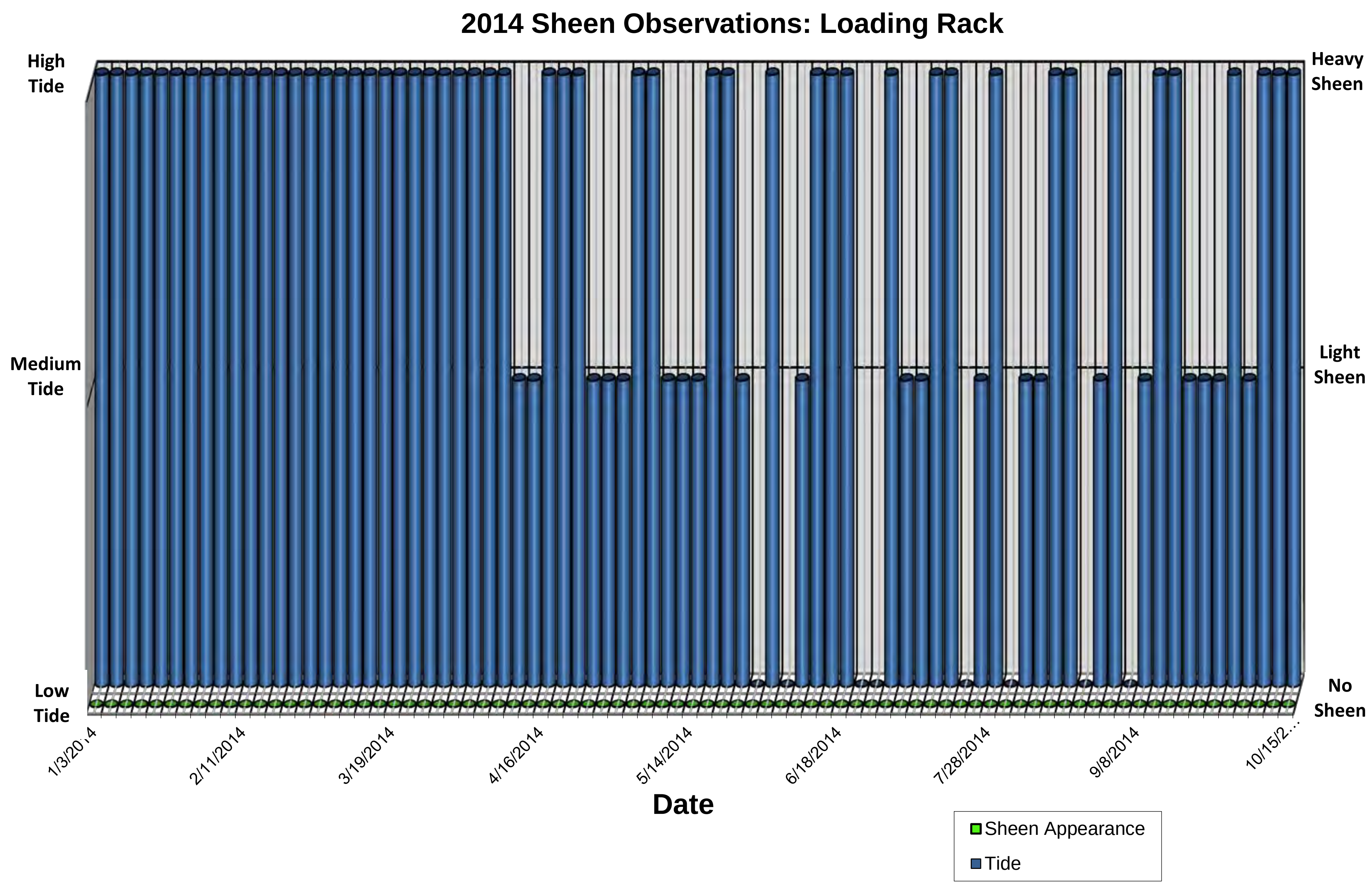


Figure 11. **2013 Sheen Observations - Warehouse**
BP West Coast Products Terminal 21T, Harbor Island, Seattle

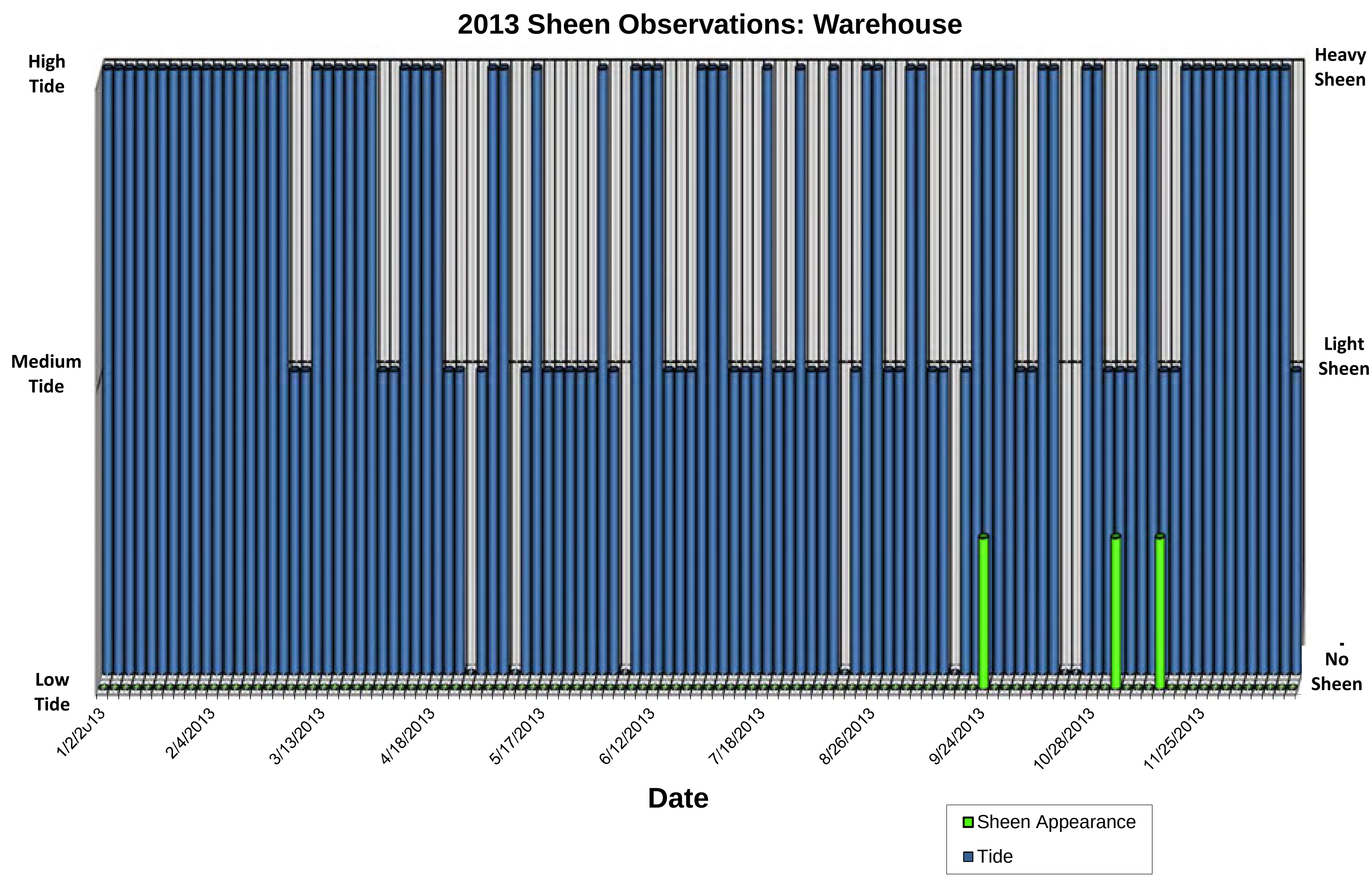
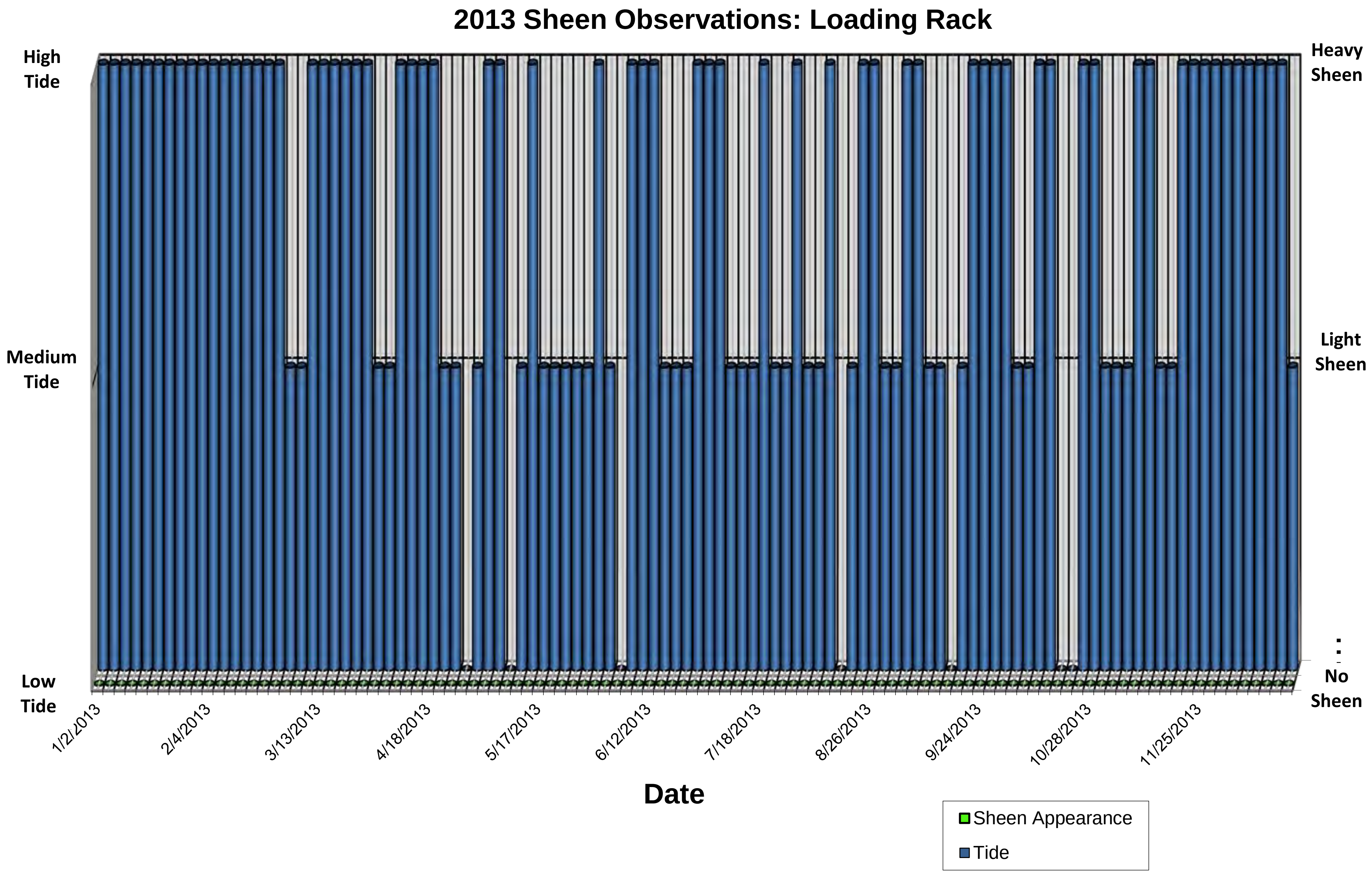
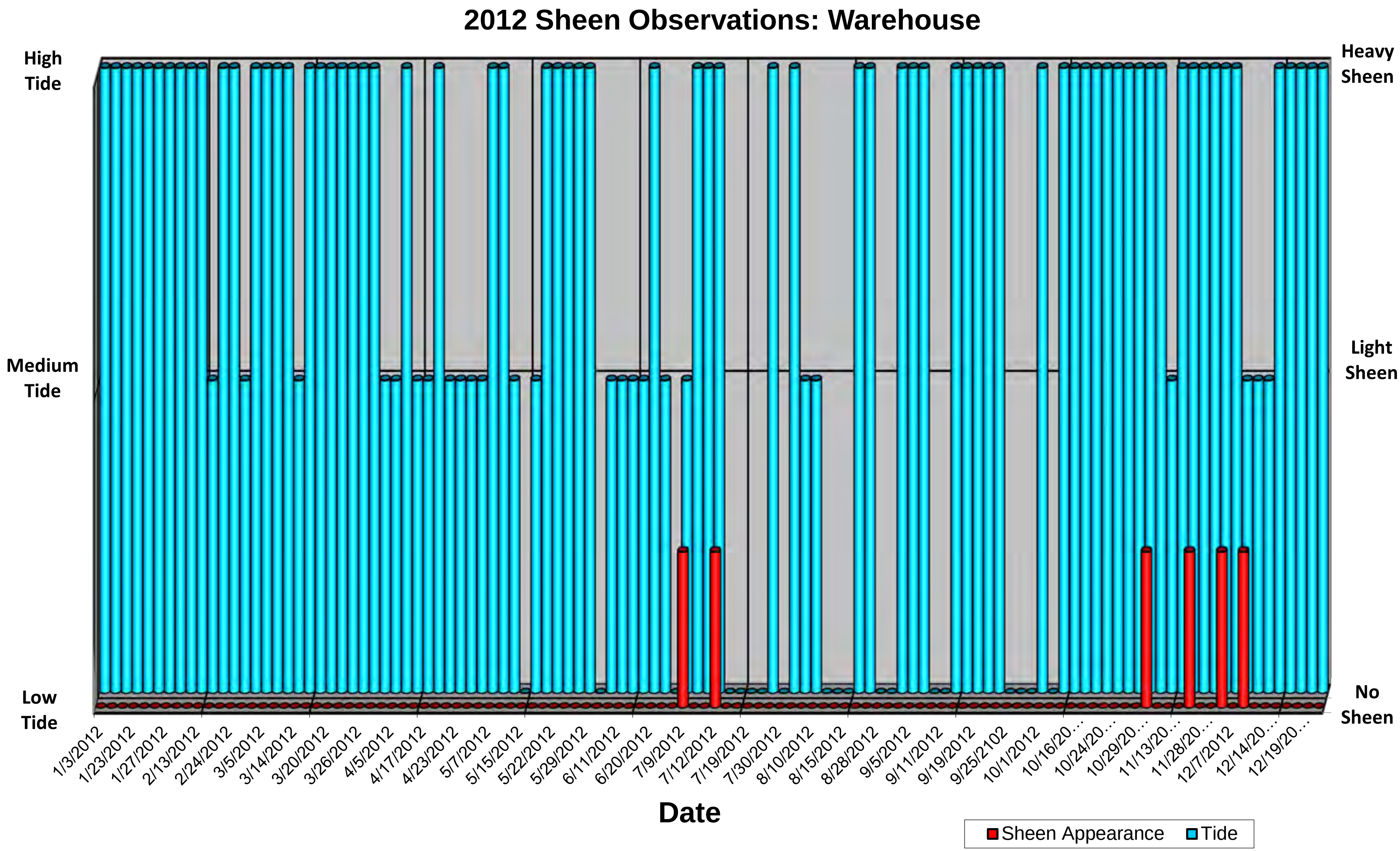
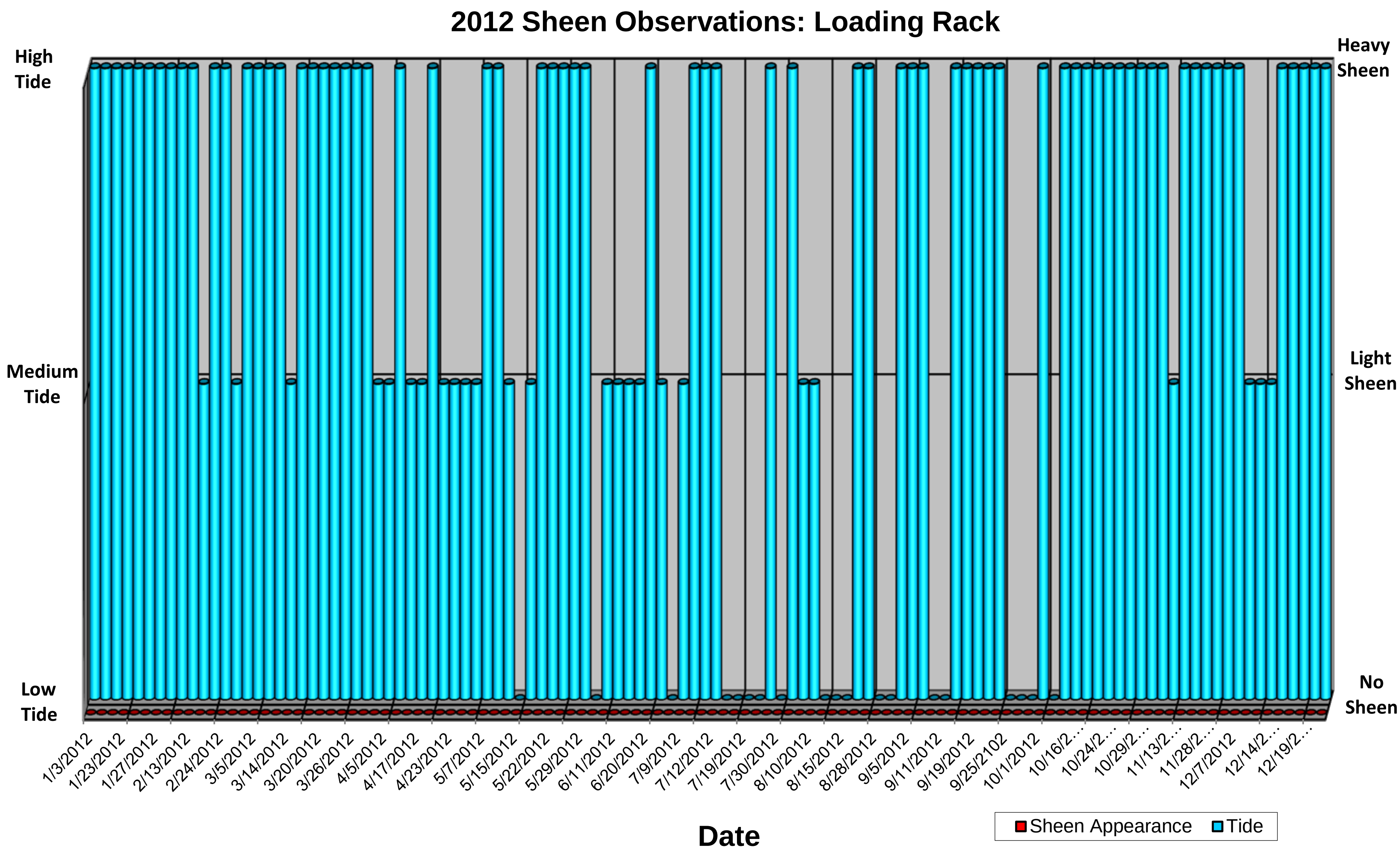


Figure 10. **2013 Sheen Observations - Loading Rack**
BP West Coast Products Terminal 21T, Harbor Island, Seattle

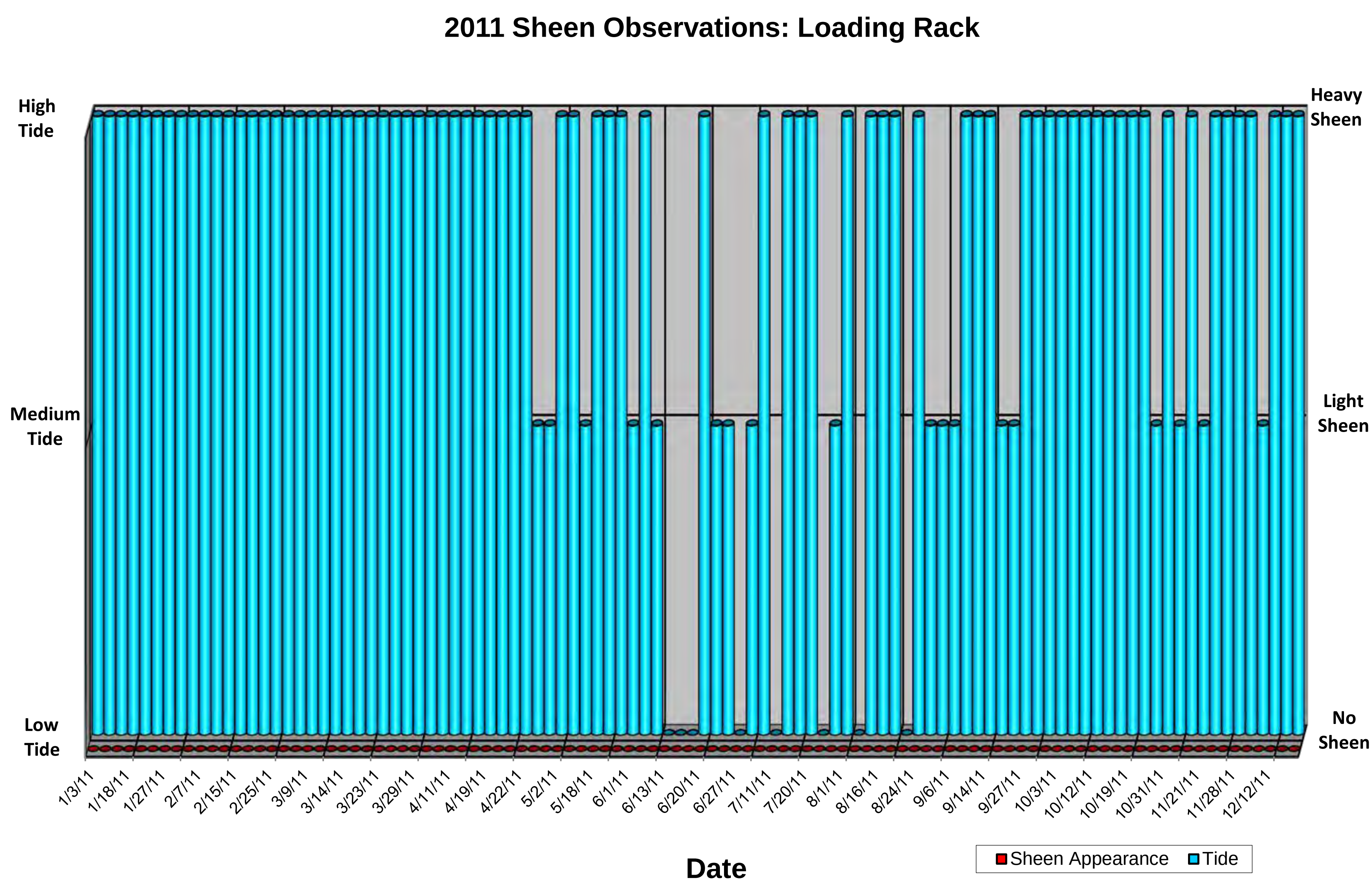




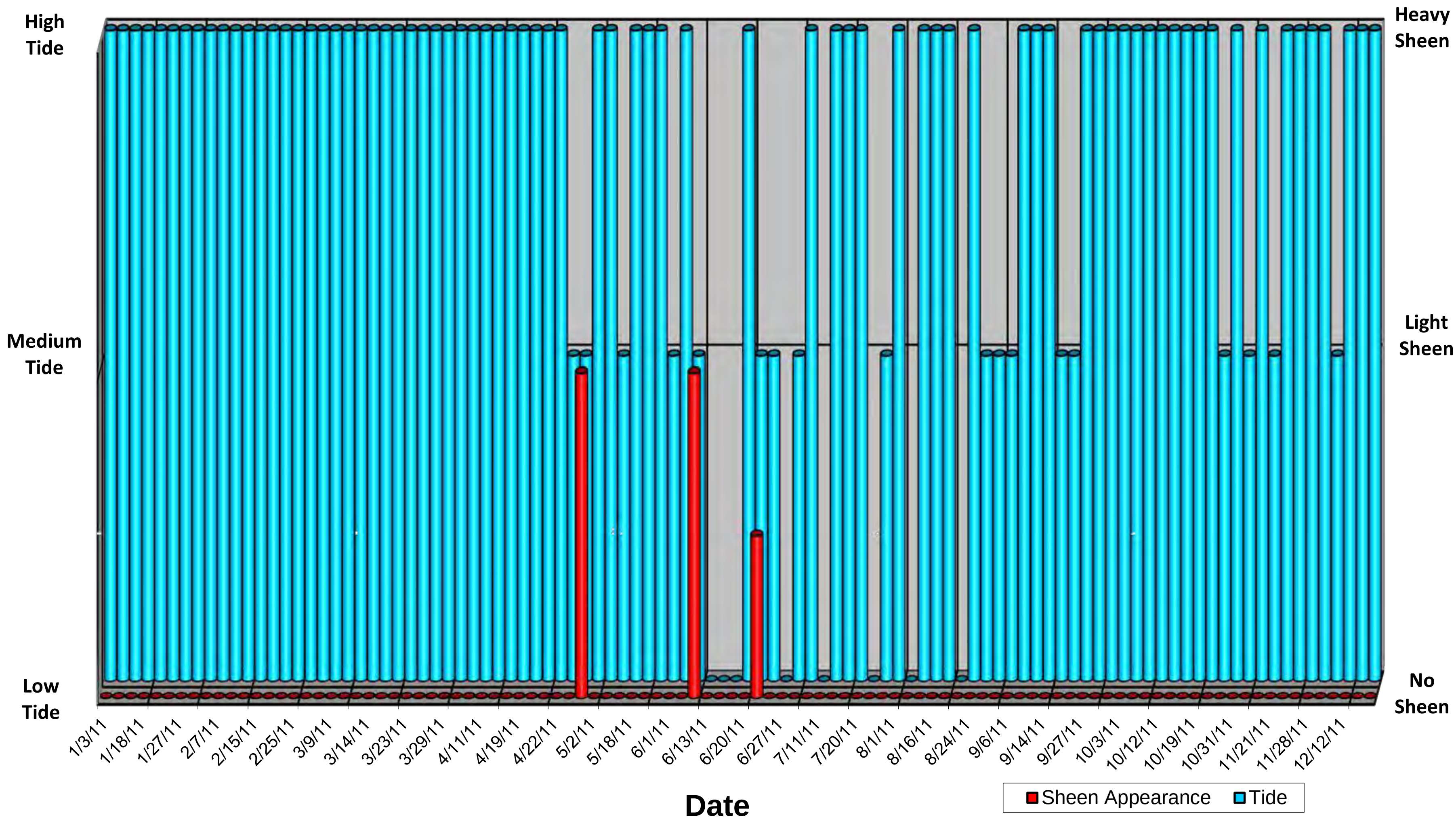
2012 Sheen Observations: Warehouse
High Tide
Medium Tide
Low Tide
Heavy Sheen
Light Sheen
No Sheen
1/3/2012
1/23/2012
1/27/2012
2/13/2012
2/24/2012
3/5/2012
3/14/2012
3/20/2012
3/26/2012
4/5/2012
4/17/2012
4/23/2012
5/7/2012
5/15/2012
5/22/2012
5/29/2012
6/11/2012
6/20/2012
7/9/2012
7/12/2012
7/19/2012
7/30/2012
8/10/2012
8/15/2012
8/28/2012
9/5/2012
9/11/2012
9/19/2012
9/25/2102
10/1/2012
10/16/20…
10/24/20…
10/29/20…
11/13/20…
11/28/20…
12/7/2012
12/14/20…
12/19/20…
Date
Sheen Appearance
Tide



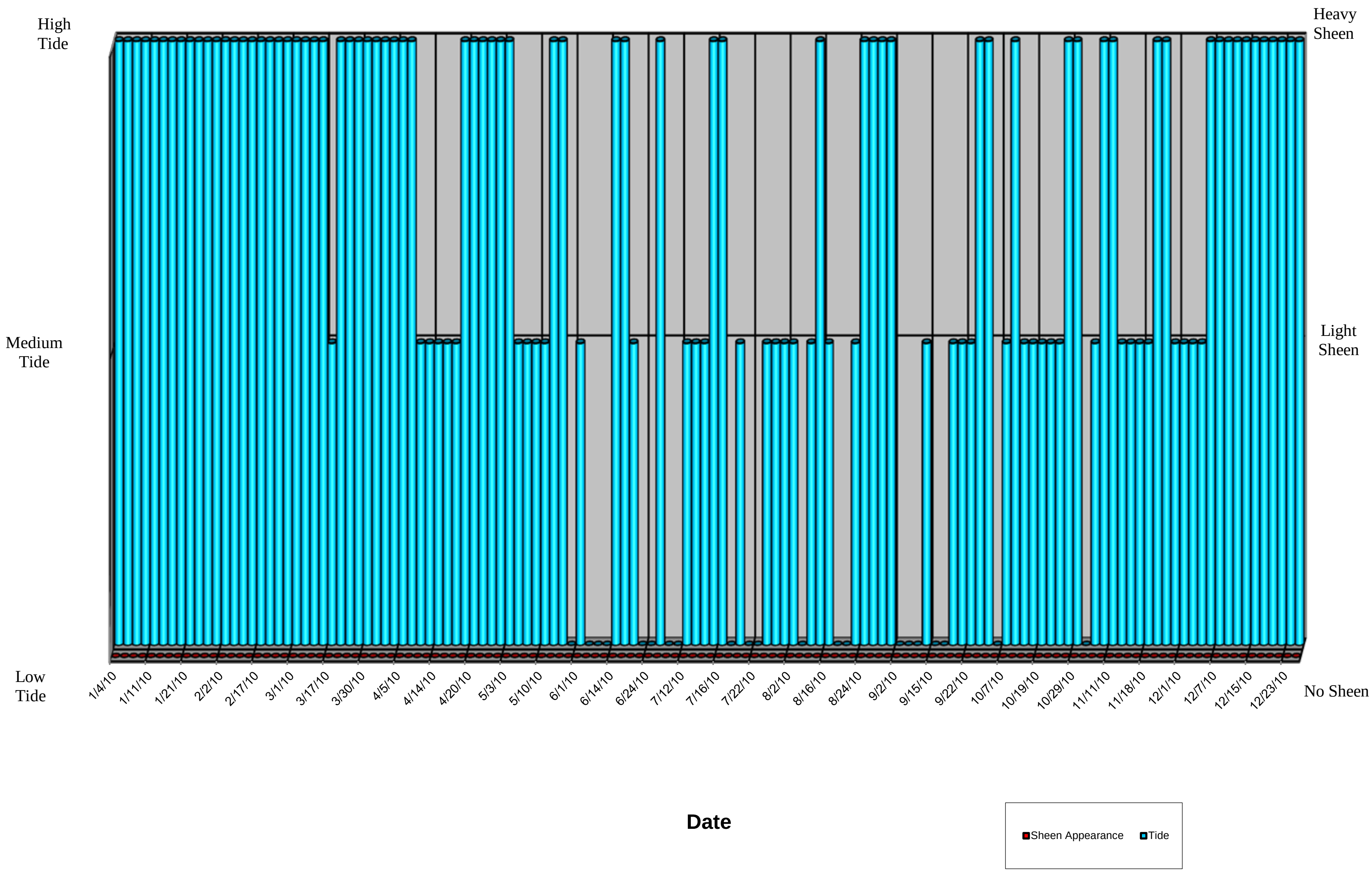
2012 Sheen Observations: Loading Rack
High Tide
Medium Tide
Low Tide
Heavy Sheen
Light Sheen
No Sheen
1/3/2012
1/23/2012
1/27/2012
2/13/2012
2/24/2012
3/5/2012
3/14/2012
3/20/2012
3/26/2012
4/5/2012
4/17/2012
4/23/2012
5/7/2012
5/15/2012
5/22/2012
5/29/2012
6/11/2012
6/20/2012
7/9/2012
7/12/2012
7/19/2012
7/30/2012
8/10/2012
8/15/2012
8/28/2012
9/5/2012
9/11/2012
9/19/2012
9/25/2102
10/1/2012
10/16/2…
10/24/2…
10/29/2…
11/13/2…
11/28/2…
12/7/2012
12/14/2…
12/19/2…
Date
Sheen Appearance
Tide

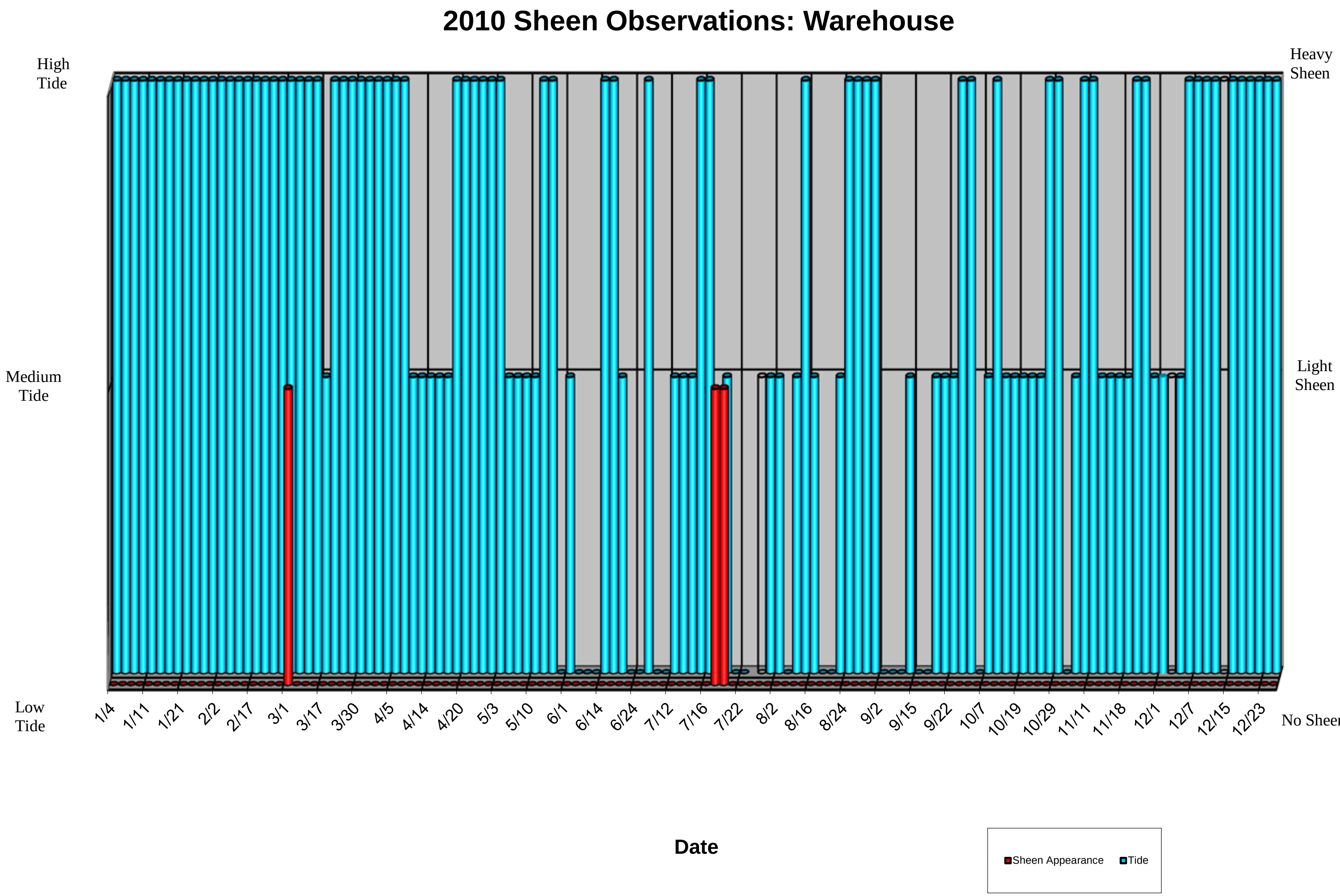

2011 Sheen Observations: Loading Rack
High Tide
Medium Tide
Low Tide
Heavy Sheen
Light Sheen
No Sheen
1/3/11
1/18/11
1/27/11
2/7/11
2/15/11
2/25/11
3/9/11
3/14/11
3/23/11
3/29/11
4/11/11
4/19/11
4/22/11
5/2/11
5/18/11
6/1/11
6/13/11
6/20/11
6/27/11
7/11/11
7/20/11
8/1/11
8/16/11
8/24/11
9/6/11
9/14/11
9/27/11
10/3/11
10/12/11
10/19/11
10/31/11
11/21/11
11/28/11
12/12/11
Date
Sheen Appearance
Tide

2011 Sheen Observations: Warehouse

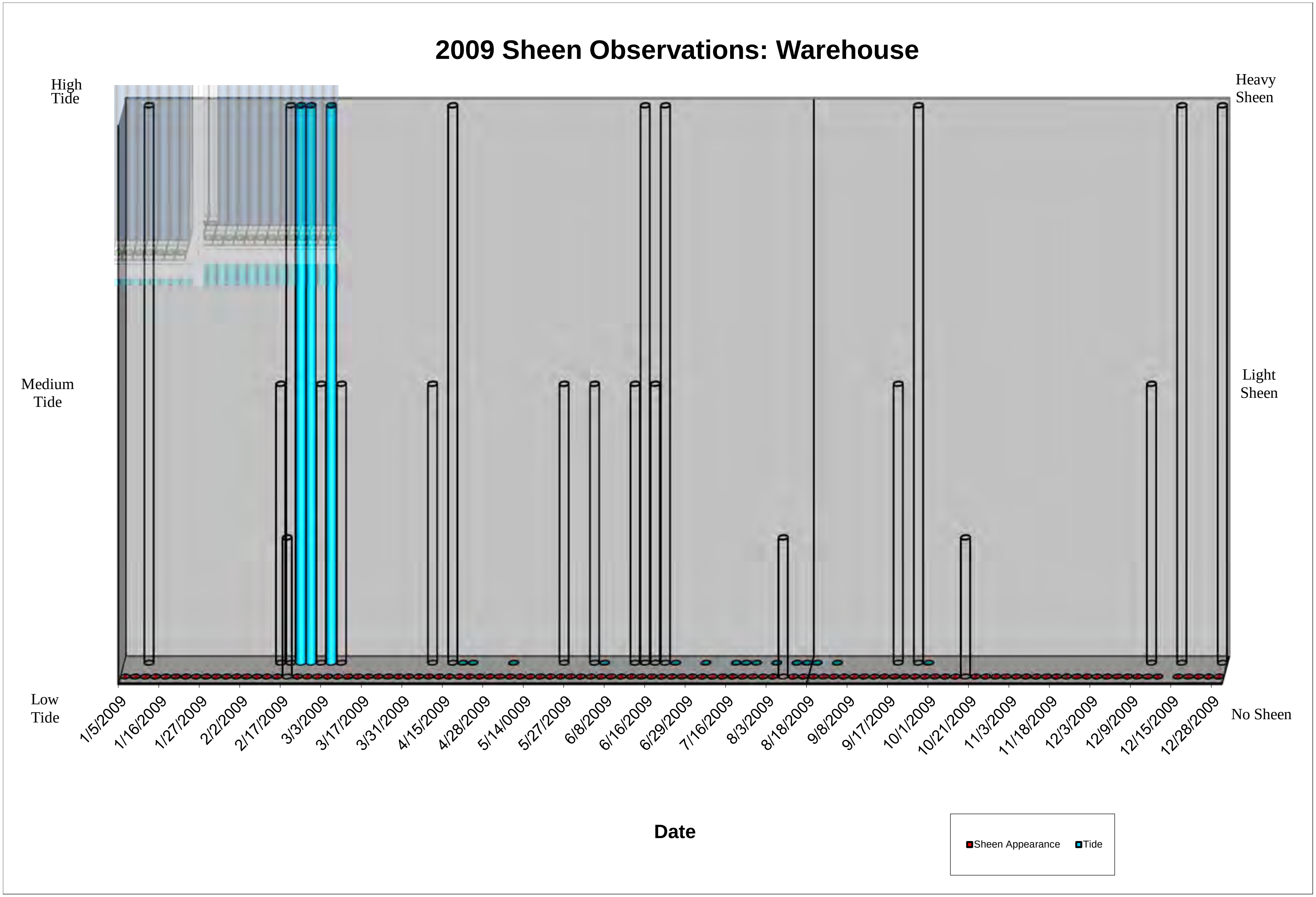


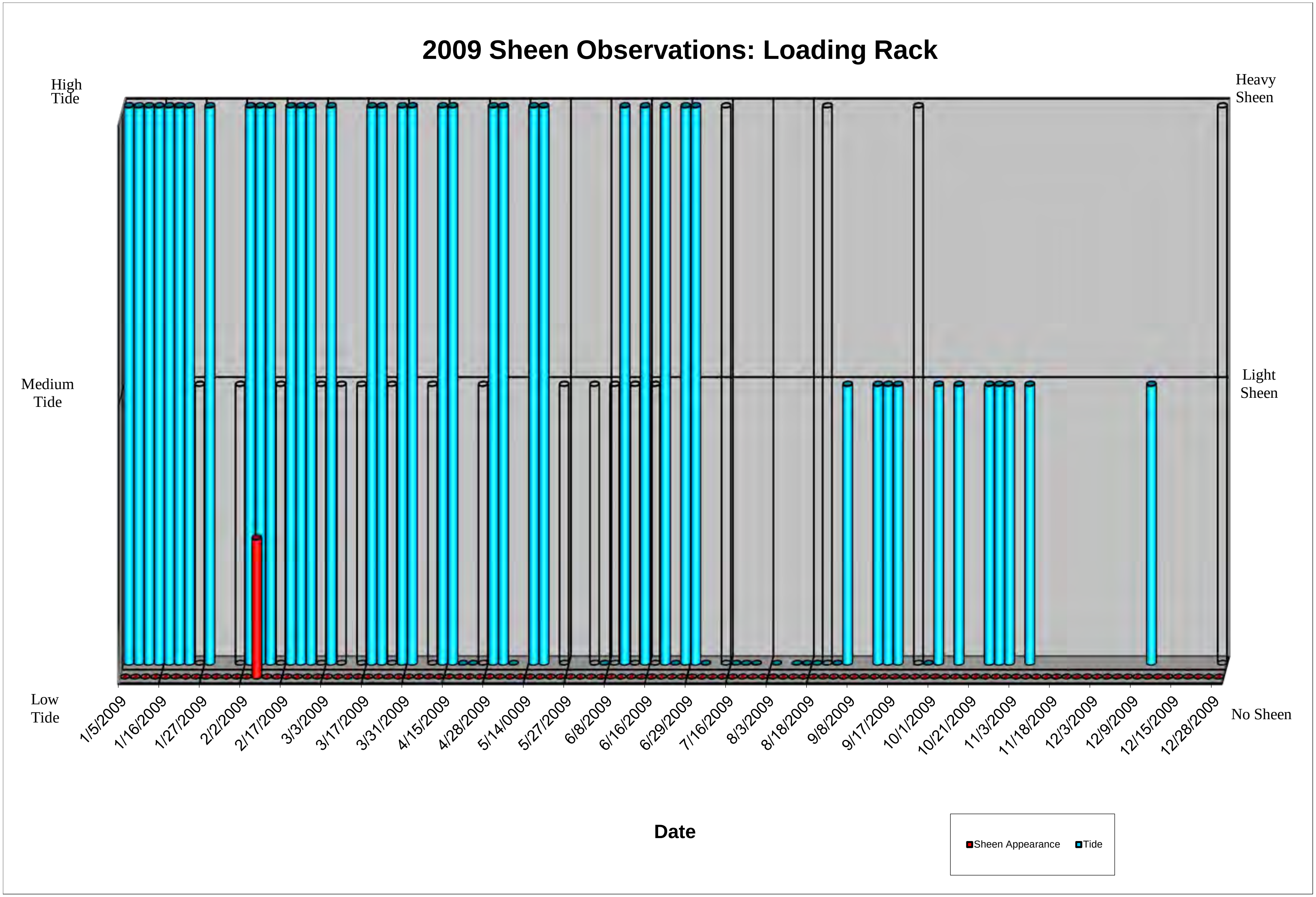
2010 Sheen Observations: Loading Rack



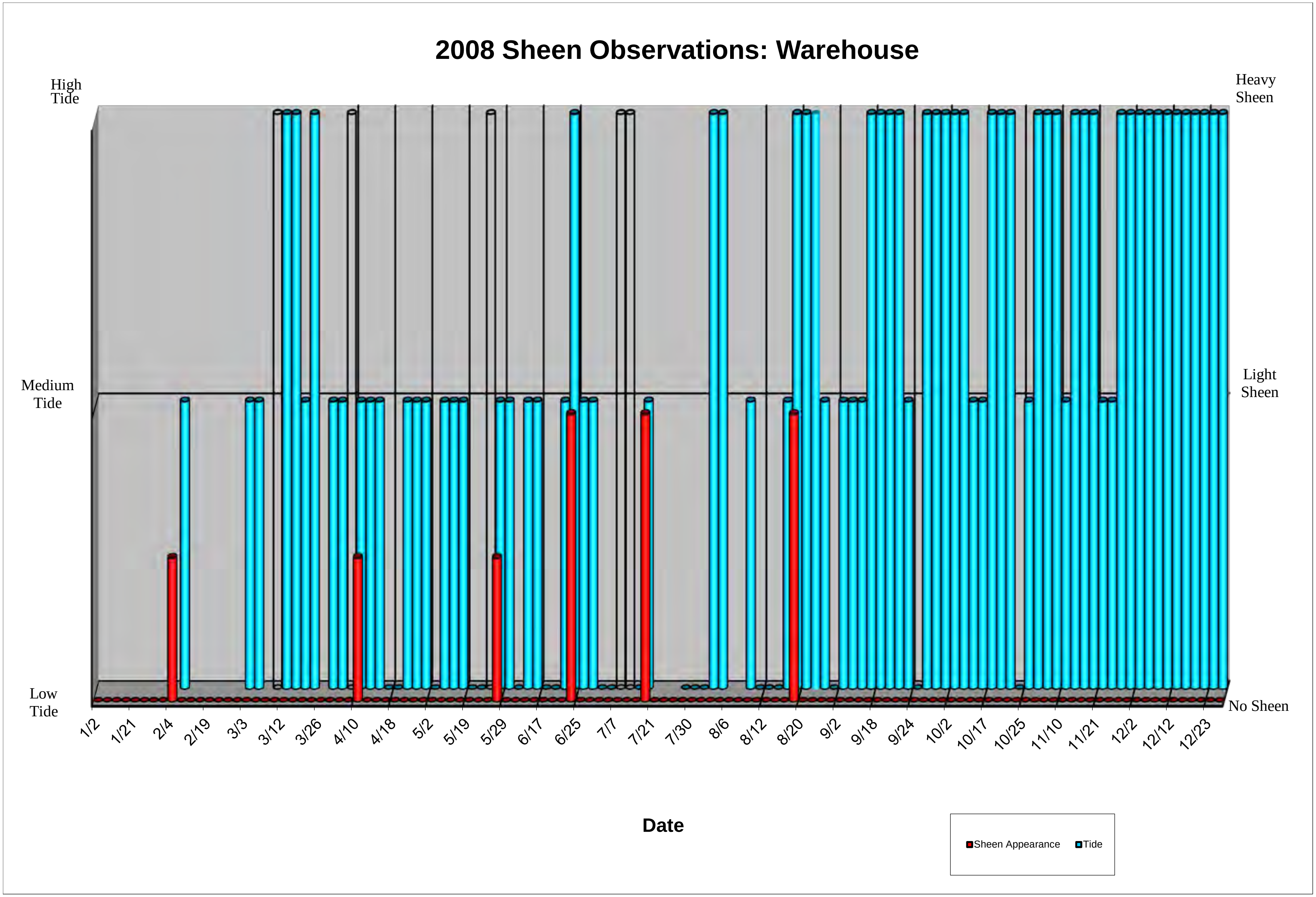


2010 Sheen Observations: Warehouse
High Tide
Medium Tide
Low Tide
Heavy Sheen
Light Sheen
No Sheen
1/4
1/11
1/21
2/2
2/17
3/1
3/17
3/30
4/5
4/14
4/20
5/3
5/10
6/1
6/14
6/24
7/12
7/16
7/22
8/2
8/16
8/24
9/2
9/15
9/22
10/7
10/19
10/29
11/11
11/18
12/1
12/7
12/15
12/23
Date
Sheen Appearance
Tide

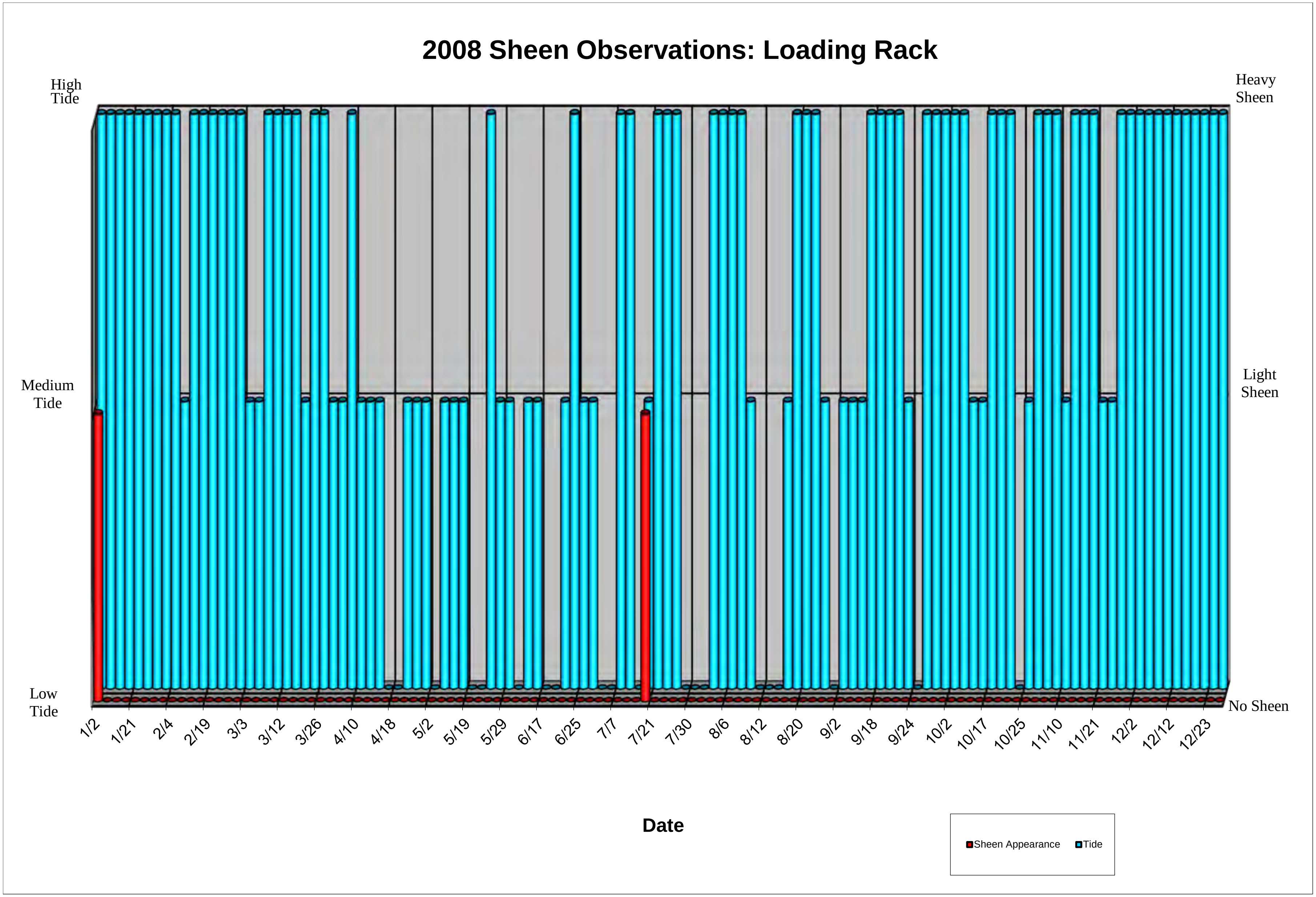

2009 Sheen Observations: Warehouse
High Tide
Medium Tide
Low Tide
Heavy Sheen
Light Sheen
No Sheen
1/5/2009
1/16/2009
1/27/2009
2/2/2009
2/17/2009
3/3/2009
3/17/2009
3/31/2009
4/15/2009
4/28/2009
5/14/0009
5/27/2009
6/8/2009
6/16/2009
6/29/2009
7/16/2009
8/3/2009
8/18/2009
9/8/2009
9/17/2009
10/1/2009
10/21/2009
11/3/2009
11/18/2009
12/3/2009
12/9/2009
12/15/2009
12/28/2009
Date
Sheen Appearance
Tide



2009 Sheen Observations: Loading Rack
High Tide
Medium Tide
Low Tide
Heavy Sheen
Light Sheen
No Sheen
1/5/2009
1/16/2009
1/27/2009
2/2/2009
2/17/2009
3/3/2009
3/17/2009
3/31/2009
4/15/2009
4/28/2009
5/14/0009
5/27/2009
6/8/2009
6/16/2009
6/29/2009
7/16/2009
8/3/2009
8/18/2009
9/8/2009
9/17/2009
10/1/2009
10/21/2009
11/3/2009
11/18/2009
12/3/2009
12/9/2009
12/15/2009
12/28/2009
Date
Sheen Appearance
Tide

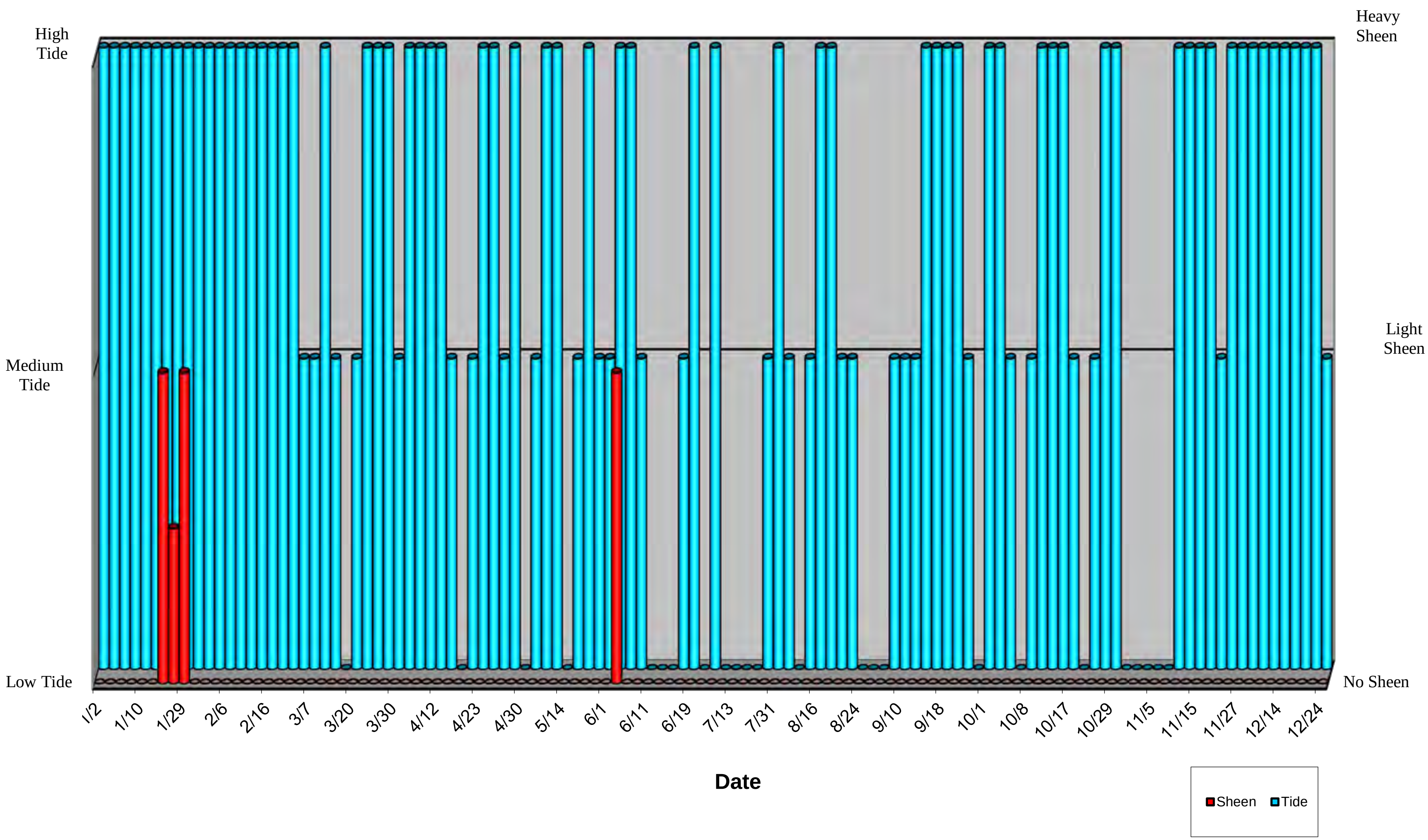


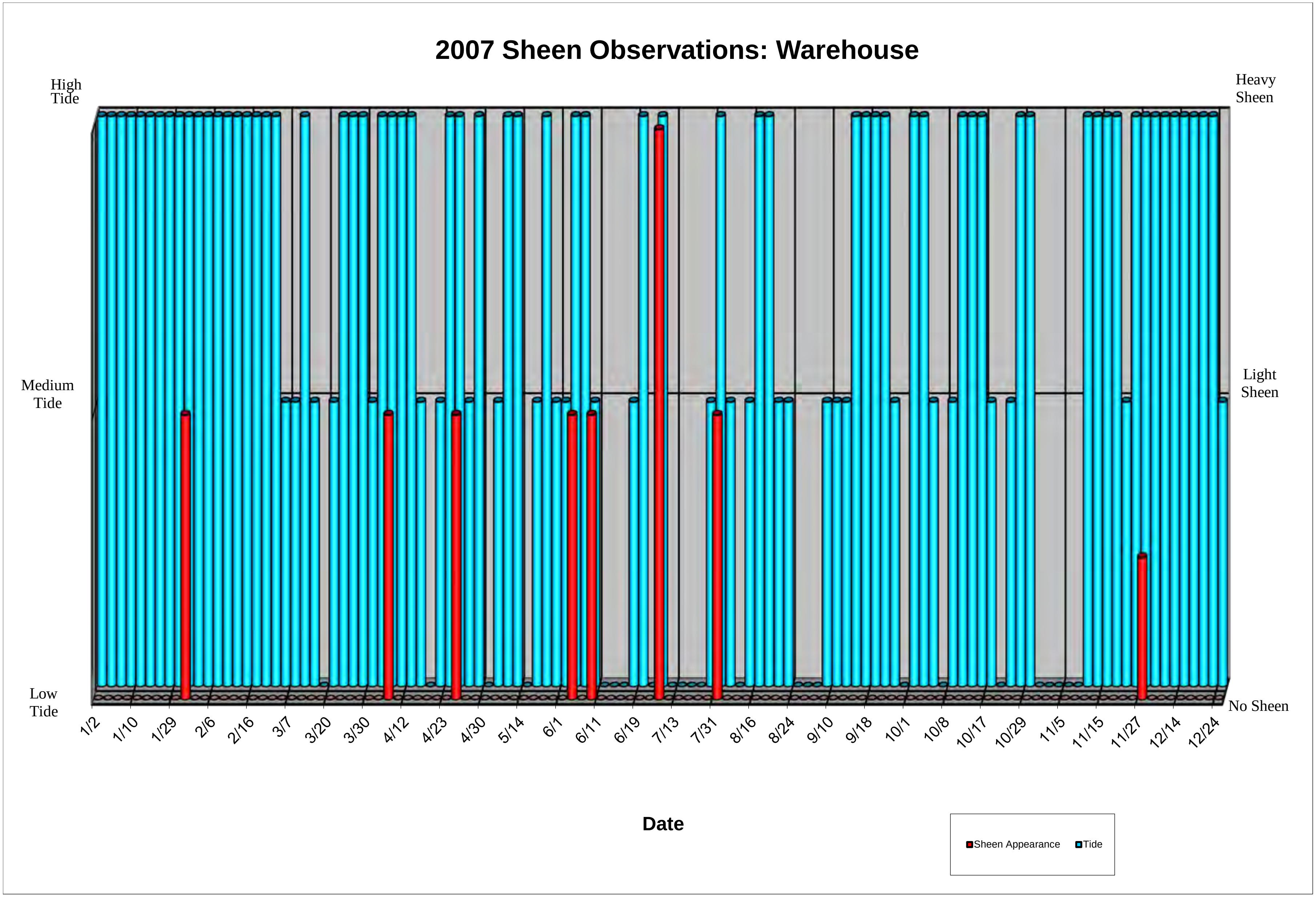
2008 Sheen Observations: Warehouse
High Tide
Medium Tide
Low Tide
Heavy Sheen
Light Sheen
No Sheen
1/2
1/21
2/4
2/19
3/3
3/12
3/26
4/10
4/18
5/2
5/19
5/29
6/17
6/25
7/7
7/21
7/30
8/6
8/12
8/20
9/2
9/18
9/24
10/2
10/17
10/25
11/10
11/21
12/2
12/12
12/23
Date
Sheen Appearance
Tide



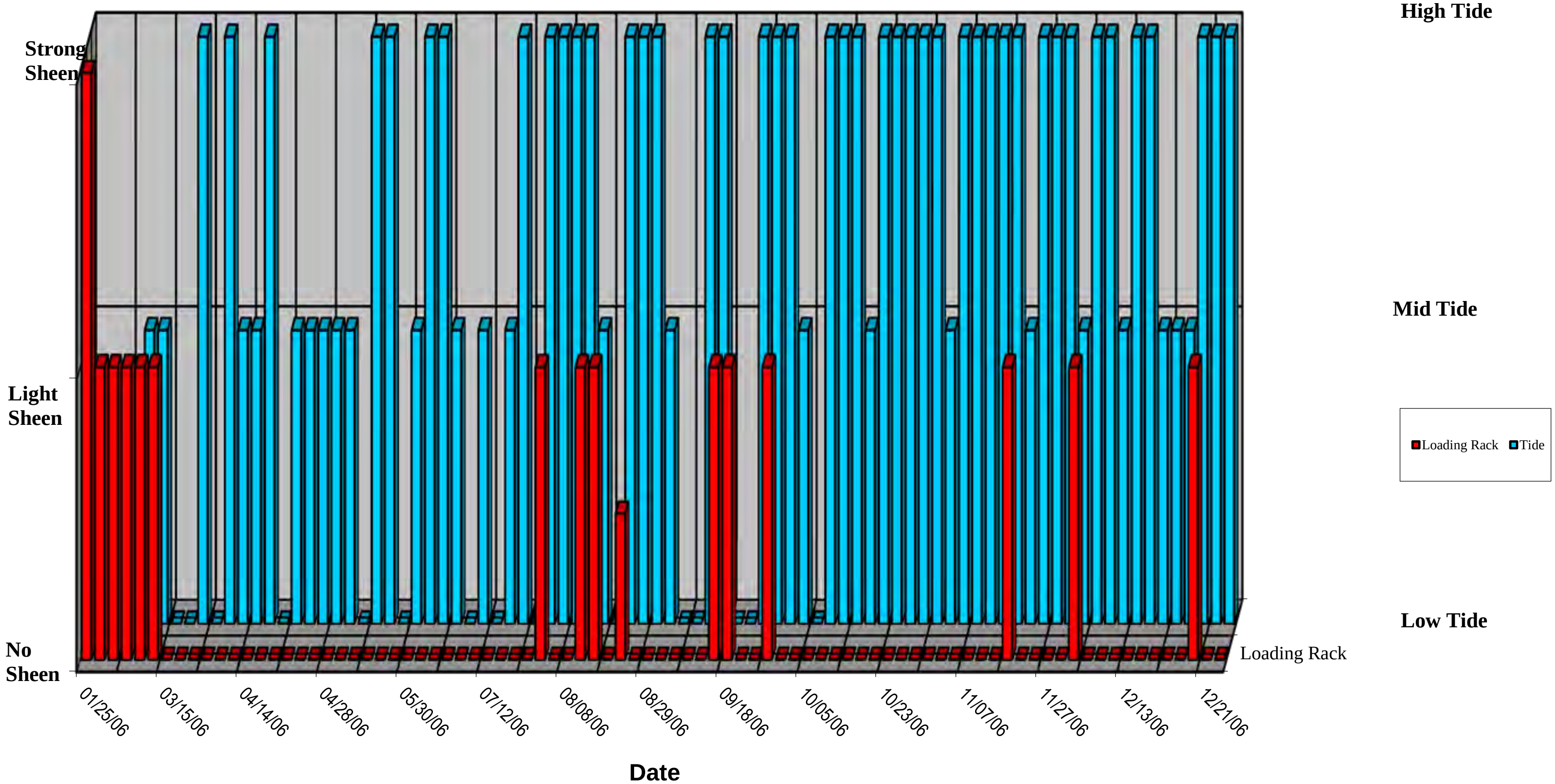
2008 Sheen Observations: Loading Rack
High Tide
Medium Tide
Low Tide
Heavy Sheen
Light Sheen
No Sheen
1/2
1/21
2/4
2/19
3/3
3/12
3/26
4/10
4/18
5/2
5/19
5/29
6/17
6/25
7/7
7/21
7/30
8/6
8/12
8/20
9/2
9/18
9/24
10/2
10/17
10/25
11/10
11/21
12/2
12/12
12/23
Date
Sheen Appearance
Tide

2007 Sheen Observations: Loading Rack

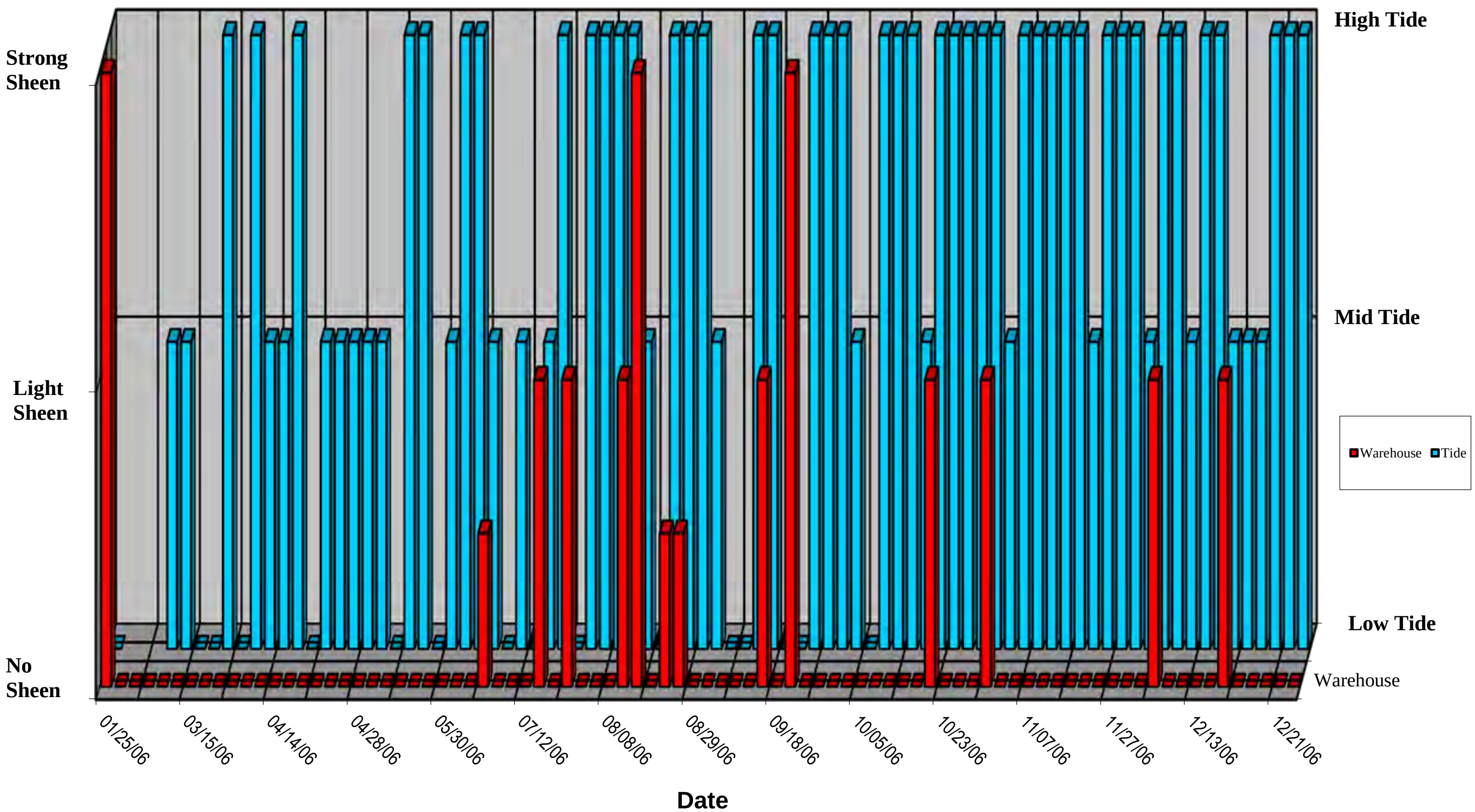


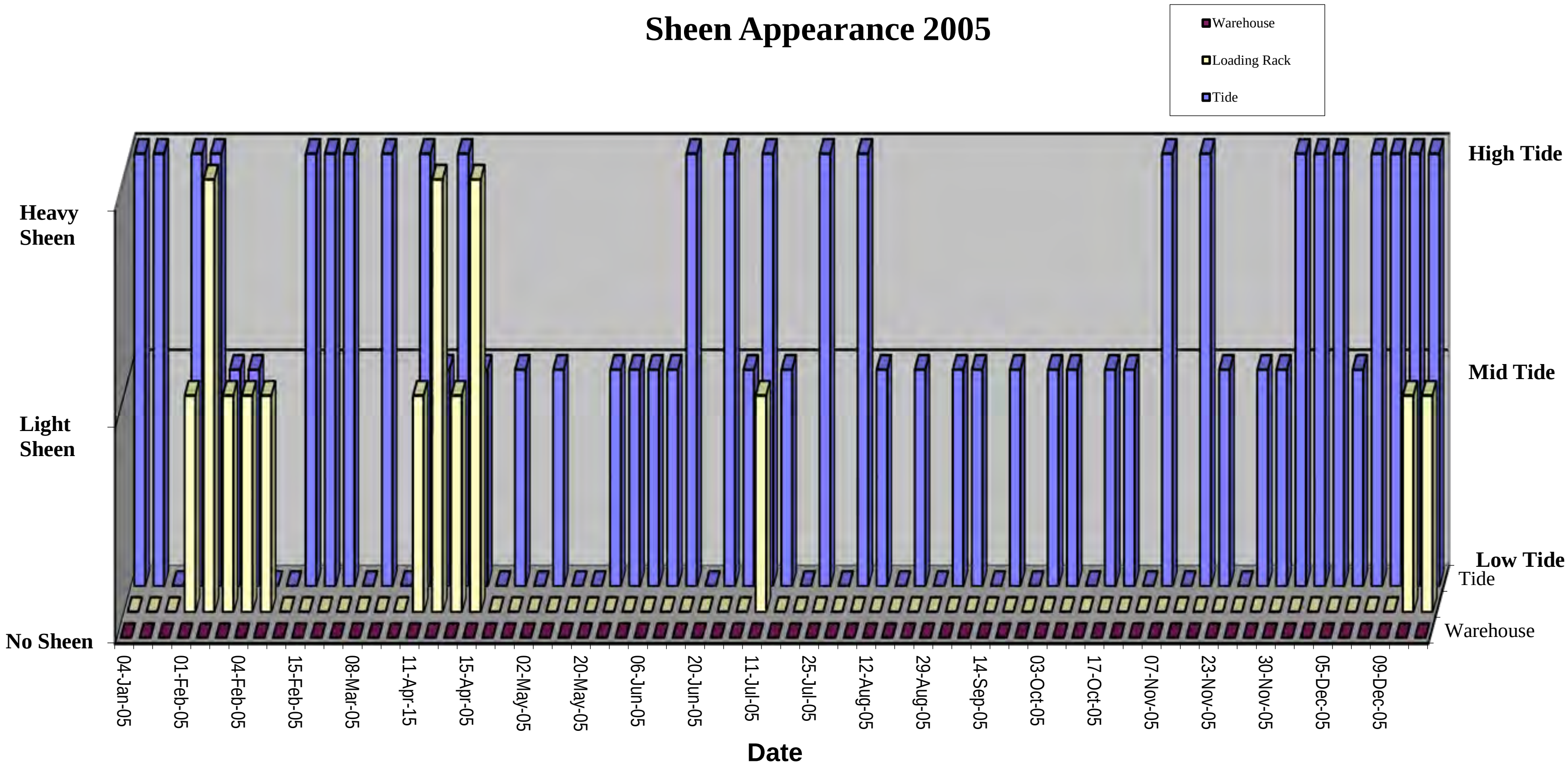

2007 Sheen Observations: Warehouse
High Tide
Medium Tide
Low Tide
Heavy Sheen
Light Sheen
No Sheen
1/2
1/10
1/29
2/6
2/16
3/7
3/20
3/30
4/12
4/23
4/30
5/14
6/1
6/11
6/19
7/13
7/31
8/16
8/24
9/10
9/18
10/1
10/8
10/17
10/29
11/5
11/15
11/27
12/14
12/24
Date
Sheen Appearance
Tide

Sheen Appearance 2006



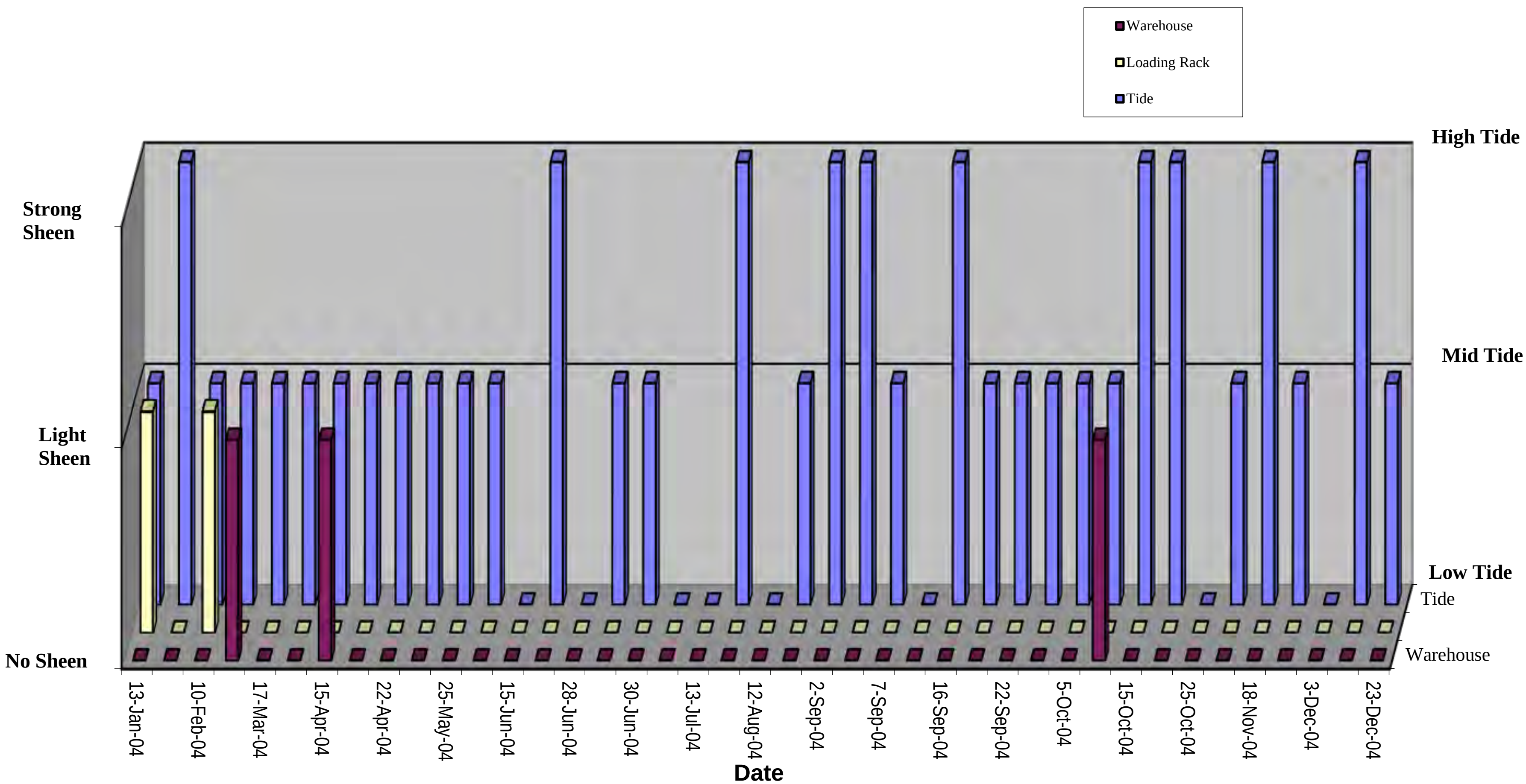
Sheen Appearance 2006

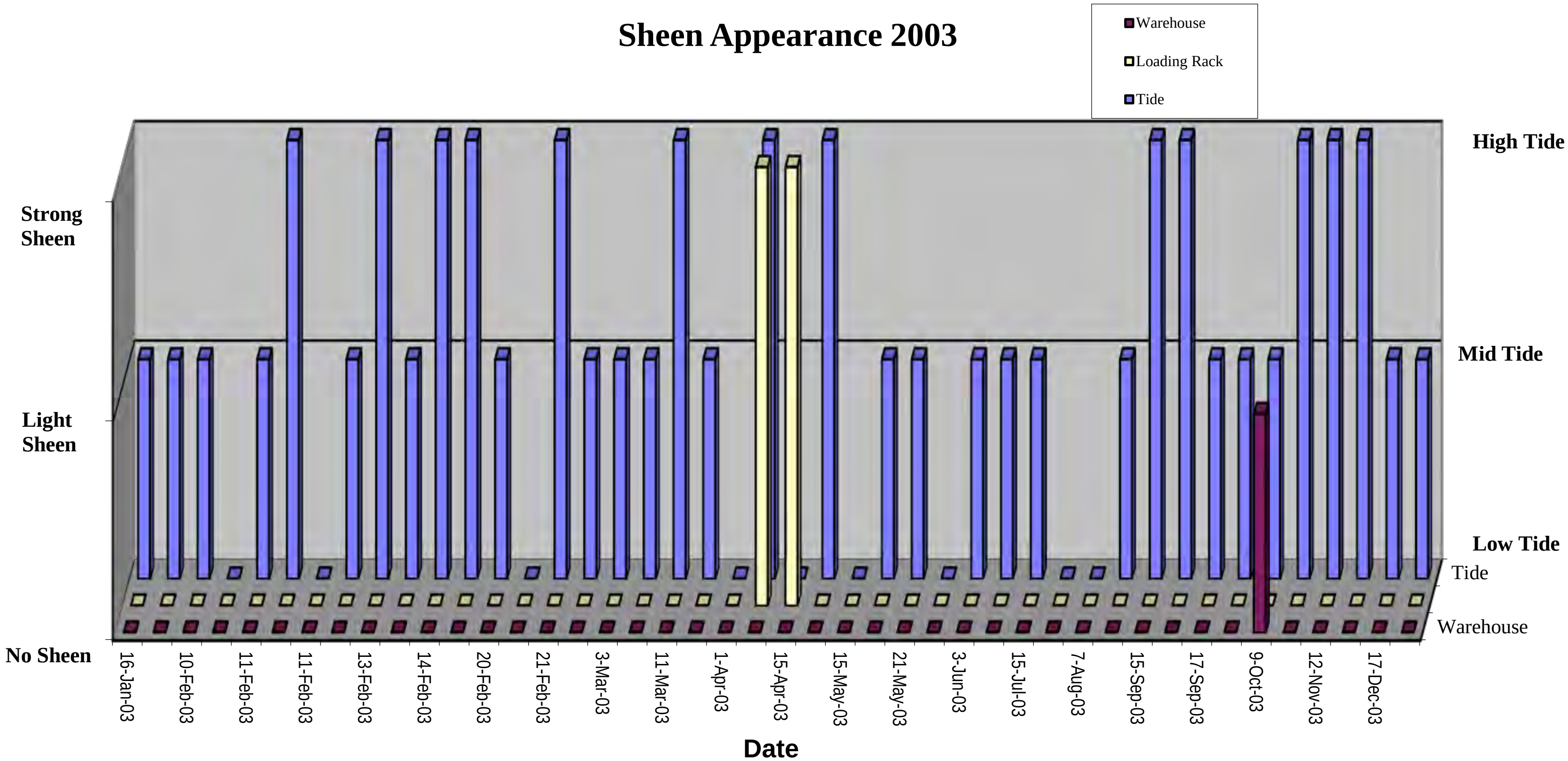




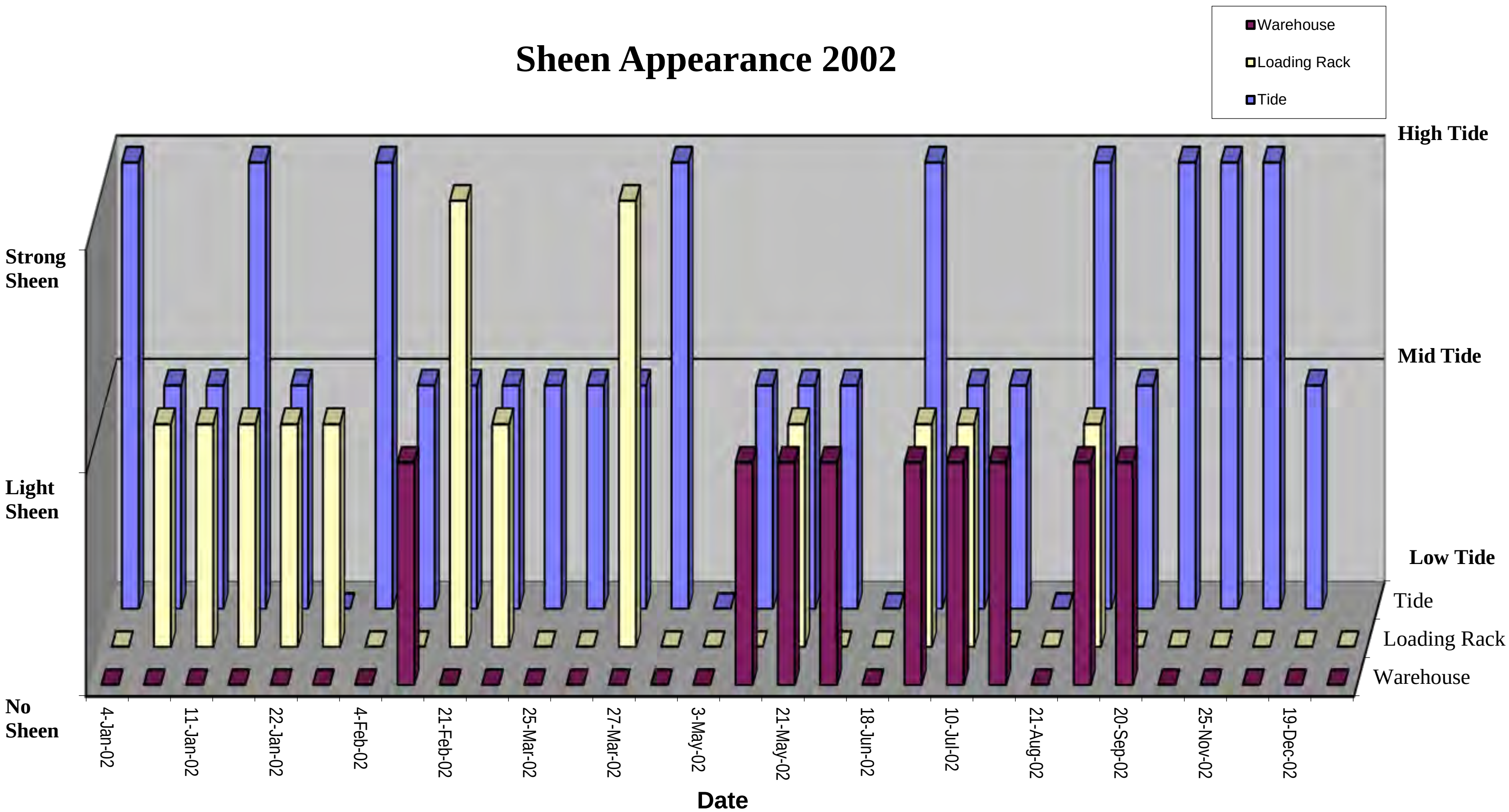
Sheen Appearance 2005
Warehouse
Loading Rack
Tide
Heavy Sheen
Light Sheen
No Sheen
High Tide
Mid Tide
Low Tide
Tide
Warehouse
04-Jan-05
01-Feb-05
04-Feb-05
15-Feb-05
08-Mar-05
11-Apr-15
15-Apr-05
02-May-05
20-May-05
06-Jun-05
20-Jun-05
11-Jul-05
25-Jul-05
12-Aug-05
29-Aug-05
14-Sep-05
03-Oct-05
17-Oct-05
07-Nov-05
23-Nov-05
30-Nov-05
05-Dec-05
09-Dec-05
Date

Sheen Appearance 2004

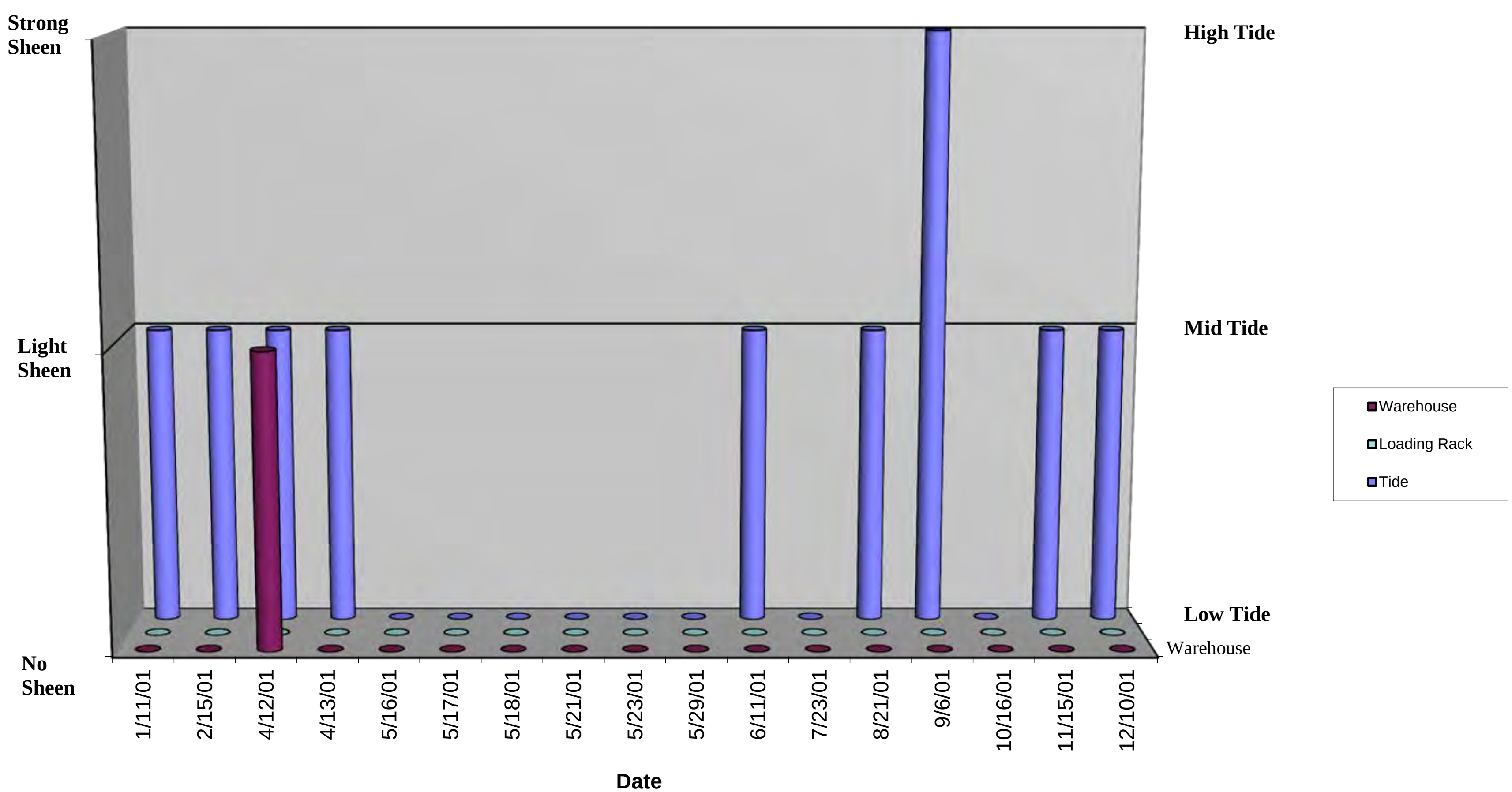



Sheen Appearance 2003
Warehouse
Loading Rack
Tide
Strong Sheen
Light Sheen
No Sheen
High Tide
Mid Tide
Low Tide
Tide
Warehouse
16-Jan-03
10-Feb-03
11-Feb-03
11-Feb-03
13-Feb-03
14-Feb-03
20-Feb-03
21-Feb-03
3-Mar-03
11-Mar-03
1-Apr-03
15-Apr-03
15-May-03
21-May-03
3-Jun-03
15-Jul-03
7-Aug-03
15-Sep-03
17-Sep-03
9-Oct-03
12-Nov-03
17-Dec-03
Date

Sheen Appearance 2002



Sheen Appearance 2001



Sheen Appearance 2000