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Prepared for:
The BNSF Railway Company
Seattle, Washington

Annual Site-Wide Groundwater Monitoring Report

Former Fueling and Maintenance Facility – Skykomish, Washington

The RETEC Group, Inc.
January 2008
Document No.: 01140-204-0340

Merged with ENSR in 2007
RETEC

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Prepared by Krystle L. Nichols, Hydrogeologist

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Reviewed by Stephen Howard, Project Manager

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1.0 Introduction

This Site-Wide Groundwater Monitoring Report (report) has been prepared on behalf of the BNSF Railway Company (BNSF), in accordance with Section VI.A.6. of Consent Decree No. 07-2-33672-9SEA and the *Groundwater Monitoring Plan* (Plan; RETEC, 2005a and 2007) and describes the details and results of the site-wide groundwater monitoring activities performed during 2006 and the first three quarters of 2007.

1.1 Groundwater Monitoring Objectives

The Groundwater Monitoring Plan is intended to meet the following objectives:

- Monitor any changes in contaminant distribution pending implementation of the cleanup actions throughout the Site.
- Provide monitoring data for the groundwater in the levee zone to assess the impact of the interim cleanup of the levee zone on groundwater quality.

1.2 Background

The Site includes BNSF property and adjacent property and encompasses an area of about 40 acres (Figures 1-1 and 1-2). The approximate boundaries of the Site are as follows: the Skykomish River to the north, Skykomish city limits to the east, approximately the Old Cascade Highway to the south, and Maloney Creek to the west. Railroad Avenue separates BNSF property from the main commercial district of the town.

The former railway maintenance and fueling facility in Skykomish is owned and operated by BNSF. Historical activities since the facility opened in the late 1890s included refueling and maintaining locomotives and operating an electrical substation for electric engines. BNSF stored Bunker C and diesel fuel at the Site in aboveground storage tanks (ASTs) and underground storage tanks (USTs) until 1974, when BNSF discontinued most fuel handling activities at the Site.

Some of the historic Site activities resulted in the release of contaminants to the surrounding environment. In early 1991, Ecology designated the Site (aka BNSF Former Fueling and Maintenance Facility) as a high priority cleanup site. Later that year, BNSF indicated a desire to initiate a Remedial Investigation/ Feasibility Study (RI/FS) in accordance with the Model Toxics Control Act (MTCA). At that time formal negotiations for Agreed Order No. DE 91TC-N213 were initiated. Negotiations were completed in mid-1993. Following a public comment period, the Agreed Order, which included detailed work plans for the RI/FS process and early interim action for cleanup work, was signed by Ecology and BNSF. BNSF and Ecology signed a separate agreed order (No. DE 01TCPNR-2800) in 2001 for additional interim action cleanup work near the South Fork Skykomish River and the levee west of 5th Street. BNSF has been routinely monitoring groundwater at the Site pursuant to the 2001 Agreed Order and *Interim Action Basis of Design Report for the LNAPL Barrier System* (RETEC, 2001). BNSF also conducted groundwater monitoring pursuant to the 1993 Order (after the RI and supplemental RI) in conjunction with the 1995 interim action (passive skimming wells).

In 2006, BNSF and Ecology signed an additional agreed order (No. DE-2379) that outlined the interim action for cleanup work in the Levee Zone and part of the Northwest Developed Zone (NWDZ). This interim action consisted of temporary relocation of five residences, excavation of the levee, underlying soils and sediments along the south bank of the South Fork Skykomish River, reconstruction of the levee, and restoration of natural resources, private property and public infrastructure that were disturbed by the remediation activities. Under the 2006 Agreed Order, BNSF was required to continue groundwater monitoring as described in the *Groundwater Monitoring Plan* (RETEC, 2005a). In October 2007, BNSF and Ecology signed a Consent Decree (CD, No. 07-2-33672-9 SEA). Any remaining work required by the 2006 order was incorporated into

and required by the CD. The CD requires BNSF to conduct a final cleanup of the Site by implementing the Cleanup Action Plan in accordance with the schedule identified in the CD. Section VI.A.6 of the CD requires BNSF to conduct groundwater monitoring consistent with the *Groundwater Monitoring Plan* (RETEC, 2005a) as amended. Upon the approval of Ecology, the *Groundwater Monitoring Plan* was amended in 2007 to the *Groundwater Monitoring Plan, Revision 1* (RETEC, 2007), which went into effect in July 2007.

Since 1993, investigations performed by BNSF, in cooperation with Ecology, have revealed petroleum contamination in soil, groundwater, sediments, and surface water. Detailed information about the scope of prior investigations and the results appear in the 1996 *Remedial Investigation Report* (RETEC, 1996), the 2002 *Supplemental Remedial Investigation Report* (RETEC, 2002), and the 2005 *Feasibility Study*. In addition, monthly fluid level gauging was performed between 2001 and the adoption of the Groundwater Monitoring Plan in 2005 to monitor the performance of the 2001 interim remedial actions, namely the recovery system and barrier wall required by the 2001 Agreed Order. This monitoring was focused near the barrier wall and recovery system.

1.3 Report Organization

Section 1 of this report provides an introduction, background information and the objectives of the site-wide groundwater monitoring. Section 2 describes the monitoring well network, changes made to the network during the monitoring period, and forthcoming changes related to cleanup activities. Section 3 describes the methods used to perform the monitoring activities. Section 4 describes the laboratory analyses and reporting and the subsequent data management and validation activities performed by RETEC/ENSR. The section also describes the groundwater cleanup levels and remediation levels that have been established for the Site. Section 5 describes the results of the monitoring activities, specifically the fluid level gauging and analytical results from the groundwater sampling. Section 6 provides a summary of the data and recommendations for future sampling events. Finally, Section 7 provides cited references.

2.0 Monitoring Well Network

This section identifies the wells that were included in the groundwater monitoring network for fluid level gauging and groundwater sampling. The initial monitoring network outlined in the 2005 Plan included the following:

- 92 monitoring wells for monthly fluid level gauging
- 9 locations for surface water level gauging
- 75 monitoring wells for analysis of total petroleum hydrocarbons by NWTPH-Dx
- 39 monitoring wells for analysis of volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs) and volatile and extractable hydrocarbons (VPH/EPH)
- 79 monitoring wells for analysis of total and dissolved lead and arsenic
- 10 monitoring wells for analysis of PCBs.

The groundwater monitoring network was modified[1] after the May 2005 sampling event, as follows:

- The five deep wells (DW-1, DW-2, DW-3, DW-4 and DW-5) were removed from the sampling program, because no contamination was detected in these wells in May 2005, and no contamination had been detected in these wells during previous sampling events
- PCB analyses were discontinued because no PCBs were detected in groundwater during May 2005.

The monitoring network was further modified prior to the May 2006 sampling event. This modification consisted of the abandonment and subsequent removal of the monitoring and recovery wells within the Levee Zone Interim Action excavation area[2] and the installation of replacement wells[3] in July 2007.

In addition, the following changes to the analyte list and sampling frequency, which relate to future sampling, were agreed upon during a meeting on May 19, 2006, between RETEC and Ecology:

- Sampling frequency will change from quarterly to semi-annually
- Fluid level gauging frequency will change from monthly to quarterly.
- VOC and VPH/EPH analyses will be discontinued from all wells

All of these changes were incorporated into a formal revision to the *Groundwater Monitoring Plan, Revision 1* (RETEC, 2007). The 2007 Plan also included the installation of monitoring wells in the levee zone. The current monitoring network, as defined in the June 2007 revision of the Plan, consists of:

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[1] The changes were proposed by RETEC in a memorandum to Ecology dated August 26, 2005, and approved by Ecology in an e-mail dated August 31, 2005.

[2] Specifically, these wells were abandoned and removed: 5-W-5, 5-W-6, DW-4, MW-23, MW-24, MW-25, MW-41, MW-42, MW-43, MW-44, MW-45, MW-46, PZ-1, PZ-3, PZ-4, PZ-5, R-1, R-2, R-3, R-4, R-6, R-8 and R-9.

[3] The following replacement wells were installed: 5-W-14, 5-W-15, 5-W-16, 5-W-17, 5-W-18, 5-W-19, and 5-W-20,

- 54 monitoring wells for quarterly fluid level gauging
- 9 locations for quarterly surface water level gauging
- 34 monitoring wells for semiannual analysis of total petroleum hydrocarbons by NWTPH-Dx only. PAH, lead, and arsenic analyses were discontinued with Ecology's approval.

In the remainder of this document, the "Plan" refers to the 2005 Groundwater Monitoring Plan and subsequent revisions, as approved by Ecology, and described above.

The point of compliance for groundwater is generally described in Section 3.4 and Figure 6 of the CAP. The monitoring network described above was established before the CAP was issued by Ecology in October 2007, but all of the wells in the network are well inside the groundwater point of compliance. Point of compliance wells will be identified in the Final Compliance Monitoring Plan to be developed at the conclusion of active remediation.

3.0 Groundwater Monitoring Procedures

This section describes the field methods that were used for the groundwater monitoring activities described in the Plan.

3.1 Fluid Level Gauging

3.1.1 Groundwater Levels and Product Thickness Measurements

Fluid level gauging consists of the measurement of groundwater levels and free product thicknesses. The methods used to conduct fluid levels differed in wells that did not contain free product compared with wells that contained free product.

All fluid level measurements were collected in accordance with the Plan. Gauging equipment was decontaminated between wells in accordance with SOP 120 (Appendix A of the Plan). All fluid gauging data was recorded on an appropriate field form (Appendix A of the Plan). The field form included the date and time of gauging, depth to water (ft), depth to light non-aqueous phase liquid (LNAPL) (ft), LNAPL thickness (ft), and method of measurement. In addition, the condition of the lock, monument integrity, and legibility of well labels was noted on the field form.

At the completion of each gauging event, the field manager signed off on the quarterly gauging sheets before demobilization from the Site to assure that all wells had been gauged.

3.1.2 Surface Water Level Measurements

Temporary benchmarks were installed to allow the measurement of surface water levels from five locations along the South Fork Skykomish River and four locations along the former Maloney Creek channel. The surface water level measurements were obtained using a surveyor's level and staff gauge.

3.2 Sampling Methods

Standard EPA-approved low flow sampling techniques, described in the Plan, were used for monitoring wells that have historically been free of product.

The groundwater monitoring network includes wells that contain free product. Due to the nature and physical properties (high viscosity and specific gravity of 0.97) of Bunker C, there is a risk that oil would be entrained in groundwater samples using standard sampling procedures. Therefore, as described in the Plan, a dedicated tubing system was used for groundwater sampling of wells containing free product. This technique was employed to reduce the risk of entraining droplets of free product in the groundwater samples[4]. The dedicated tubing system consists of a dedicated Teflon tube that was inserted into each monitoring well prior to sampling, which is used as a conduit for a polyethylene sampling tube to withdraw a water sample under the overlying product. In order to install the Teflon tube, air was pumped into the tube as it was initially lowered into the well to prevent free product from entering the inside of the tube as it passed through the free product. The tube is stored in between sampling events with the inlet near the bottom of the well, to prevent product from entering.

Fluid levels were measured and recorded at the start of each sampling period. These data were used at each product-containing well to position the Teflon conduit tube such that the tubing inlet was approximately one

[4] As discussed further in Section 5, the analytical data strongly suggests that this method has not been successful in preventing the entrainment of free product in the groundwater samples.

foot below the base of the product layer. Samples were collected using low-flow sampling techniques, from the polyethylene tubing inserted through the conduit tube. After sampling was complete, the Teflon tube was lowered back to its original position (with the inlet near the bottom of the well) and secured for subsequent sampling, and the polyethylene sampling tube was then discarded. Field forms are included in Appendix A.

3.2.1 Well Purging

Each well was purged prior to sampling using a peristaltic pump with new disposable tubing at a flow rate of 0.1 to 0.5 L/min. During purging, the flow rates, water levels, and field water quality parameters (pH, conductivity, temperature, dissolved oxygen, oxidation-reduction potential, and turbidity) were measured and recorded. Purging continued until the field parameters stabilized. Final field parameters are discussed in Section 5.2 of this report.

3.2.2 Sample Preservation and Handling

Proper packaging and shipping methods were used to minimize the potential for sample breakage, leakage or cross contamination. In addition, clear documentation provided a record of sample custody from collection to analysis. All sample containers were pre-preserved in laboratory cleaned containers. All sample preservation, handling, and analysis were conducted in accordance with the Plan.

3.2.3 Investigation-Derived Waste

All decontamination water and purge water was drummed, labeled and disposed of at a licensed disposal facility in accordance with applicable regulations and the Plan.

4.0 Laboratory Analysis and Reporting

This section summarizes the laboratory analysis and reporting procedures, and the subsequent validation and use of the data. Groundwater samples were sent to TestAmerica Analytical Laboratories (TestAmerica) in Bothell, Washington for analysis. TestAmerica is a Washington-certified laboratory.

4.1 Analytical Methods

Groundwater samples from selected wells were analyzed for total petroleum hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAHs), lead and arsenic. The samples were analyzed using Washington State methods, as appropriate and in accordance with the Plan, and as summarized below.

- Total petroleum hydrocarbons were analyzed using method NWTPH-Dx
- Polycyclic aromatic hydrocarbons were analyzed using EPA method 8270C-HVI
- Lead and arsenic were analyzed were analyzed using EPA method 6010.

Groundwater collected in May and November 2006 was analyzed for NWTPH-Dx, total and dissolved arsenic, total and dissolved lead, and PAHs in accordance with the 2005 Plan. Groundwater collected in July 2007 was analyzed for NWTPH-Dx in accordance with the 2007 Plan.

The laboratory was instructed to report sample concentrations to the method detection limit (MDL) rather than the higher method reporting limit (MRL). It was recognized that reported concentrations below the MRL have a greater degree of uncertainty and these results were qualified as estimated (J-flagged). Reporting of results to the MDL has the advantage of minimizing the number of non-detected results, which is especially important in those cases when the MRL is greater than the cleanup level.

4.2 Data Packages

TestAmerica provided analytical data in the form of both electronic data deliverables (EDDs) suitable for import into EQuIS and full text data reports. The data reports are sent as hard copy (Appendix B) and in electronic (.pdf) files.

Each data report includes copies of the chain-of-custody forms, and a case narrative with the following information: description of case, comments on sample receipt, and description of preparation and analysis. The following data are reported: detection limit (MDL), reporting limit (MRL), units of measure, dilution factor, batch number, date received, date prepared, date analyzed, analytical method, and any notes or qualifiers.

Finally, the report contains the details and results of laboratory QA/QC procedures which were performed on the sample water.

4.3 Data Management

Upon receipt of the data from TestAmerica, the EDDs and case narratives are checked for completeness, and are then validated by RETEC/ENSR chemists. The validated data are finally imported into EQuIS.

4.4 Data Validation

RETEC/ENSR evaluated all groundwater data to assess whether analytical results met laboratory quality control procedures specified in the Plan, to evaluate the precision, accuracy, method compliance and

completeness of the data set, and to evaluate the suitability of the data for their intended use. Data were evaluated based on validation criteria as set forth in the following documents:

- USEPA Contract Laboratory Program (CLP) National Functional Guidelines for Organic/Inorganic Data Review (document numbers EPA540/R-99/008 and EPA540/R-04/004 of October 1999 [Organic] and October 2004 [Inorganic])
- The USEPA CLP National Functional Guidelines for Superfund Organic Methods Data Review, document number USEPA-540-R-04-009, January 2005, as they applied to the reported methodology.

Ecology methods were also reviewed as per Ecology Analytical Methods for Petroleum Hydrocarbons, ECY 97-602 of June 1997. Field duplicate Relative Percent Difference (RPD) control limits were taken from the USEPA Region I Laboratory Data Validation Functional Guidelines for Evaluating Organics Analyses, December 1996. Data validation reports are presented in Appendix C.

4.5 Groundwater Cleanup Levels and Remediation Levels

The groundwater cleanup level (CUL) and Remediation Level (RL) are specified in Section 3.4 and Table 1 of the CAP in accordance with WAC 173-340-720. The groundwater data are compared against the CUL (208 μg/L NWTPH-Dx) and RL (477 μg/L NWTPH-Dx) in Section 5. There are no CULs for PAH, arsenic, or lead in groundwater for the Site specified in the CAP.

5.0 Results

This section presents and evaluates the results from the quarterly fluid level gauging and semi-annual groundwater sampling conducted during the reporting period. Groundwater samples collected in May and November 2006 were analyzed for NWTPH-Dx, total and dissolved arsenic, total and dissolved lead, and PAHs in accordance with the 2005 Plan. Groundwater samples collected in July 2007 were analyzed for NWTPH-Dx in accordance with the 2007 Plan.

5.1 Fluid Levels

This section provides data and conclusions drawn from quarterly gauging of fluid levels which occurred from May 2006 to July 2007. Table 5-1 presents all gauging results from May 2006 to July 2007. Seasonal variations in groundwater elevations, product thickness, and changes in potentiometric surfaces and groundwater gradients are discussed below.

Groundwater levels show seasonal variations in response to river levels and precipitation changes. Figure 5-1 shows the placement of the wells and Skykomish river gauges used in the hydrographs. Figures 5-2 and 5-3 show seasonal groundwater variation for the past five years (January 2002 to July 2007) and for the period from May 2006 to July 2007, respectively. These figures show that during a normal wet winter the groundwater elevations rise and, in the drier summer months, the groundwater elevations decline. This seasonal variation was also seen in the Skykomish River gauging data (Figure 5-4). Figure 5-4 shows river levels and groundwater well data from May 2006 to July 2007. This figure shows that the groundwater level changes generally mimic water level fluctuations in the South Fork Skykomish River.

Six wells from around the Site were selected to show the relationship between free product thicknesses and groundwater elevations. Figures 5-5 through 5-10 are scatter plot graphs of water levels vs. product thicknesses from gauging events between 1997 and 2007.

Semi-annual potentiometric surface maps for the reporting period are shown in Figures 5-11 through 5-13. As shown in these figures, the groundwater flow direction is consistently towards the river, to the north or northwest, regardless of the season.

5.2 Field Parameters

Table 5-2 presents stabilized field parameters measured during the semi-annual groundwater sampling events from the reporting period from all wells except those containing free product. Each field parameter is discussed separately below.

5.2.1 pH

The median pH of groundwater across the Site during the reporting period was 5.89, with a minimum value of 5.06, and a maximum value of 7.56. The minimum value was detected in MW-12 in May 2006 and the maximum value was detected in 5-W-16 in July 2007. These pH values are consistent with past measurements at the Site.

5.2.2 Conductivity

The median conductivity (in µmhos/cm) of groundwater across the Site during the reporting period was 69, with a minimum value of 7.3, and a maximum value of 370. The maximum value was detected in MW-10 in November 2006; the minimum value was detected in monitoring well MW-3 in November 2006. These values are consistent with the data from previous sampling events.

5.2.3 Temperature

The median temperature (ºC) of groundwater across the Site during the reporting period was 8.53 with a minimum value of 0.64 and a maximum value of 15.03. The temperature fluctuation varies seasonally. The maximum value was detected in 5-W-16 in July 2007 and the minimum value was detected in 1A-W-5 in November 2006.

5.2.4 Dissolved Oxygen

Typical dissolved oxygen (DO) concentrations in groundwater are between 0 mg/L and 10 mg/L, which is equal to the saturation index of dissolved oxygen in water. The median DO concentration in groundwater across the Site during the reporting period was 1.44 mg/L, with a minimum value of 0.00 mg/L, and a maximum value of 9.60 mg/L. The wells within and hydraulically downgradient of the areas of known contamination contained very low concentrations of DO, consistent with DO concentrations measured in the 2002 Supplemental RI, and oxygen deficient conditions typically associated with ground water contamination. Higher concentrations of DO were typically measured in areas up gradient from the areas of known contamination and in areas having concentrations of contaminants that are very low or non-detect, with the exception of MW-35 in November 2006 with a DO concentration of 7.24 mg/L and an estimated concentration of NWTPH-Dx of 1,717 µg/L. The highest concentration of 9.60 mg/L was measured in MW-16.

5.2.5 Oxidation-Reduction Potential

The median oxidation reduction potential (ORP) in groundwater across the Site during the reporting period was 86.50, with a minimum value of -276.00, and a maximum value of 274.00. ORP in groundwater at the Site is generally positive with a slightly larger amount of negative values in wells in November 2006. The negative ORP values were concentrated around areas of free product, and indicate typical reducing conditions that are associated with the presence of free product in groundwater.

5.2.6 Turbidity

The median turbidity in groundwater across the Site during the reporting period was 1.50 (NTU) with a minimum value of 0.0 and a maximum value of 128. Reported turbidity values were generally less than 10 during the reporting period.

5.3 Total Petroleum Hydrocarbons (TPH)

TPH in groundwater was analyzed using method NWTPH-Dx (TPH) during all three semi-annual monitoring events during the reporting period. This method reports diesel range (TPH-D, C12–C25) and oil range (TPH-O, C25-C36) hydrocarbons. Groundwater samples were collected site-wide from select wells during May and November 2006, and July 2007, per the Plan. Figures 5-14 through 5-16 show the extent of TPH (measured as NWTPH-Dx) in groundwater. Table 5-3 presents the TPH data for the reporting period.

All sampled wells inside the estimated residual and free product plume areas contained TPH concentrations above the CUL of 208 µg/L and the RL of 477 µg/L in November 2006. During the May 2006 and July 2007 sampling events, a few wells inside the estimated residual and free product plume areas contained TPH concentrations above the CUL of 208 µg/L but below the RL of 477 µg/L. TPH concentrations in wells outside the free product plumes ranged from 9.05 to 2,399 µg/L. Wells installed in the levee zone cleanup area were sampled for TPH during the July 2007 sampling event. Two of the seven new wells contained TPH above the RL. Additionally, one of the new wells contained TPH above the CUL but below the RL.

Analytical results from groundwater samples collected from the semi-annual sampling events were reviewed to evaluate whether TPH concentrations vary seasonally to determine of the apparent increase in November 2006 is part of the overall trend. Figure 5-17 presents time-concentration plots of TPH in selected wells. As this figure shows, TPH concentrations were generally greatest during November 2006. This event correlates

with higher groundwater levels. Figure 5-18 shows historical TPH data (when available); no long term trends are evident within the Site, indicating that the plume location is relatively stable, and that the apparent increase in November 2006 was not part of an overall trend.

TPH-Dx results in several wells show increasing concentrations from May to November with concentrations decreasing from November to July. The reasons behind the TPH concentration fluctuations, although not fully understood, are thought to result from changes in groundwater flow direction throughout the year. The groundwater flow directions indicate that the source of the TPH in groundwater is most likely the free product plumes to the east.

The highest TPH concentrations are present in wells that contain free product. Free product was noted in the sample tubing during sampling of some of these wells; this is most likely due to entrainment during sampling (see Table 5-3). Although care was taken to prevent NAPL entrainment, the closeness of the NAPL specific gravity with that of water combined with the small distance (one foot) between the sample inlet tube and the product-water interface (as required in the Plan), has made NAPL entrainment highly likely. Due to the presence of free-phase product, TPH concentrations from monitoring wells containing free-phase product may not be representative of dissolved TPH concentrations in groundwater. Therefore, it is suggested that the sampling of these wells be discontinued until free product is no longer present in the wells.

5.4 Polycyclic Aromatic Hydrocarbons (PAHs)

PAH constituents in groundwater were analyzed using EPA Method SW8270C-HV1 in May and November 2006. PAH analysis was dropped for the July 2007 event, per Revision 1 of the Plan (RETEC, 2007). All eighteen PAH compounds were detected at least once in groundwater. These compounds are:

- Acenaphthalene
- Benzo(a)anthracene
- Benzo(a)pyrene
- Benzo(b)fluoranthene
- Benzo(k)fluoranthene
- Chrysene
- Dibenz(a,h)anthracene
- Fluoranthene
- Fluorene
- Indeno(1,2,3-cd)pyrene
- Naphthalene
- Pyrene.

Table 5-4 shows the PAH data from the semi-annual groundwater sampling events. Concentrations detected were sporadic over the two sampling events, but were more frequent in the November 2006 event than the May 2006 event. Chrysene was the only compound detected consistently in wells throughout the semi-annual sampling events and was always detected if another PAH compound was detected. Therefore, chrysene concentrations from the November 2006 event were selected to illustrate (Figure 5-19) the most widespread extent of any PAH throughout the Site during the reporting period.

PAH concentrations were highest within or adjacent to the estimated free product plumes. The highest PAH detections corresponded with TPH-Dx concentrations greater than 1,000 µg/L or free product present in the

well during the time of sampling. This corresponds to a general trend of increased chrysene concentrations associated with increased TPH-Dx concentrations.

5.5 Arsenic and Lead

5.5.1 Arsenic

Total and dissolved arsenic were analyzed using EPA Method 6020 in May and November 2006. Arsenic was not included in the July 2007 event, per Revision 1 of the Plan (RETEC, 2007). Table 5-5 shows the total and dissolved arsenic data from the semi-annual groundwater sampling events. Figures 5-21 and 5-22 show the distribution of total and dissolved arsenic from May 2006 and November 2006. Total and dissolved arsenic was detected during both sampling events in wells throughout much of the Site, with higher concentrations generally present within the free product plume area. The highest concentration of arsenic (7.16 µg/L – total and 7.66 µg/L – dissolved) was detected in MW-28 during May 2006.

The total arsenic data was compared with dissolved arsenic data to determine the relationship between the results. Figure 5-23 shows a linear trend for the results of selected wells. Data from all wells in which total arsenic was detected were plotted to determine the ratio of total to dissolved arsenic at the Site. Using this dataset, total and dissolved arsenic concentrations have an approximate 1:1 correlation, indicating that virtually all of the arsenic in groundwater is in the dissolved phase.

5.5.2 Lead

Total and dissolved lead were analyzed using EPA Method 6020 during the May and November 2006 sampling events. Lead was not included in the July 2007 event, per Revision 1 of the Plan (RETEC, 2007). Table 5-5 shows total and dissolved lead data from the semi-annual groundwater sampling events. Total lead concentrations were consistently detected in two wells within the approximate footprint of the free product plume (MW-28, and 5-W-1). One well, 5-W-1, contained dissolved lead in both May and November 2006. Total and dissolved lead concentrations outside the plume were variable, with generally low concentrations ranging from non-detect to 0.12(J)µg/L. There was one exception, MW-32, had 0.29(J) µg/L for total lead and 0.51(J) µg/L for dissolved lead in May 2006. Figure 5-24 shows the distribution of total and dissolved lead from May and November 2006.

The highest concentration of total lead (0.77J µg/L) was detected in monitoring well 5-W-1 during the May 2006 event. A trace of product was detected in well 5-W-1 during the corresponding gauging event. The highest concentration of dissolved lead (0.51J µg/L) was detected in MW-32 during the May 2006 event.

The total lead data was compared with dissolved lead data to determine if a relationship exists between the results. Data from all wells within which total and dissolved lead was detected were plotted in Figure 5-25. Because lead was infrequently detected, there is insufficient data to evaluate the relationship between total and dissolved lead.

6.0 Summary and Recommendations

This report presents the results of groundwater monitoring performed in 2006 and the first three quarters of 2007. Approximately 150 groundwater samples were collected during the reporting period.

The fluid level and monitoring data collected throughout the reporting period have been analyzed and also compared to previous monitoring data. These data indicate groundwater flow gradients are relatively consistent throughout the year. These data also indicate that the plume extent (LNAPL and dissolved) has remained stable throughout the monitoring period and does not appear to have migrated or changed size, although there are some seasonal fluctuations in TPH concentrations.

The TPH cleanup level (208 µg/L) and remediation level (477 µg/L) was exceeded in groundwater from wells within and immediately adjacent to areas containing free and residual product during all three sampling events.

PAHs were detected throughout much of the Site in May and November 2006. PAH was generally detected in samples collected within or adjacent to the estimated free product plumes, in samples from wells with greater than 1,000 µg/L TPH (NWTPH-Dx), or in samples believed to contain entrained product.

Arsenic was detected in samples from throughout much of the Site in May and November 2006. The higher concentrations tend to be associated with the free product plumes.

Lead was detected in several wells throughout the Site in May and November 2006. PAH, lead, and arsenic analyses were discontinued with Ecology's approval in June 2007.

The analytical data and observations made during sampling strongly suggests that free product was entrained in many of the groundwater samples collected from wells located within the free product plumes. Some entrainment was to be expected given the similarity between the specific gravities of the free product and water. As a result, the results from samples obtained from wells that contained free product frequently may not accurately represent the dissolved concentrations of TPH in groundwater. Therefore, it is suggested that the sampling of these wells be discontinued in future sampling events.

Point of compliance wells will be identified in the Final Compliance Monitoring Plan to be developed at the conclusion of active remediation.

7.0 References

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