# Exhibit B

# Cleanup Action Plan

# DRAFT CLEANUP ACTION PLAN

BNSF Railway Black Tank Property Site
Spokane, WA
FSID 98615712, CSID 3243

May 2018
Washington Department of Ecology
Toxics Cleanup Program
Eastern Regional Office
Spokane, WA

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# 1.0 INTRODUCTION

This report presents the Washington State Department of Ecology's (Ecology) proposed cleanup action for the BNSF Railway Black Tank Property Site (Site) (Facility Site #98615712, Cleanup Site #3243), generally located at 3202 East Wellesley Avenue in Spokane, Spokane County, Washington (Figure 1). This Draft Cleanup Action Plan (DCAP) is required as part of the Site cleanup process under the Model Toxics Control Act (MTCA), Ch. 70.105D Revised Code of Washington (RCW), implemented by Ecology. The cleanup action decision is based on the Remedial Investigation/Feasibility Study (RI/FS) and other relevant documents in the administrative record. BNSF Railway (BNSF) and Marathon Oil Company have been named as potentially liable persons (PLPs) by Ecology. Marathon Oil Company's obligations for this project are being performed by Husky Oil Operations Limited. The PLPs completed Site investigation activities under Agreed Order No. 9188.

This DCAP outlines the following:

- The history of operations, ownership, and activities at the Site;
- The nature and extent of contamination as presented in the RI;
- Cleanup levels (CULs) for the Site that are protective of human health and the environment;
- The selected remedial action for the Site; and
- Any required compliance monitoring and institutional controls.

## 1.1 DECLARATION

Ecology has selected this remedy because it will be protective of human health and the environment. Furthermore, the selected remedy is consistent with the preference of the State of Washington for permanent solutions, as stated in RCW 70.105D.030(1)(b).

## 1.2 APPLICABILITY

Cleanup standards specified in this DCAP are applicable only to the BNSF Railway Black Tank Property Site. They were developed as a part of an overall remediation process under Ecology oversight using the authority of MTCA, and should not be considered as setting precedents for other sites.

## 1.3 ADMINISTRATIVE RECORD

The documents used to make the decisions discussed in this DCAP are on file in the administrative record for the Site. Major documents are listed in the reference section. The entire administrative record for the Site is available for public review by appointment at Ecology's Eastern Regional Office, located at 4601 N. Monroe Street, Spokane, Washington, 99205-1295. Results from applicable studies and reports are summarized to provide background information pertinent to the DCAP. These studies and reports include:

- *Remedial Investigation/Feasibility Study Work Plan*, January 2013

- *Addendum to the RI/FS Project Plan, March 2016*
- *Remedial Investigation/Feasibility Study Report*, March 2017

## 1.4 Cleanup Process

Cleanup conducted under the MTCA process requires the PLPs or Ecology to prepare specific documents. These procedural tasks and resulting documents, along with the MTCA section requiring their completion, are listed below with a brief description of each task.

- Public Participation Plan (Washington Administrative Code [WAC] 173-340-600) — summarizes the methods that will be implemented to encourage coordinated and effective public involvement. Ecology prepares this document.
- Remedial Investigation and Feasibility Study (WAC 173-340-350) — documents the investigations and evaluations conducted at the Site from the discovery phase to the RI/FS document. The RI collects and presents information on the nature and extent of contamination and the risks posed by the contamination. The FS presents and evaluates Site cleanup alternatives and may propose a preferred cleanup alternative. The documents are usually prepared by the PLPs, accepted by Ecology, and undergo public comment.
- Cleanup Action Plan (CAP) (WAC 173-340-380) — sets cleanup standards for the Site, and selects the cleanup actions intended to achieve the cleanup standards. Ecology issues the document, and it undergoes public comment.
- Engineering Design Report, Construction Plans and Specifications (WAC 173-340-400) — outlines details of the selected cleanup action, including any engineered systems and design components from the CAP. These may include construction plans and specifications with technical drawings. The PLPs usually prepare the document, and Ecology approves it. Public comment is optional.
- Operation and Maintenance Plan(s) (WAC 173-340-400) — summarizes the requirements for inspection and maintenance of remediation operations. They include any actions required to operate and maintain equipment, structures, or other remedial systems. The PLPs usually prepare the document, and Ecology approves it.
- Cleanup Action Report (WAC 173-340-400) — provides details on the cleanup activities along with documentation of adherence to or variance from the CAP following implementation of the cleanup action. The PLPs usually prepare the document, and Ecology approves it.
- Compliance Monitoring Plan (WAC 173-340-410) — details the monitoring activities required to ensure the cleanup action is performing as intended. The PLPs usually prepare the document, and Ecology approves it.

# 2.0 SITE BACKGROUND

## 2.1 SITE HISTORY

The Site consists of industrial land owned by BNSF. In addition, groundwater contamination has migrated beneath property owned by the Washington State Department of Transportation (WSDOT). It is bounded by the extent of groundwater contamination to the north (approximately Wellesley Avenue) and to the west (approximately Market Street), the Aluminum Recycling and Sem Materials cleanup sites to the east, and the extent of groundwater contamination to the south (Figure 1). BNSF's property is zoned Light Industrial, and WSDOT's property is zoned Center and Corridor Core, which allows for many types of uses including commercial, office, residential, and parks.

BNSF and its predecessors have owned the majority of the Site property since at least 1910. The State of Washington acquired the portion of the Site west of the BNSF railway right-of-way for the (NSC) North Spokane Corridor limited-access freeway project in 2014. BNSF and its predecessors leased portions of the Site property and infrastructure to other operators, including Blackline Asphalt Sales, Husky, Intermountain Asphalt Company, and Koch Materials.

Based on historical documents, the Site was developed as early as 1913. By 1928, the Black Tank and associated infrastructure had been constructed on the Site. The Black Tank was a 50-foot-diameter, 420,000-gallon, above-ground storage tank used to store Bunker C oil for the purpose of refueling locomotives from circa 1913 until at least 1956. The Black Tank was used to store various other petroleum products until its removal in 2006. By 1937, the Red Tank and associated infrastructure was installed on the Site. The Red Tank was a 420,000-gallon, above-ground storage tank used to store diesel in support of locomotive refueling until its removal sometime between 1990 and 1997.

At some point or points in time, operations resulted in infrastructure leaks and/or fuel spills at the Site. As a result, petroleum contamination exceeding CULs has been confirmed to be present in surface soil (≤15 feet below ground surface [bgs]), intermediate soil, as a light non-aqueous phase liquid (LNAPL) in smear zone soil, and in groundwater. Further descriptions of Site-related contamination are located in Section 3.0.

## 2.2 SITE INVESTIGATIONS

In 1999, BNSF first notified Ecology that surface contamination existed at the Site. A Site Hazard Assessment was conducted in 2000 to assess the Site's risk to human health and the environment based on the information known at the time. The Site Hazard Assessment results were evaluated using the Washington Ranking Method. The ranking for the Site was a three, with one representing the highest risk relative to other sites in Washington and five being the lowest. Groundwater impacts were not known at the time the ranking was completed.

In 2006, BNSF had the Black Tank decommissioned and removed from the Site. In addition, petroleum-contaminated soil was removed from beneath and adjacent to the Black Tank. The results of this effort and associated initial groundwater investigation are described in the following reports:

- *Black Tank Removal, Remedial Excavation, and Supplemental Assessment Report*, dated May 14, 2008, prepared by GeoEngineers.
- *Black Tank Supplemental Well Installation and Groundwater Monitoring Report*, dated August 5, 2010, prepared by GeoEngineers.

On June 19, 2008, Ecology received the Black Tank Removal report dated May 14, 2008 (referenced above). This report contains well logs for the first groundwater monitoring wells installed at the Site (MW-1 through MW-5). These wells were installed as an independent remedial action by BNSF in January and February 2008, and four of the five wells contained free product at the water table, approximately 170 feet bgs.

In 2011, Ecology began identifying PLPs for the Site. This process concluded in February 2012 with final PLP determinations. Ecology invited the PLPs to negotiate an Agreed Order for the completion of an RI/FS. Agreed Order No. 9188 became effective on August 23, 2012. The PLPs submitted the first draft of the RI/FS document on January 17, 2015. Ecology provided comments on this document to the PLPs on July 28, 2015. Ecology received a revised document on September 12, 2016, which included cleanup alternatives for the remediation of groundwater contamination. Ecology provided comments to the PLPs on the second draft of the RI/FS on January 4, 2017. A third draft of the RI/FS was submitted to Ecology on March 6, 2017.

The revised RI/FS did not address all of Ecology's comments, and Ecology did not concur with every assertion in the revised RI/FS. However, in a letter dated May 19, 2017, Ecology informed the PLPs the document meets the requirements of the Agreed Order, the provisions of MTCA, and provided Ecology the necessary information to select a cleanup action. Ecology made the revised RI/FS available for public review and comment from May 22 to June 22, 2017. Ecology received comments from twenty-one (21) people, and their comments helped guide Ecology in developing portions of this DCAP. After completing the Response to Comments document on July 31, 2017, the March 6, 2017 draft of the RI/FS became final.

## 2.3 Physical Site Characteristics

### 2.3.1 Topography and Climate

The Site is at an approximate elevation of 2,035 feet. The adjacent area is generally level; however, the rail lines running north/south though the Site are located in an excavated trench area approximately 100 feet wide and five to ten feet below the surrounding grade. To the east, the land remains generally flat for approximately 0.5 miles where the grade rises at Beacon Hill. To the south, the land gently decreases in elevation for approximately 1.5 miles until an abrupt decrease in elevation at the Spokane River. The region is semi-arid, receiving around 18 inches of precipitation annually. The majority of the precipitation occurs in late fall through early spring; winter precipitation is usually in the form of snow. Summers are warm and dry. The annual mean temperature is about 50˚F.

### 2.3.2 Regional Hydrogeology

The geology in the vicinity of the Site is primarily basalt flows of the Columbia Plateau overlain by Quaternary glacial flood deposits. The flood deposits are composed of thickly bedded, poorly sorted boulders, cobbles, gravel, sand, and silt and are approximately 300 feet thick in the Site vicinity. Depth to bedrock near the Site is believed to be 500 to 600 feet bgs. The coarse nature of the glacial flood deposits results in very high permeabilities. Intermittent layers of sand and silty sand are present within the coarse deposits. To the north of this Site, the intermittent layers of sandy silt tend to become more continuous and have a smaller grain size (generally described as a silty clay), and this layer divides the coarse deposits into two zones. Overlying the flood deposits are native surficial soils consisting of gravelly loam with thicknesses of up to five feet (Kahle and Bartolino 2007).

The primary aquifer underlying the Site is the Spokane-Valley Rathdrum-Prairie Aquifer (SVRP), which is the sole source of drinking water for over 500,000 people in the greater Spokane area. The aquifer flows from northern Idaho to the west and southwest down the Spokane Valley and, in some areas, at rates of over 100 feet per day. Once reaching the greater downtown Spokane area, groundwater flow direction in the aquifer turns north. The Site overlies an area of the SVRP known as the Hillyard Trough, which flows north from the Spokane River area near downtown Spokane towards the Little Spokane River. At the Site, depth to water is approximately 170 feet, with a seasonal variation approximately five to eight feet. Groundwater elevation gradients at the Site are fairly flat, with a change of approximately 0.001 feet/foot (GeoEngineers 2010).

## 3.0 REMEDIAL INVESTIGATION

A RI was performed to assess the nature and extent of contamination. Soil and groundwater were investigated to determine whether they were impacted by Site contaminants. Additional information regarding Site activities, sampling, analyses, and methodology is contained in the RI/FS (ERM 2017). The analytical results of the RI are summarized in Section 3.6.

### 3.1 TEST PITS AND TRENCHES

One hundred twenty-seven test pits and nine trenches were excavated near pipeline alignments and dispensers at the Site (Figure 2). Fifty-six soil samples were collected from test pits for laboratory chemical analysis of diesel- and heavy-oil range total petroleum hydrocarbons (TPH-D/HO), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), cadmium, chromium, copper, lead, nickel, and zinc. An acid/silica gel cleanup was applied to all soil samples collected from the test pits/trenches prior to analyzing for TPH-D/HO. Samples containing obvious petroleum contamination based on field screening data (i.e., soil staining, sheen test results, etc.) were analyzed for extractible petroleum hydrocarbons (EPH) and volatile petroleum hydrocarbons (VPH); a total of 23 samples from Site test pits, trenches, and borings were analyzed for these parameters.

Soil samples were collected from obviously contaminated areas where field screening identified the presence of contamination, and from immediately beneath or adjacent to areas of soil contamination.

### 3.2 Soil Borings

Seventeen soil borings were completed during the RI (Figure 3). Soil samples from each boring were selected for laboratory analysis based on the results of field screening.

Two soil borings were conducted to assess the vertical extent of the contamination near the Red Tank dispensers and Black Tank and Chemical Solution Pipelines; they were advanced to depths of between 77 to 177 feet bgs. Soil samples were collected at five-foot intervals and were field screened for the presence of contamination.

Fifteen soil borings were drilled near the Black Tank, Oil Tank, and various pipelines in the southeast portion of the Site to assess the vertical and lateral extent of contamination. In addition to defining the contamination extent, the physical and chemical properties of the LNAPL and smear zone and the hydrogeologic characteristics of the vadose zone and aquifer were characterized. The borings ranged in depth from 177.5 to 188 feet bgs. Soil samples were collected continuously in 5- to 10-foot intervals to document soil lithology.

Undisturbed core samples were collected from five soil borings. The core samples were collected in 5- to 10-foot intervals and preserved in 2.5-foot sections. Core samples from select intervals were analyzed for LNAPL mobility parameters.

Samples collected from soil borings were analyzed for TPH-D/HO, VOCs, PAHs, PCBs, cadmium, chromium, copper, lead, nickel, and zinc. An acid/silica gel cleanup was applied to soil samples collected from less than 10 feet bgs in the soil borings prior to analyzing for TPH-D/HO. Samples containing obvious petroleum contamination based on field screening data were analyzed for EPH and VPH; a total of 23 samples from Site test pits, trenches, and borings were analyzed for these parameters.

In addition, 26 soil borings were completed between 2006 and 2012 during Site investigation activities that were not part of the RI.

### 3.3 Groundwater

Permanent groundwater monitoring wells (MW-16 through MW-30) were constructed in each of the 15 soil borings drilled in the southeast portion of the Site, described in Section 3.2 (Figure 3). Monitoring wells MW-1 through MW-15 were previously constructed between 2006 and 2012 during pre-RI activities as an independent remedial action by BNSF without Ecology oversight.

Quarterly groundwater monitoring was performed in Site wells in December 2013, March 2014, July 2014, October 2014, March 2016, June 2016, September 2016, and December 2016. Groundwater elevation and LNAPL thickness data was collected during each quarterly event and used to calculate groundwater flow direction and gradient. Groundwater generally flows to the north, with seasonal variations slightly to the northeast or northwest at a rate of 41 to 47 feet/day.

Groundwater samples were collected on a quarterly basis from all Site monitoring wells that did not contain LNAPL at the time of sampling. Groundwater was generally analyzed for TPH-D/HO, benzene, toluene, ethylene, xylene, and carcinogenic PAHs (cPAHs), with the following additional analyses:

- The first four rounds of RI groundwater samples were analyzed for TPH-D/HO following an acid/silica gel cleanup. Groundwater samples collected in March and December 2016 were analyzed for TPH-D/HO both with and without an acid/silica gel cleanup, and samples collected in June 2016 and September 2016 were analyzed for TPH-D/HO without an acid/silica gel cleanup.
- Four groundwater samples were collected in June 2014 and analyzed for PCBs at a lower detection limit than had been used previously. The previous detection limits were not sufficiently low to evaluate compliance with MTCA groundwater cleanup criteria, so additional groundwater samples were collected during the fifth quarterly monitoring event; detection limits from this sampling event were below the MTCA cleanup criteria.
- Four groundwater samples were collected in June 2014 and analyzed for total and dissolved chromium and lead to evaluate potential impact to groundwater, based on the presence of these metals in mixed LNAPL and groundwater samples collected from the same wells in December 2013.
- Groundwater samples were collected from all wells not containing LNAPL during the fifth quarterly monitoring event in June 2016 and analyzed for total cadmium to evaluate potential groundwater impacts from cadmium soil contamination.
- Groundwater samples collected in March 2016 were analyzed for PCBs, total cadmium, sulfate, nitrate and nitrite, ferrous iron, total organic carbon, dissolved methane ($CH_4$), and total alkalinity.

## 3.4 LNAPL Recovery Testing

In March 2016, manual LNAPL skimming tests were conducted in twelve (12) Site monitoring wells. The purpose of the testing was to semi-quantitatively assess LNAPL recoverability at the Site. The manual LNAPL skimming tests included collecting fluid level measurements from LNAPL-containing monitoring wells then removing LNAPL using a disposable bailer until LNAPL was no longer present in the well. The process was then repeated, and the volume of LNAPL recovered each time was recorded. Precautions were taken to minimize water removal, which would artificially induce drawdown in the monitoring well. The LNAPL volume and water removed from each monitoring well was measured using a graduated cylinder. ERM attempted to gauge fluid levels in the monitoring wells after each LNAPL recovery event; however, LNAPL spilled and smeared onto the well casing, which resulted in the water level indicator probe sticking to the accumulated LNAPL, making reliable fluid level measurements difficult. Recovery tests were initially attempted at monitoring wells MW-1 through MW-5, MW-7, MW-9, MW-17 through MW-20, and MW-23. Sufficient LNAPL to provide a reliable estimate of recoverability (at least six inches) was not present in seven of these monitoring wells; therefore, subsequent LNAPL recovery testing focused only on monitoring wells having a sufficiently thick layer of LNAPL (MW-3, MW-4, MW-7, MW-17, and MW-20).

## 3.5 NATURAL SOURCE ZONE DEPLETION TESTING

### 3.5.1 Carbon Traps

On March 23, 2016, ERM deployed four carbon traps using the at-grade method. The traps were recovered on April 5, 2016, (after approximately two weeks deployment) and shipped to E-Flux in Fort Collins, Colorado, for analysis. E-Flux analyzed the samples for total sorbed carbon dioxide ($CO_2$) to evaluate the total $CO_2$ soil flux and used carbon-14 dating to assess the fraction of $CO_2$ soil flux attributable to petroleum degradation. Natural source zone depletion (NSZD) rates were estimated by utilizing the stoichiometric conversion of the $CO_2$ flux to petroleum hydrocarbons as decane (C10H22).

### 3.5.2 Carbon Flux Chambers

ERM installed carbon flux chamber monitoring stations at 20 locations across the Site. Monitoring stations were installed at locations upgradient, downgradient, cross-gradient, and within the extent of the LNAPL plume to assess carbon flux across the entire Site. To minimize the contribution of root respiration and maximize sensitivity to contaminant-related soil respiration, 10 centimeters (cm) of topsoil was removed at each survey location.

Subsequently, polyvinyl-chloride collars (10-cm inner diameter) were placed at the survey location such that approximately four cm remained above ground surface. Soil collars were positioned within an approximate one-meter radius of an existing monitoring well, with the exception of the MW-19/LI-19 location, which was positioned approximately four meters from the well to avoid placing it in railroad ballast.

After collar placement, ERM allowed a minimum of 24 hours to elapse to allow for stabilization of the $CO_2$ soil flux before initiating data collection. $CO_2$ flux measurements were collected between March 17 and April 11, 2016. Measurements were collected by attaching a soil carbon flux measurement system, which is comprised of a survey chamber and soil analyzer to the monitoring station. The soil analyzer control unit draws soil gas through the survey chamber, analyzes the $CO_2$ content, and records the data for later download. A background $CO_2$ flux location was selected upgradient of known TPH impacts to provide background data. Background measurements were collected at the beginning and end of each set of measurements, and background measurement amounts were used for correction according to the corresponding time for each individual measurement. The $CO_2$ production rates attributable to biodegradation of petroleum hydrocarbons (background-corrected flux) were calculated by subtracting the background $CO_2$ soil flux. Soil flux measurements from LI-06 near MW-06 were considered representative of background conditions (natural $CO_2$ respiration). NSZD rates were estimated by stoichiometric conversion of the background corrected $CO_2$ flux to petroleum hydrocarbons as decane (C10H22).

### 3.5.3 Metabolic Gas Monitoring

Metabolic gas monitoring measures respiration parameters (oxygen [$O_2$], $CO_2$, and $CH_4$) associated with biodegradation of petroleum in soil gas obtained from vadose zone soil immediately above the air/LNAPL interface or air/groundwater interface. Between March 17 and 21, 2016, ERM performed metabolic gas monitoring at one upgradient well (MW-6), eight wells within the LNAPL footprint (MW-4, MW-5, MW-7, MW-16, MW-17, MW-18, MW-20, and MW-23), and two downgradient wells (MW-11 and MW-22). The well volume (volume of air in each well casing) was calculated based on well diameter and depth to groundwater data. Each monitoring well was capped using a Fernco pipe fitting equipped with a sampling port, then sample tubing was attached to the sampling port on the Fernco and connected with a sample chamber. Air was purged from the well while periodically collecting $CH_4$, $O_2$, $CO_2$, and VOC measurements with a multi-gas meter until the readings stabilized and at least one well volume had been purged. Sample measurements were collected by filling a 1-liter Teflon bag from the sample port on the sample chamber. The soil gas monitors used for collecting measurements included a Landtec GEM-2000 Field Gas Meter for measuring $CH_4$, $O_2$, and $CO_2$ concentrations and a MultiRAE IR Meter equipped with a photoionization detector (PID) for measuring $CO_2$ and VOC concentrations in parts per million. After readings on the soil gas meters stabilized to within ±10%, a final set of $CH_4$, $O_2$, CO2, and PID measurements were collected and documented.

#### 3.5.4 Saturated Zone NSZD

Groundwater samples were collected from one upgradient well (MW-6) and three downgradient wells (MW-10, MW-11, and MW-22) on March 16, 2016, for analysis of NSZD parameters (dissolved $O_2$, $CH_4$, nitrate, sulfate, iron, and manganese). The changes in dissolved concentrations of $O_2$, $CH_4$, nitrate, sulfate, iron, and manganese from the upgradient well to the downgradient wells were used to approximate the rate of saturated zone NSZD in accordance with the April 2009 Interstate Technology & Regulatory Council (ITRC) guidance for "Evaluating Natural Source Zone Depletion at Sites with LNAPL" (ITRC 2009).

### 3.6 Analytical Results

The analytical results for the Site media are described in the following subsections and compared to the applicable CULs, which are summarized in Tables 1 and 2. The development of the applicable CULs is presented in Section 4.0.

#### 3.6.1 Surface Soils

Surface soils at the Site are defined as soils from 0 to 15 feet bgs. A total of 92 surface soil samples have been collected from the Site since 2007. TPH-D/HO, cadmium, cPAHs, and naphthalenes were detected in surface soil samples collected from the Site at concentrations greater than the applicable soil CULs and are contaminants of concern (COCs).

Of the 92 surface soil samples, 64 contained detectable concentrations of TPH-D/HO and 25 contained concentrations exceeding the CUL. The detected TPH-D/HO concentrations range from 10.4 to 152,000 milligrams per kilogram (mg/kg). All 61 surface soil samples analyzed for cPAHs and naphthalenes contained detectable concentrations of cPAHs and total naphthalenes, but only 18 contained detectable concentrations of benzo(a)pyrene and 25 contained detectable concentrations of naphthalene. The detected concentration ranges for benzo(a)pyrene TEF are 0.00755 to 13.7 mg/kg. The detected concentration ranges for total naphthalenes are 0 to 159 mg/kg.

The five surface soil areas containing COC concentrations exceeding the CULs are shown on Figure 4. CULs for soil are presented in Table 2.

### 3.6.2 Subsurface Soils (Intermediate and Smear Zone Soils)

Subsurface soils at the Site are defined as soils below 15 feet bgs. A total of 171 subsurface soil samples have been collected from the Site since 2007. TPH-D/HO was detected in 99 subsurface soil samples, and 53 of those samples contained concentrations of TPH-D/HO greater than the soil CUL calculated to be protective of groundwater. TPH-D/HO is a Site COC. CULs for soil are presented in Table 2.

#### Intermediate Soils

Intermediate soils are vadose zone soils that extend from below the surface soils (i.e., >15 feet bgs) to the top of the smear zone. Analytical data from intermediate soil samples show one area of TPH-D/HO impact exceeding the preliminary CUL for TPH-D/HO. The area encompasses the Black Tank and Chemical Solution Pipelines and the Black Tank Sump which is immediately north of the former Black Tank.

The COCs in intermediate soil are limited to TPH-D/HO. Of the 85 intermediate soil samples collected during the RI and analyzed for TPH-D/HO, 48 contained detectable concentrations of TPH-D/HO and 17 contained TPH-D/HO concentrations exceeding the CUL. The detected TPH-D/HO concentrations range from 11.6 to 67,500 mg/kg.

#### Smear Zone Soils

Smear zone soils are deep soils that have been impacted by LNAPL located on and within groundwater. Analytical data from the smear zone soil samples show a contiguous area of TPH-D/HO impact above CULs, which results in the presence of measureable LNAPL in some groundwater monitoring wells. Of the 86 smear zone soil samples collected during the RI and analyzed for TPH-D/HO, 51 contained detectable concentrations of TPH-D/HO and 36 contained TPH-D/HO concentrations exceeding the CUL. The detected TPH-D/HO concentrations range from 7.5 to 61,700 mg/kg.

### 3.6.3 LNAPL

The approximate areal extent of LNAPL at the Site was assessed based on the presence or absence of measurable LNAPL in monitoring wells. The Site area having less than 1 foot of measureable LNAPL is shown as the low restoration timeframe (RTF) area on Figure 4. The Site area having greater than 1 foot of measureable LNAPL includes the medium and high RTF areas presented on Figure 4.

#### 3.6.4 Groundwater

Between 2008 and December 2017, 139 groundwater samples were collected from monitoring wells at the Site not containing LNAPL. Five of the groundwater samples collected from the Site and one groundwater sample collected upgradient of the Site contained TPH-D/HO and/or cPAH concentrations exceeding the applicable CULs. Those constituents are Site COCs for groundwater. CULs for groundwater are presented in Table 1.

### 3.7 RISKS TO HUMAN HEALTH AND THE ENVIRONMENT

The Site encompasses several parcels owned by BNSF and one parcel owned by the WSDOT. The Site and surrounding properties are currently zoned as Heavy Industrial, Light Industrial, and Center and Corridor Core in the City of Spokane.

Exposures to human populations could occur through contact with or ingestion of contaminated surface or subsurface soil, dust entrained in air, or use of contaminated groundwater. Trespass is possible due to the Site's proximity to main roads and the railroad tracks. The Site is not currently fenced. Potential exposed populations include workers at the Site, current and future users of the Site, unauthorized trespassers to the Site, and potential future users of on-site groundwater. The Site overlies the Hillyard Trough portion of the SVRP sole-source aquifer, that provides drinking water to nearly 500,000 residents in the Spokane area; however the contaminated groundwater is limited to the Site where there are no drinking water wells and the contaminated groundwater is beyond the capture zone of any known drinking water wells. During remedial activities, nearby residents and patrons of and employees at nearby businesses could also be exposed if dust is not well controlled on Site.

Exposure to ecological receptors is possible given the presence of vegetation and open space. The Site is a developed property having low-quality habitat, and wildlife is not considered a potential receptor. A terrestrial ecological assessment that evaluates the ecological receptor exposure was conducted and is discussed further in Section 4.3.

## 4.0 CLEANUP STANDARDS

MTCA requires the establishment of cleanup standards for individual sites. The two primary components of cleanup standards are CULs and points of compliance. CULs determine the concentration at which a substance does not threaten human health or the environment. All media exceeding a cleanup level is addressed through a cleanup remedy that prevents exposure to the contaminated material. Points of compliance represent the locations on the site where CULs must be met.

### 4.1 OVERVIEW

The process for establishing CULs involves the following:

- Determining if methods A, B, or C are applicable;
- Developing CULs for individual contaminants in each media;

- Determining which contaminants contribute the majority of the overall risk in each media (indicators); and
- Adjusting the CULs downward for carcinogenic substances based on total site risk of 1 X $10^{-5}$, and for a hazard index of 1 for non-carcinogenic substances, if necessary.

MTCA provides three options for establishing CULs: Methods A, B, and C.

- Method A may be used to establish CULs at routine sites or sites with relatively few hazardous substances.
- Method B is the standard method for establishing CULS and may be used to establish CULs at any site.
- Method C is a conditional method used when a cleanup level under Method A or B is technically impossible to achieve or may cause significantly greater environmental harm. Method C also may be applied to qualifying industrial properties.

MTCA defines the factors used to determine whether a substance should be retained as an indicator for the Site. When defining CULs at a site contaminated with several hazardous substances, Ecology may eliminate from consideration those contaminants contributing a small percentage of the overall threat to human health and the environment. WAC 173-340-703(2) provides a substance may be eliminated from further consideration based on:

- The toxicological characteristics of the substance which govern its ability to adversely affect human health or the environment relative to the concentration of the substance;
- The chemical and physical characteristics of the substance which govern its tendency to persist in the environment;
- The chemical and physical characteristics of the substance which govern its tendency to move into and through the environment;
- The natural background concentration of the substance;
- The thoroughness of testing for the substance;
- The frequency of detection; and
- The degradation by-products of the substance.

## 4.2 SITE USE

The evaluation of both CULs and ecological exposures depends on the nature of the Site use. Options under MTCA are either an unrestricted property or an industrial property.

Industrial properties are defined in WAC 173-340-200; the definition includes properties characterized by transportation areas and facilities zoned for industrial use. Industrial properties are further described in WAC 173-340-745(1) with the following factors:

- People do not normally live on industrial property;
- Access by the general public is generally not allowed;
- Food is not grown/raised;
- Operations are characterized by chemical use/storage, noise, odors, and truck traffic;

- Ground surface is mostly covered by buildings, paved lots and roads, and storage areas; and
- Presence of support facilities serving the industrial facility employees and not the general public.

The Site is currently zoned Light Industrial and Center and Corridor Core, which allows for daycare centers and residential use, and therefore does not qualify as an industrial site use. Current use is as an active rail line and WSDOT plans to develop a limited access highway on a portion of the Site. Human and ecological exposure to Site contamination is discussed further in Sections 3.7 and 4.3.

## 4.3 TERRESTRIAL ECOLOGICAL EVALUATION

WAC 173-340-7490 a terrestrial ecological evaluation (TEE) to determine the potential effects of soil contamination on ecological receptors. For sites that do not qualify for a TEE exclusion, either a simplified TEE or a site-specific TEE must be conducted to determine if a threat to terrestrial ecological receptors exists or if the site can be removed from further ecological consideration during the RI and cleanup process.

In the RI, it was determined that the Site does not exhibit any of the characteristics identified in WAC 173-340-7491(2)(a) that would require a Site-specific TEE. This determination was made because the Site has historically been developed property used for transportation purposes with no known usage by threatened or endangered species and without maintained vegetation areas as defined in WAC 173-340-7490 (3)(b). Therefore, the Site qualifies for a simplified TEE that only evaluates future potential exposure to soil by terrestrial wildlife.

The process for conducting a simplified TEE includes an evaluation of the extent of exposure, exposure pathways, and type of contaminants present. Under the simplified TEE process, the evaluation ends if any one of the exposure pathway evaluations determines that there is not a substantial threat of significant adverse effects to terrestrial ecological receptors.

An exposure analysis was completed based on Table 749-1 Simplified TEE Exposure Analysis Procedure under WAC 173-340-749(2)(a)(ii). The Site is a developed property having low-quality habitat, and the contaminants identified in Step 5 are not present. Based on the results of this evaluation, further TEE is not necessary, and wildlife is not considered a potential receptor.

## 4.4 SITE CLEANUP LEVELS

The RI and previous investigations have documented the presence of contamination in soil and groundwater at the Site. The detection frequency and the contaminant concentrations exceeded screening levels, therefore, CULs will be developed for both soil and groundwater.

### 4.4.1 Groundwater

Because this Site meets the requirements identified in WAC 173-340-704 for groundwater, Method A CULs will apply to groundwater. Table 1 lists the final CULs for COCs in groundwater.

### 4.4.2 Soil

Since groundwater is contaminated at concentrations that exceed Method A CULs, soil CULs need to consider the leaching pathway and be set at concentrations protective of groundwater. In addition, CULs for surface soils must be protective of the direct-contact pathway. Table 2 lists the final CULs for COCs in soil.

#### *4.4.2.1 Surface Soils*

MTCA Method A soil CULs for unrestricted land use are selected as the CULs for surface soils at the Site. Method A CULs are protective of all exposure pathways (direct contact, protection of groundwater, and vapor intrusion). In addition, MTCA Method A CULs are considered applicable for the Site because they address the soil exposure pathways and receptors of concern for both the current and future land use and conditions. Constituents requiring CULs for surface soil include TPH-D/HO, benzo(a)pyrene, benzo(a)pyrene TEF, naphthalene, and total naphthalenes.

Three of 35 soil samples contained cadmium above the Method A CUL of 2 mg/kg with a maximum of 3.3 mg/kg. Because the Method A CUL for cadmium is set for the protection of groundwater, groundwater at the Site is not contaminated with cadmium, and the CUL protective of direct contact is 80 mg/kg, Ecology has determined that cadmium in soil is not a COC at this Site.

#### *4.4.2.2 Subsurface Soils*

For this Site, it was determined that residual saturation (i.e., prevention of LNAPL generation) would be the driver for development of a TPH-D/HO CUL for subsurface soil. The PLPs utilized the MTCATPH 11.1 spreadsheet (toxicity analysis) and laboratory-derived residual saturation values (LNAPL generation analysis) to propose a TPH-D/HO CUL for subsurface soil. However, given the specific circumstances of contamination at this Site and because LNAPL is present, Ecology prefers to utilize empirical evidence rather than laboratory methods to estimate residual saturation in order to determine the subsurface soil CUL for TPH. Therefore, Ecology used the TPH-D/HO analytical results for samples taken from borings (i.e. B12, BTSB01) completed in areas where soil contamination occurred from ground surface to groundwater to derive a conservative estimate of the average residual saturation for the Site soils. Specifically, Ecology determined the median soil TPH-D/HO concentration for each of the two borings and selected the lowest of the two median soil TPH-D/HO concentrations as a conservative average residual saturation for the Site soils. Using this approach, Ecology's residual saturation-based CUL for TPH-D/HO in subsurface soils (i.e., below 15 feet bgs) is 5,630 mg/kg. It is, however, understood that residual saturation varies at the Site. Therefore, the

TPH-D/HO CUL for subsurface soil is used to identify areas requiring cleanup action, but compliance with the cleanup standards will be based on the absence of LNAPL in monitoring wells (and not on TPH-D/HO concentrations in subsurface soils).

### 4.5 POINT OF COMPLIANCE

MTCA defines the point of compliance as the point or points where CULs shall be attained. Once CULs are met at the point of compliance, the Site is no longer considered a threat to human health or the environment.

WAC 173-340-740(6) gives the point of compliance requirements for soil. The standard point of compliance for soil CULs based on protection of the direct contact pathway is established at a depth of 15 feet. The standard point of compliance for soil CULs based on protection of groundwater is throughout the soil column.

The standard point of compliance for groundwater CULs will be all groundwater beneath the Site from the top of the saturated zone to the lowest depth that could be affected by the Site.

## 5.0 SITE-SPECIFIC CLEANUP OBJECTIVES FOR LNAPL

Ecology and the PLPs established: (1) a screening level for assessing areas of the Site where active cleanup technologies will be used for mobile LNAPL, and (2) the approximate timeframe for achieving CULs at the points of compliance at the Site (i.e., the restoration timeframe).

### 5.1 LNAPL SCREENING LEVEL

A mobile LNAPL thickness of 1 foot or greater has been established as a screening level for where active cleanup technologies will be used for mobile LNAPL. This screening level is not the same as the LNAPL CUL. The screening level is set higher than the CUL and is used to focus more aggressive cleanup technologies (and/or a contingent cleanup technology) on areas having the highest accumulations of mobile LNAPL. This screening level was identified in the FS.

Mobile LNAPL thickness data from the RI was used in the FS to approximate1-foot and 0-foot (i.e., no measurable) LNAPL isopleths for the Site (Figure 4). The Site area encompassing the primary source area and the historically highest accumulations of mobile LNAPL is defined in the FS as the high RTF area (Figure 4). The mobile LNAPL in that area would receive active remediation and, if necessary, a contingent remedy. The Site area having mobile LNAPL thicknesses greater than 1 foot, but excluding the high RTF area, is referred to as the medium RTF area (Figure 4). The mobile LNAPL in the medium RTF area would receive active remediation, but no contingent remedy. The Site area having mobile LNAPL thicknesses of 1 foot or less is identified as the low RTF area (Figure 4) and the mobile LNAPL in that area would receive passive remediation or NSZD.

### 5.2 Restoration Timeframe

To drive continuous improvement and adaptive management of the active cleanup technologies, Ecology has established an overall restoration timeframe (RTF) for the Site of 20 years. This period is consistent with the alternatives presented in the FS and evaluated in this CAP. As discussed in Section 6.7, Ecology is selecting both a primary remedy alternative and a contingent alternative for addressing deep contamination (intermediate soil, deep soil, LNAPL, and groundwater) in the high RTF Area. While a 20-year timeframe is longer than the timeframes presented in the FS with respect to any single deep contamination alternative, Ecology has determined that it is appropriate to allow adequate time to determine whether the primary alternative is successful before triggering the contingent remedy, given the disproportionate cost analysis factors discussed in Section 6.6.2.3. A 20-year timeframe allows adequate time to determine whether the primary alternative is proving effective, while allowing time to implement the contingent alternative if the primary alternative is not effective. An RTF of 20-years is intended to be the measure by which the performance of alternatives will be evaluated. However, it is Ecology's goal that cleanup standards at the Site are attained as quickly as practicable. The initiation of the RTF starts following construction, start-up, and an initial period of shakedown for the selected cleanup action.

## 6.0 Cleanup Action Selection

### 6.1 Remedial Action Objectives

The remedial action objectives are statements describing the actions necessary to protect human health and the environment by eliminating, reducing, or otherwise controlling risks posed through each exposure pathway and migration route. They are developed considering the characteristics of the contaminated media, the characteristics of the hazardous substances present, migration and exposure pathways, and potential receptor points.

Soil and groundwater have been contaminated by past activities at the Site. Given the current status of the Site, people may be exposed to contaminated soil via dermal contact or inhalation of dust, or contaminated groundwater via dermal contact or ingestion (however, no water well is installed in the area of contaminated groundwater). Potential human receptors include on-Site workers, trespassers, residents, and recreational users. As described in Section 4.3 above, exposure to both plant and animal receptors is not likely under the current and proposed Site use.

Given these potential exposure pathways, the following are the remedial action objectives for the Site:

- Prevent direct contact, ingestion, or inhalation of contaminated soil by humans.
- Prevent direct contact or ingestion of contaminated groundwater by humans.

## 6.2 Cleanup Action Alternatives

Cleanup alternatives to meet these remedial action objectives are evaluated as part of the FS. The FS evaluated multiple alternatives for addressing all contaminated media at the Site.

The RI determined that preliminary CULs were exceeded in four different media/media zones (Figure 4):

- Surface soil (between ground surface and 15 feet bgs)
- Intermediate soil (between groundwater and15 feet bgs)
- LNAPL
- Groundwater

Each remedial alternative is summarized below. The alternatives are presented as described in the FS, together with selected Ecology observations. For more detailed explanations of each remedial alternative, please refer to the FS.

## 6.3 Surface Soil Alternatives

The following two alternatives for the remediation of surface soil are based on remedies evaluated in the FS.

### 6.3.1 Surface Soil Alternative A (SS-A): Capping and Institutional Controls

This alternative would, at each of the five surface soil contaminated areas, excavate the top three feet of contaminated soil, which would then be transported off-site for disposal at a landfill permitted to receive the contaminated soil. Clean soil would be imported and placed into the excavations to act as a physical separation layer. Compliance sampling would occur in the excavation walls prior to backfill to ensure the lateral extent of contamination was removed. In addition, remaining underground piping and infrastructure would be removed and disposed at an off-site landfill.

Institutional controls would be implemented at the Site, including an environmental covenant to prohibit excavation into contaminated soil located below three feet bgs. The environmental covenant would remain in place until CULs are achieved.

### 6.3.2 Surface Soil Alternative B (SS-B): Excavation and Off-Site Disposal

This alternative would, at each of the five surface soil contaminated areas, excavate contaminated soil exceeding CULs to a depth of 15 feet bgs and transport it off-Site for disposal at a landfill. Excavation may extend deeper if high-concentration source material is encountered and readily accessible and removable without resorting to shoring or other substantive measures. All excavations would be backfilled (and compacted) with clean imported fill soil. Excavated soil exceeding CULs would be transported to a permitted landfill for disposal. Compliance sampling would occur in the excavation walls prior to backfill to ensure the lateral extent of contamination was removed. In addition, remaining underground piping and infrastructure would be removed and disposed at an off-Site landfill. CULs would be achieved in the upper 15 feet of contaminated soil upon completion of the excavation.

## 6.4 Deep Contamination (Intermediate Soil, LNAPL, and Groundwater)

The following five alternatives for the remediation of deep contamination are based on remedies evaluated in the FS. For the purpose of analysis, the area of deep contamination is divided into three sub-areas based on RTFs projected in the FS. The high, medium, and low RTF areas are depicted in Figure 4 and are defined as follows:

- The high RTF area encompasses the primary source area at the Site and contains the largest amount of contamination per acre;
- The medium RTF area includes the area containing one foot or more of gauged LNAPL, minus the high RTF area; and
- The low RTF area includes the area containing any measureable thickness of LNAPL, minus the high and medium RTF areas.

### 6.4.1 Deep Contamination Alternative A (DC-A): Natural Source Zone Depletion

This alternative applies NSZD throughout the mobile LNAPL area and intermediate soil. DC-A does not meet MTCA requirements that prohibit reliance on natural processes alone to clean up LNAPL sites where more active remedial measures are practicable. See WAC 173-340-360(2)(a), (b), (c); see also, WAC 173-340-370(1), (7). This alternative is therefore not considered further in this DCAP.

### 6.4.2 Deep Contamination Alternative B (DC-B): Bioventing/Biosparging

This alternative utilizes bioventing and biosparging in the medium and high RTF areas. Bioventing is the injection of air into subsurface soil and biosparging is the injection of air into the groundwater. Bioventing is intended to accelerate, *in the unsaturated zone*, the natural biodegradation processes achieved by NSZD alone. Biosparging is intended to accelerate, *in the saturated zone*, the natural biodegradation processes achieved by NSZD alone.

The FS estimates that 8 and 14 years of bioventing/biosparging would be required to remediate mobile LNAPL in the medium and high RTF areas, respectively. Performance monitoring would be conducted to measure degradation rates. Progress of the remedial action toward achieving the CULs within the 20-year RTF would be considered as discussed in Section 7.7.

If performance monitoring indicates that meeting the 20-year RTF would be at risk, then subsequent phases of bioventing/biosparging optimization would be implemented. As described in the FS, optimization techniques could include increasing the air flow to existing wells, combining air injection with extraction in a push-pull configuration, increasing the density of injection wells, additional biosparging, bioaugmentation, and/or heated bioventing.

Cleanup of the low RTF area would occur via NSZD. The FS estimates that NSZD would require seven years to remediate LNAPL in the low RTF area.

Groundwater monitoring would occur until CULs are achieved in all Site areas. As identified in Ecology's comments to the draft RI/FS documents, dissolved-phase groundwater treatment may also be required and would be considered as discussed in Sections 7.2 and 7.7.

Institutional controls would be implemented at the Site, including an environmental covenant to prohibit both the development of groundwater for drinking water purposes as well as excavation into contaminated soil located below 15 feet bgs. The environmental covenant would remain in place until CULs are achieved for soil and groundwater.

#### 6.4.3 Deep Contamination Alternative C (DC-C) Bioventing, Biosparging, and Manual LNAPL Removal

This alternative retains all aspects of DC-B (bioventing/biosparging) with the addition of a network of LNAPL removal wells in the high RTF area. The FS indicates manual LNAPL removal is not expected to appreciably reduce the RTF in the high RTF area.

Cleanup of the low RTF area would occur via NSZD. The FS estimates that NSZD would require seven years to remediate LNAPL in the low RTF area.

Groundwater monitoring would occur until CULs are achieved in all Site areas. As identified in Ecology's comments to the draft RI/FS documents, dissolved-phase groundwater treatment may also be required and would be considered as discussed in Sections 7.2 and 7.7.

Institutional controls would be implemented at the Site, including an environmental covenant to prohibit both the development of groundwater for drinking water purposes as well as excavation into contaminated soil located below 15 feet bgs. The environmental covenant would remain in place until CULs are achieved.

#### 6.4.4 Deep Contamination Alternative D (DC-D): Steam-Enhanced LNAPL Extraction

This alternative utilizes steam-enhanced LNAPL extraction (SEE) in the high RTF area and bioventing/biosparging in the medium RTF area. Bioventing/biosparging would be implemented in the high RTF area following application of SEE. SEE involves the injection of steam into the contaminated subsurface which would reduce LNAPL viscosity, making it more mobile in the subsurface and amenable to removal via pumping. It is estimated that SEE would operate for up to three years in the high RTF area, followed by an additional few years of bioventing/biosparging.

Cleanup of the low RTF area would occur via NSZD. The FS estimates that NSZD would require seven years to remediate LNAPL in the low RTF area.

Groundwater monitoring would occur until CULs are achieved in all Site areas. As identified in Ecology's comments to the draft RI/FS documents, dissolved-phase groundwater treatment may also be required and would be considered as discussed in Sections 7.2 and 7.7.

Institutional controls would be implemented at the Site, including an environmental covenant to prohibit both the development of groundwater for drinking water purposes as well as excavation into contaminated soil located below 15 feet bgs. The environmental covenant would remain in place until CULs are achieved.

#### 6.4.5 Deep Contamination Alternative E (DC-E): Smoldering Combustion

This alternative utilizes smoldering combustion in the high and medium RTF areas. Smoldering combustion thermally treats combustible materials (in this case, the petroleum contaminating the Site) in the ground. Smoldering combustion involves igniting petroleum contamination in the ground until a smoldering front is developed. The smoldering front is propagated by injecting air into the ground. This is a newer technology that has not been previously implemented at a site as complicated as Black Tank, and thus some concern over remedial effectiveness exists. The FS estimates that, if effective, smoldering combustion would require one year to treat the contamination in the high and medium RTF areas.

Cleanup of the low RTF LNAPL area would occur via NSZD. The FS estimates that NSZD would require seven years to remediate LNAPL in the low RTF area.

Groundwater monitoring would occur until CULs are achieved in all Site areas.

Institutional controls would be implemented at the Site, including an environmental covenant to prohibit both the development of groundwater for drinking water purposes as well as excavation into contaminated soil located below 15 feet bgs. The environmental covenant would remain in place until CULs are achieved.

### 6.5 REGULATORY REQUIREMENTS

MTCA sets forth the minimum requirements and procedures for selecting a cleanup action. A cleanup action must meet each of the minimum requirements specified in WAC 173-340-360(2), including certain threshold and other requirements. These requirements are outlined below.

#### 6.5.1 Threshold Requirements

WAC 173-340-360(2)(a) requires that the cleanup action shall:

- Protect human health and the environment;
- Comply with cleanup standards (see Section 4.0);
- Comply with applicable state and federal laws (see Section 6.5.4); and
- Provide for compliance monitoring.

#### 6.5.2 Other Requirements

In addition, WAC 173-340-360(2)(b) states the cleanup action shall:

- Use permanent solutions to the maximum extent practicable;

- Provide for a reasonable RTF; and
- Consider public concerns.

WAC 173-340-360(3) describes the specific requirements and procedures for determining whether a cleanup action uses permanent solutions to the maximum extent practicable. A permanent solution is defined as one where CULs can be met without further action being required at the Site other than the disposal of residue from the treatment of hazardous substances. To determine whether a cleanup action uses permanent solutions to the maximum extent practicable, a disproportionate cost analysis is conducted. This analysis compares the costs and benefits of the cleanup action alternatives and involves the consideration of several factors, including:

- Protectiveness;
- Permanent reduction of toxicity, mobility, and volume;
- Cost;
- Long-term effectiveness;
- Short-term risk;
- Implementability; and
- Consideration of public concerns.

The comparison of benefits and costs may be quantitative, but will often be qualitative and require the use of best professional judgment.

WAC 173-340-360(4) describes the specific requirements and procedures for determining whether a cleanup action provides for a reasonable RTF.

### 6.5.3 Cleanup Action Expectations

WAC 173-340-370 sets forth the following expectations for the development of cleanup action alternatives and the selection of cleanup actions. These expectations represent the types of cleanup actions Ecology considers likely results of the remedy selection process; however, Ecology recognizes that there may be some sites where cleanup actions conforming to these expectations are not appropriate.

- Treatment technologies will be emphasized at sites with liquid wastes, areas with high concentrations of hazardous substances, or with highly mobile and/or highly treatable contaminants;
- To minimize the need for long-term management of contaminated materials, hazardous substances will be destroyed, detoxified, and/or removed to concentrations below CULs throughout sites with small volumes of hazardous substances;
- Engineering controls, such as containment, may need to be used at sites with large volumes of materials with relatively low levels of hazardous substances where treatment is impracticable;
- To minimize the potential for migration of hazardous substances, active measures will be taken to prevent precipitation and runoff from coming into contact with contaminated soil or waste materials;

- When hazardous substances remain on-site at concentrations which exceed CULs, they will be consolidated to the maximum extent practicable where needed to minimize the potential for direct contact and migration of hazardous substances;
- For sites adjacent to surface water, active measures will be taken to prevent/minimize releases to that water; dilution will not be the sole method for demonstrating compliance;
- Natural attenuation of hazardous substances may be appropriate at sites under certain specified conditions (see WAC 173-340-370(7)); and
- Cleanup actions will not result in a significantly greater overall threat to human health and the environment than other alternatives.

#### 6.5.4 Applicable, Relevant, and Appropriate State and Federal Laws, and Local Requirements

WAC 173-340-710(1) requires that all cleanup actions comply with all applicable local, state, and federal law. It further states the term "applicable state and federal laws" shall include legally applicable requirements and those requirements that the department determines "…are relevant and appropriate requirements." This section discusses applicable state and federal law, relevant and appropriate requirements, and local permitting requirements that were considered and were of primary importance in selecting cleanup requirements. If other requirements are identified at a later date, they will be applied to the cleanup actions at that time.

MTCA provides an exemption from the procedural requirements of several state laws and from any laws authorizing local government permits or approvals for remedial actions conducted under a consent decree, order, or agreed order (RCW 70.105D.090). However, the substantive requirements of a required permit must be met. The procedural requirements of the following state laws are exempted:

- Ch. 70.94 RCW, Washington Clean Air Act;
- Ch. 70.95 RCW, Solid Waste Management, Reduction, and Recycling;
- Ch. 70.105 RCW, Hazardous Waste Management;
- Ch. 75.20 RCW, Construction Projects in State Waters;
- Ch. 90.48 RCW, Water Pollution Control; and
- Ch. 90.58 RCW, Shoreline Management Act of 1971.

WAC 173-340-710(4) sets forth the criteria Ecology evaluates when determining whether certain requirements are relevant and appropriate for a cleanup action. Table 3 lists the local, state, and federal laws containing the applicable or relevant and appropriate requirements that apply to the cleanup action at the Site. Local laws, which may be more stringent than specified state and federal laws, will govern where applicable.

### 6.6 Evaluation of Cleanup Action Alternatives

The requirements and criteria outlined in Section 6.6 are used to conduct a comparative evaluation of the cleanup action alternatives and to select a cleanup action from those alternatives. Table 4 provides a summary of the ranking of the deep contamination alternatives against the various criteria. Note that as stated in Section 6.4.1, DC-A is not a viable alternative under MTCA and is not further considered or evaluated. The comparative evaluation of the cleanup action alternatives against the requirements and criteria are summarized below.

### 6.6.1 Threshold Requirements

#### *6.6.1.1 Protection of Human Health and the Environment*

- Surface Soil Contamination: SS-A would reduce the risk posed from Site-related contamination, as it would no longer be available for direct contact by human and ecological receptors; however, it may not eliminate the soil-to-groundwater pathway. SS-B would eliminate the risk posed from Site-related contaminated surface soil through complete removal of soil exceeding the CULs to a depth of at least 15 feet bgs. SS-B is more protective of human health and the environment.

- Deep Contamination: Assuming remedy effectiveness, all four deep contamination alternatives (DC-B through DC-E) would achieve protection of human health and the environment, but over different RTFs. These timeframes are evaluated in Section 6.6.2.3.

#### *6.6.1.2 Compliance with Cleanup Standards*

- Surface Soil Contamination: Both shallow soil alternatives would eventually achieve compliance with cleanup standards.

- Deep Contamination: Assuming remedy effectives, all four deep contamination alternatives (DC-B through DC-E) would achieve compliance with cleanup standards, although over different RTFs. These timeframes are evaluated in Section 6.6.2.3.

#### *6.6.1.3 Compliance with Local, State, and Federal Laws*

- Shallow Soil Contamination: Both shallow soil alternatives would be performed in compliance with applicable state and federal laws listed in Table 3. Local laws, which can be more stringent, will govern actions when they are applicable. These would be established during the design phase of the project.

- Deep Contamination: All four deep contamination alternatives (DC-B through DC-E) would be performed in compliance with applicable state and federal laws listed in Table 3. Local laws, which can be more stringent, will govern actions when they are applicable. These would be established during the design phase of the project.

#### *6.6.1.4 Provision for Compliance Monitoring*

There are three types of compliance monitoring: protection, performance, and confirmational. Protection monitoring is designed to protect human health and the environment during the construction and operation and maintenance phases of the cleanup action. Performance monitoring confirms the cleanup action has met cleanup and/or performance standards.

Confirmational monitoring confirms the long-term effectiveness of the cleanup action once cleanup standards have been met or other performance standards have been attained.

Both shallow soil alternatives and all four deep contamination alternatives (DC-B through DC-E) would meet this provision as all require varying levels of all three types of compliance monitoring.

### 6.6.2 Other Requirements

#### *6.6.2.1 Use of Permanent Solutions to the Maximum Extent Practicable*

As discussed previously, to determine whether a cleanup action uses permanent solutions to the maximum extent practicable, the disproportionate cost analysis specified in the regulation is used. The analysis compares the costs and benefits of the cleanup action alternatives and involves the consideration of several factors. The comparison of costs and benefits may be quantitative, but will often be qualitative and require the use of best professional judgment. Table 4 provides a summary of the relative ranking of each deep contamination alternative in the decision process. The relative ranking of each deep contamination alternative for each of the evaluation factors is summarized below.

- Protectiveness measures the degree to which existing risks are reduced, time required to reduce risk and attain cleanup standards, on- and off-site risks resulting from implementing the alternative, and improvement of overall environmental quality.

  Shallow Soil Contamination: SS-B would be more protective than SS-A, as all future risk from shallow contamination would be removed from the Site.

  Deep Contamination: Although all the alternatives would eventually be protective, DC-D and DC-E would be more protective than DC-B or DC-C, as the time required to reduce risk and attain cleanup standards would be much shorter, assuming remedy effectiveness. DC-C is slightly more protective that DC-B, as cleanup would occur in slightly less time, again assuming remedy effectiveness.

- Permanent reduction of toxicity, mobility, and volume measures the adequacy of the alternative in destroying the hazardous substance(s), the reduction or elimination of releases or sources of releases, the degree of irreversibility of any treatment process, and the characteristics and quantity of any treatment residuals.

  Shallow Soil Contamination: SS-B would be more permanent than SS-A, as all shallow contamination would be removed from the Site.

  Deep Contamination: DC-D and DC-E would be more permanent than DC-B or DC-C, as less soil contamination and smear zone contamination would remain at the conclusion of SEE or smoldering compared to the amount of contamination that would remain at the end of bioventing. DC-C and DC-B have a similar level of permanence.

- Cleanup costs are estimated based on specific design assumptions for each alternative. Although the costs are estimates based on design assumptions that might change, the relative costs can be used for this evaluation. For a detailed description of the costs involved with each alternative, please refer to the FS.

  Shallow Soil Contamination: SS-A (capping) is estimated to cost $490,000, and SS-B (excavation and off-Site disposal) is estimated to cost $1,500,000.

  Deep Contamination: DC-B (bioventing/biosparging) is estimated to cost $5,451,000. DC-C (DC-B + manual LNAPL recovery) is estimated to cost $8,888,000. DC-D (DC-B + SEE) is estimated to cost $19,500,000. DC-E (smoldering combustion) is estimated to cost $25,073,000.

- Long-term effectiveness measures the degree of success, the reliability of the alternative during the period that hazardous substances will remain above cleanup levels, the magnitude of residual risk after implementation, and the effectiveness of controls required to manage remaining wastes.

  Shallow Soil Contamination: SS-B would be more effective for the long-term than SS-A, as all shallow contamination would be removed from the Site.

  Deep Contamination: DC-D and DC-E would rank higher than DC-B or DC-C, as less soil contamination and smear zone contamination (less residual risk) would remain at the conclusion of SEE or smoldering compared to the amount of contamination that would remain at the end of bioventing. DC-C and DC-B have a similar level of long-term effectiveness.

- Short-term risk measures the risks related to an alternative during construction and implementation, and the effectiveness of measures that will be taken to manage such risks.

  Shallow Soil Contamination: SS-A would have a lower short-term risk since less excavation and contaminated soil transport would occur as compared to SS-B. However, both alternatives utilize standard construction techniques and any risks are easily mitigated.

  Deep Contamination: DC-D and DC-E would have a higher short-term risk as compared to DC-B or DC-C because both DC-D and DC-E utilize more aggressive and labor-intensive technologies. Risks associated with DC-E include the release of combustion byproducts into the environment. Risks associated with DC-D include the potential to mobilize contaminants at depth, however, effective measures can be taken to manage the short-term risks associated with DC-D, which results in it ranking higher than DC-E.

- Implementability considers whether the alternative is technically possible, the availability of necessary off-site facilities, services, and materials, administrative and regulatory requirements, scheduling, size, complexity, monitoring requirements, access for operations and monitoring, and integrations with existing facility operations.

  Shallow Soil Contamination: Both SS-A and SS-B are fully implementable at this Site. SS-A ranks slightly lower, as it requires inspection and maintenance until the contamination degrades to a point of meeting CULs.

  Deep Contamination: All four deep contamination alternatives are implementable at the Site. DC-E would rank the lowest for implementability, as smoldering combustion has not yet been utilized at a site of this magnitude. DC-B would rank the highest for implementability due to its simplicity and ability to be utilized at a site with very deep contamination. DC-C would be slightly less implementable than DC-B, as adding manual LNAPL removal increases complexity. DC-D would rank between DC-E and DC-C in terms of implementability as DC-D is a more complicated process than DC-C yet a more proven technology when compared to DC-E.

- To understand and consider public concerns, Ecology presented the RI/FS for public review and comment. Most comments involved possible remedial alternatives for the deep contamination and are discussed below. This DCAP will also undergo public review and comment.

  Shallow Soil Contamination: Few comments were received regarding the remedial alternatives for shallow soil contamination; however, those that were received favored excavation (SS-B) over capping (SS-A).

  Deep Contamination: Many comments were received regarding the remedial alternatives for deep contamination. Generally, smoldering combustion (DC-E) was the least desirable, while bioventing/biosparging with manual LNAPL (DC-C) was the most favorable. Concerns with DC-B (bioventing/biosparging) included being the least expensive and longest-term alternative. Concerns with DC-D (SEE) included the mobilization of contaminants into the aquifer.

*6.6.2.2 Disproportionate Cost Analysis Results*

Costs are disproportionate to the benefits if the incremental costs of an alternative are disproportionate to the incremental benefits of that alternative.

Shallow Soil Contamination: Based on the analysis of the factors listed above, Ecology determined that the additional cost of SS-B is not disproportionate to its incremental benefit over SS-A. In addition, because SS-B is a permanent remedy, a disproportionate cost analysis is not necessary to complete the shallow soil remedy selection.

Deep Contamination: Table 4 summarizes the relative ranking of each deep contamination alternative in the decision process. Based on the analysis of the factors listed above, Ecology determined that the additional cost of DC-E is disproportionate to its incremental benefit over other alternatives. The additional costs of DC-C or DC-D over DC-B are disproportionate to the incremental benefits of DC-C or DC-D, so long as the estimated restoration time frames associated with DC-B are met. If DC-B is incapable of meeting estimated restoration time frames, then the additional costs of DC-C or DC-D over DC-B *are not* disproportionate to the incremental benefits of DC-C or DC-D.

*6.6.2.3 Provide a Reasonable Restoration Timeframe*

WAC 173-340-360(4) describes the specific requirements and procedures for determining whether a cleanup action provides for a reasonable RTF, as required under subsection (2)(b)(ii). The factors used to determine whether a cleanup action provides a reasonable RTF are set forth in WAC 173-340-360(4)(b). The following RTF estimates were provided in the FS and are all based on the assumptions that the individual remedy is effective and remediation of mobile LNAPL is the driver for the RTF. A summary of the comparative analysis of the estimated RTFs for the alternatives is provided below.

- Shallow Soil Contamination: SS-B would have a shorter RTF than SS-A.

- Deep Contamination: DC-E would have an RTF in the high and medium RTF areas of approximately one year. DC-D would have an RTF in the high and medium RTF areas of approximately three and eight years, respectively. DC-C would have an RTF in the high and medium RTF areas of approximately 14 and 8 years, respectively. DC-B would also have an RTF in the high and medium RTF areas of approximately 14 and 8 years, respectively.

The RTF in the low RTF area for all alternatives would be seven years utilizing NSZD.

These estimated RTFs indicate all deep contamination alternatives would provide for a reasonable RTF (i.e., less than or equal to 20 years for the depletion of mobile LNAPL).

6.6.3 Groundwater Cleanup Action Requirements

Cleanup actions that address groundwater must meet the specific requirements described in WAC 173-340-360(2)(c). Assuming remedy effectiveness, all of the deep contamination alternatives (DC-B through DC-E) meet the requirement for use of a permanent groundwater cleanup action.

6.6.4 Cleanup Action Expectations

Specific expectations of cleanup actions are outlined in WAC 173-340-370 and are described in Section 6.5.3. The alternatives, *if successful*, would address applicable expectations in the following manner.

Shallow Soil Contamination:

- SS-A would excavate the top three feet of the contaminated shallow soil and would use engineering controls such as an asphalt cap at the Site to reduce the risk posed by the remaining hazardous substances remaining between 3 and 15 feet bgs.
- SS-B would remove all contaminated materials from the ground surface to 15 feet bgs to concentrations less than cleanup levels, which would eliminate the requirement for long-term management.

Deep Contamination:

- The FS estimates that DC-B would treat petroleum contamination lower than 15 feet bgs and achieve cleanup levels in the low, medium, and high RTF areas within 7, 8, and 14 years, respectively.
- The FS estimates that DC-C would treat petroleum contamination lower than 15 feet bgs and achieve cleanup levels in the low, medium, and high RTF areas within 7, 8, and 14 years, respectively.
- The FS estimates that DC-D would treat petroleum contamination lower than 15 feet bgs and achieve cleanup levels in the low, medium, and high RTF areas within 7, 8, and 3 years, respectively.
- The FS estimates that DC-E would treat petroleum contamination lower than 15 feet bgs and achieve cleanup levels in the low, medium, and high RTF areas within 7, 1, and 1 year, respectively.

## 6.7 Decision

Based on the analysis described above, SS-B has been selected as the proposed remedial action for shallow soil contamination at the Site. DC-B, with a contingent remedy of DC-D for the high RTF area, as outlined in Section 7.0 below, has been selected as the proposed remedial action for deep soil contamination and free product at the Site. DC-B costs less than half of DC-D and has a reasonable restoration timeframe, *if it is successful in meeting the projected RTF*.

If for any reason DC-B is not successful in achieving cleanup standards within the projected RTF (subject to the criteria in section 7.3), DC-D is chosen as a required contingent remedy within the high RTF[1] area so long as DC-D is determined to be feasible.

DC-E is not selected as it has been determined that its cost is disproportionate to any additional environmental benefit over that of other available alternatives. The selected remedies (SS-B for shallow soil contamination and the combination of DC-B and DC-D for deep contamination) meet each of the minimum requirements for remedial actions. Careful remedial monitoring and operation will be required to minimize the potential for any part of the chosen remedy to

[1] Because contingent remedy infrastructure cannot be installed within the footprint of an active freeway, portions of the high RTF area, if any, that are inaccessible because of the NSC freeway may not be addressed using the contingent remedy.

mobilize contamination. As identified in Ecology's comments to the draft RI/FS documents, dissolved-phase groundwater treatment may also be required. If at any point in the cleanup process, monitoring indicates the dissolved-phase plume poses a material risk of: (1) significantly increasing in off-site size and/or magnitude, or (2) not achieving the dissolved phase groundwater cleanup standards within the 20-year RTF, the DC-B technologies capable of treating the dissolved-phase groundwater plume may be expanded to other areas of the Site as needed to address these issues.

# 7.0 SELECTED REMEDIAL ACTION

## 7.1 SHALLOW SOIL CONTAMINATION – EXCAVATION

The selected cleanup action for shallow soil at the Site includes the excavation of contaminated soil exceeding CULs in the five surface soil contamination areas to depths of 15 feet bgs (Figure 4). The contaminated soil will be transported off Site for disposal at a landfill facility permitted to accept the waste. Excavation may extend deeper if high-concentration source material is encountered and readily accessible for removal without resorting to shoring or other substantive measures.

All excavations shall be backfilled (and compacted) with clean imported fill soil. Compliance sampling shall occur in the excavation walls prior to backfill to ensure the lateral extent of contamination was removed. Performance sampling shall occur in the excavation bottom to document the level of contamination left in place. In addition, remaining underground piping and infrastructure throughout the Site shall be removed and disposed at an off Site landfill.

## 7.2 DEEP CONTAMINATION

The selected cleanup action for deep contamination at the Site uses bioventing/biosparging in the medium and high RTF areas and NSZD in the low RTF area. Due to the uncertainty associated with the RTF of bioventing/biosparging in the high RTF area, SEE has been selected as a contingent remedy for the high RTF area. Performance monitoring will be conducted to assess: (1) progress of the cleanup action, (2) whether achieving cleanup standards throughout the Site within the 20-year RTF is at material risk, and (3) adaptive management actions to be taken to keep the cleanup action on track.

If performance monitoring indicates that the 20-year RTF is at risk, optimization of bioventing/biosparging will be aggressively performed in the medium and high RTF areas. If performance monitoring conducted following optimization efforts in the high RTF area show that achieving the cleanup standards in that area within the 20-year RTF is at material risk (consistent with the process outlined in subsequent sections), the contingent remedy (SEE) will be considered for implementation in that area.

The tasks to be implemented for the deep contamination cleanup action and the decision-making process for system optimization and contingent remedy implementation are summarized on Tables 5 (Deep Contamination Cleanup Action Summary) and 6 (Deep Contamination Cleanup Action Timeline) and in subsequent text below. This process was designed by the PLPs and

Ecology to encourage continuous improvement and adaptive management of the cleanup action to achieve the cleanup standards within the 20-year RTF.

The bioventing/biosparging systems shall be operated until mobile LNAPL is no longer present in the medium and high RTF areas, or until no appreciable increase in contaminant destruction over that of demonstrated NSZD is attained, so long as cleanup standards for mobile LNAPL and dissolved-phase contaminants will be achieved within the 20-year RTF.

Careful remedial monitoring and operation will be required to minimize the potential for any part of the chosen remedy to mobilize contamination. As previously indicated, dissolved-phase groundwater treatment may also be required. If at any point in the cleanup process, monitoring indicates the dissolved-phase plume poses a material risk of: (1) significantly increasing in off-Site size and/or magnitude, or (2) not achieving the dissolved phase groundwater cleanup standards within the 20-year RTF, the DC-B technologies capable of treating the dissolved-phase groundwater plume may be expanded to other areas of the Site as needed to address these issues.

### 7.2.1 Engineering Design Report - Bioventing/Biosparging

The PLPs will submit an Engineering Design Report (EDR), including a Compliance Monitoring Plan (CMP), for Ecology's review and approval. The EDR will document the design-basis, civil/mechanical design, and permitting necessary for implementation of the primary cleanup action (i.e., bioventing/biosparging for deep contamination and excavation for shallow soil contamination). The CMP will describe: (1) confirmation monitoring required for excavation of contaminated shallow soil, (2) protection monitoring for dust control during any work with contaminated soil, and (3) performance monitoring for verification that cleanup standards are being met by the deep contamination remedy(ies). If needed, a supplemental EDR will be prepared to describe implementation of the contingent remedy.

In advance of and to support completion of the initial EDR, certain data will need to be collected. A work plan for obtaining the following information will be prepared and executed as the first step in the remedial design process following approval of the DCAP. The following scope of work items will be addressed in the work plan:

- Determination of the bioventing radius of influence (ROI);
- SEE propagation test; and
- Baseline parameter monitoring.

The bioventing ROI is a key design parameter. A standard ROI determination involves measuring air flow and pressure with distance from an air injection well completed in the formation where remediation is to occur. The ROI will be used to establish bioventing well spacing in the EDR.

The SEE propagation test will be used to determine the energy requirements and ROI of steam injection wells. This propagation study shall be completed in a low-risk portion of the LNAPL plume to ensure similar geologic and contaminant conditions between the propagation test and, if necessary, full-scale implementation. If the study determines that steam cannot be effectively propagated from a steam injection well, then SEE will be deemed technically infeasible and not considered further as a contingent remedy. Effective propagation is defined as achieving conditions adequate to enhance LNAPL flow in the stratigraphic units containing mobile LNAPL such that the injection well ROI is 60 feet or greater.

Baseline parameter monitoring will be undertaken to confirm initial conditions at the Site prior to active cleanup commencing. Protocols for obtaining the baseline information will be established in the work plan. The monitoring will establish baseline estimates of:

- Mobile LNAPL mass: The mass of mobile LNAPL at the Site was estimated in the RI/FS report; however, data collected during monitoring events subsequent to the RI/FS report will be used to prepare a baseline estimate of mobile LNAPL mass. Mobile LNAPL mass is expected to decrease with time, both prior to and during cleanup operations.
- LNAPL viscosity: LNAPL viscosity is a measure of LNAPL's resistance to flow and is expected to increase with time during cleanup operations.
- LNAPL transmissivity: LNAPL transmissivity is an indicator of the potential for LNAPL to move through the formation; an indicator of mobility. Transmissivity is expected to decrease with time during cleanup operations.

The design parameters for the bioventing/biosparging system will include: the baseline monitoring data, the design of the future highway and railway systems in the Site area, potential adaptive management and optimization concepts for the bioventing/biosparging system, and potential use for the contingent remedy, if needed. For example, the biosparging wells to be constructed in the high RTF area shall be designed to serve a dual purpose and be used in the future as steam injection wells should the contingent remedy be required. Unless SEE is shown to be technically infeasible, the well diameter, construction materials, screen location, and all other characteristics of high RTF area biosparging wells will conform to steam injection well standards.

The following documents will be attached to the EDR as appendices:

- Health and Safety Plan: Details the potential project hazards and the actions to be taken to address and respond to hazards.
- System Operations and Maintenance Plan: Details the practices and procedures necessary to operate and maintain the mechanical systems. The plan will provide information on process operating procedures, process data collection/reporting, and preventative maintenance.
- CMP: Details the scope, parameters, methods, and frequency to track remediation performance; informs system optimizations; and determines whether degradation rates are sufficient to achieve the 20-year RTF.

#### 7.2.2 Implementation Phasing - Bioventing/Biosparging

As shown in Tables 5 and 6, the first phase of bioventing/biosparging implementation is construction, startup, and an initial period of system shakedown. These activities will take up to 2 years (Years B and C, as needed; Table 6) following completion of the EDR. No wells or other remediation infrastructure shall be required to be installed if that infrastructure would potentially require removal or relocation to accommodate WSDOT access and work for the NSC.

Active remediation begins following system shakedown and is assumed to extend through the full 20-year RTF period (Years 1 through 20 on Table 6), unless cleanup standards are achieved or until no appreciable increase in contaminant destruction is observed compared to NSZD and cleanup standards will be achieved within the 20-year RTF. As shown in Table 5, system evaluation and optimization are anticipated to occur throughout active operation of the bioventing/biosparging system in both the high and medium RTF areas. As described in the FS, optimization techniques could include changing and/or increasing the air flow to existing wells, cycling, combining air injection with extraction in a push-pull configuration, increasing the density of bioventing and/or biosparging wells, bioaugmentation, and/or heated bioventing. Optimization will be performed in a sequential manner. Initially, the results of in situ respiration testing will be used to optimize the air flow rates of the base bioventing/biosparging system. Then the results of several performance metrics (respiration rate, LNAPL viscosity, LNAPL transmissivity, and mobile LNAPL mass) will be used to assess and optimize performance, as needed, to achieve the cleanup standards within the 20-year RTF.

Optimizing bioventing/biosparging will be critical to achieving cleanup standards in the medium and high RTF areas in 20 years. It is understood that each optimization step for the bioventing/biosparging system will require an appropriate amount of time to evaluate the performance of the optimization prior to moving to the next optimization step. However, it remains Ecology's goal to obtain cleanup as quickly as practicable. These understandings, coupled with the contingent remedy triggers described in section 7.3, will necessitate optimization of bioventing/biosparging in the event that the 20-year RTF for the high and/or medium RTF areas is at risk of not being met.

### 7.2.3 Performance Monitoring – Bioventing/Biosparging

Performance monitoring shall be conducted to assess progress of the cleanup action and whether achieving cleanup standards within the 20-year RTF is at risk. Consistent with the project implementation shown in Tables 5 and 6, the performance monitoring information will be used to: (1) inform system optimization decisions, (2) determine whether and when it is necessary to implement the contingent remedy in the high RTF area (see Section 7.3), (3) whether and when areas of the Site may transition from active remediation to NSZD, and (4) determine whether the deep contamination remedy has succeeded or failed, or will succeed or fail.

An additional goal of the performance monitoring will be to track whether remedial actions are mobilizing contamination so that actions can be taken if contaminant mobilization occurs to an extent deemed unacceptable.

The primary metrics for monitoring the performance of the bioventing/biosparging system shall be respiration rate and reduction of mobile LNAPL mass within the high RTF area. Additionally, secondary performance monitoring metrics (LNAPL viscosity and LNAPL transmissivity) shall be used as additional lines of evidence to inform decision-making.

## 7.3 Contingent Remedy – High RTF Area

Ecology expects the primary remedy of bioventing/biosparging will attain cleanup standards at the Site within the 20-year RTF. As indicated in Section 7.2 above, the contingent remedy shall be considered for implementation in the high RTF area[1] if the calculated RTF for removal of mobile LNAPL in the high RTF area shows that achieving the cleanup standards in that area within the 20-year RTF is at material risk. However, to ensure that the primary remedy is given a suitable amount of time for implementation, optimization, and evaluation, it is desirable that the contingent remedy not be implemented until there is a high level of confidence that the primary remedy will not attain cleanup standards within the 20-year RTF. Further, given the additional effort and cost needed to implement the contingent remedy, it should not be implemented if the primary remedy can still, with additional optimization efforts, attain cleanup standards within a reasonable period beyond 20 years. Therefore, the contingent remedy would not be considered for implementation:

- During Years 1 through 4, or
- During Years 5 through 7, if the calculated Restoration Timeframe of bioventing/biosparging in the high RTF area is 30 years or less and additional optimization efforts can and will be undertaken, or
- During Years 8 through 10, if the calculated Restoration Timeframe of bioventing/biosparging in the high RTF area is 25 years or less and additional optimization efforts can and will be undertaken, or
- If the restoration timeframe for the high RTF area will not exceed 20 years, or
- After Year 15.

In addition, the contingent remedy would not be considered for implementation within portions of the high RTF area having LNAPL thicknesses less than 1 foot.

As described above, the contingent remedy shall be considered for implementation in the high RTF area if the calculated RTF of the high RTF area exceeds 20 years, except for situations described by the 5 bullets above. If the situation occurs where the contingent remedy shall be considered for implementation, Ecology will make the final determination if the implementation of the contingent remedy shall occur.

Ecology will assess the criteria described in Section 7.3.3 in accordance with the schedule described on Tables 5 and 6 to determine whether performance of the bioventing/biosparging system:

- Puts achieving the cleanup standards in the high RTF area within the 20-year RTF at material risk, and
- Can be further optimized in a manner that would no longer put the 20-year RTF at risk.

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[1] Because contingent remedy infrastructure cannot be installed within the footprint of an active freeway, portions of the high RTF area, if any, that are inaccessible because of the NSC freeway may not be addressed using the contingent remedy.

This assessment will be based on a weight-of-evidence evaluation of the performance monitoring data (Table 5). The timeline for this assessment begins in Year 5, Quarter 1 and will continue until Year 15, Quarter 1 (Table 6). Section 7.3.3 further describes the decision process for determining when and if SEE shall be implemented.

### 7.3.1 Implementation Phasing: Contingent Remedy

This section and Tables 5 (Deep Contamination Cleanup Action Summary) and 6 (Deep Contamination Cleanup Action Implementation Timeline) describe implementation of the contingent remedy assuming that: (1) the SEE propagation test is successful (i.e., not technically infeasible), and (2) it is determined that bioventing/biosparging cannot achieve cleanup standards within the 20-year RTF as noted in Section 7.3. It is assumed that the SEE system would operate for up to 3 years (unless contamination continues to be removed at a rate that meets the remedial objectives) or until the contaminant mass removal rate is less than that of bioventing/biosparging alone, or the cumulative LNAPL recovery volume becomes asymptotic, or the point at which SEE has accelerated the cleanup such that the 20-year RTF will be met *and* the benefits of continued operation of SEE are no longer commensurate with the added cost, or if the management of mobilized contaminants cannot be optimized which would result in off-site contaminant migration. Following cessation of SEE, bioventing/biosparging operation is expected to continue until cleanup standards are met (Table 6).

### 7.3.2 Performance Monitoring: Contingent Remedy

Performance monitoring will be conducted to track remediation performance and inform system optimizations. The primary performance metric for the contingent remedy will be the amount of LNAPL mass removed from the subsurface.

### 7.3.3 Determination of Contingent Remedy Implementation

As indicated previously, a determination of whether the contingent remedy must be implemented will be made based on assessing whether bioventing/biosparging alone will or will not achieve the cleanup standards within the 20-year RTF as noted in Section 7.3. The primary parameters for making this assessment shall be respiration rate and reduction of mobile LNAPL mass within the high RTF area. Secondary parameters to be considered in the assessment shall be LNAPL viscosity and LNAPL transmissivity in the high RTF area.

The treatment goals associated with the implementation of bioventing/biosparging are: (1) the respiration rate will reach levels sufficient to degrade the mobile LNAPL mass within the 20-year RTF, (2) the mobile LNAPL mass will reduce at a rate indicating that the cleanup standards will be achieved within the 20-year RTF, (3) the viscosity of LNAPL will increase, and (4) the transmissivity of LNAPL will decrease. The RTF for the high RTF area will be calculated annually by: (1) estimating the mobile LNAPL mass remaining in the high RTF area at the end of that year, (2) estimating the degradation rate in the high RTF area that occurred that year, and (3) calculating the number of years needed to degrade the remaining mobile LNAPL mass in the high RTF area at the current degradation rate. The mobile LNAPL mass will be estimated using gauged LNAPL thickness data (corrected for LNAPL density and aquifer conditions) from monitoring wells in the high RTF area, whereas the degradation rate will be estimated from respiration data collected from within the high RTF area.

Section 7.3 outlines the conditions under which the contingent remedy shall or shall not be considered for implementation. If the contingent remedy is determined to be necessary based on the conditions outlined in Section 7.3, the PLPs shall undertake the contingent remedy described in the following sections.

#### 7.3.4 Pilot Testing and Supplemental Engineering Design Report – Contingent Remedy

If the contingent remedy is deemed feasible based on the SEE propagation test described in Section 7.2.1 and implementation of SEE is necessary based on the criteria in Sections 7.3 and 7.3.3, the PLPs will develop a work plan to perform a SEE pilot test and perform the pilot test. If the pilot test verifies that SEE is technically feasible as described below, the PLPs will prepare a supplemental EDR for the implementation of the contingent remedy. The SEE pilot test will consist of constructing a pilot-scale system (one extraction well and four steam injection wells) in a portion of the high RTF area and operating it in accordance with the approved work plan. If the pilot system verifies an injection well ROI of 60 feet or greater, determines the mass removal rates are greater than or equal to those achieved using bioventing/biosparging, and the mobilization of contaminants with the potential to migrate off-site can be managed and optimized, the contingent remedy will be deemed technically feasible and will be implemented. If the pilot test verifies SEE's feasibility, then the data obtained from the pilot system will be used to design the full contingent remedy and the pilot study results and contingent remedy design will be documented in a supplemental EDR. The full-scale SEE system would be designed to operate for up to 3 years (unless contamination continues to be removed at a rate that meets the remedial objectives) or until the contaminant mass removal rate is less than that of bioventing/biosparging alone, or the cumulative LNAPL recovery volume becomes asymptotic, or the point at which SEE has accelerated the cleanup such that the 20-year RTF will be met *and* the benefits of continued operation of SEE are no longer commensurate with the added cost, or if the management of mobilized contaminants cannot be optimized which would result in off-site contaminant migration. As with the primary remedy, the supplemental EDR for the contingent remedy will present the civil/mechanical design, permitting requirements, operations and maintenance plan, updated performance monitoring plan, and updated health and safety plan.

### 7.4 Groundwater Monitoring

Groundwater monitoring in select Site groundwater monitoring wells identified in the CMP will occur quarterly. This requirement will be further outlined in the operations and maintenance plan and/or CMP. Groundwater monitoring may be reduced after consultation with Ecology if it appears that a reduction in groundwater monitoring may be warranted. Additional groundwater monitoring wells will be installed downgradient of the Site to fully assess the dissolved-phase plume. Groundwater monitoring wells that require decommissioning due to the construction of the NSC may be replaced at Ecology's discretion.

### 7.5 Institutional Controls

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 both the continued protection of human health and the environment and the integrity of the cleanup action whenever hazardous substances remain at the Site at concentrations exceeding applicable CULs. Institutional controls can include both physical measures and legal and administrative mechanisms. WAC 173-340-440 provides information on institutional controls and the conditions under which they may be removed.

Institutional controls, which will include an environmental covenant prohibiting excavation or the extraction of groundwater, will be included in the cleanup action to address soil contamination remaining below the bottom of the shallow soil excavations and throughout the smear zone and area of contaminated groundwater. The environmental covenant shall be consistent with the Uniform Environmental Covenant Act (UECA; Chapter 64.70 RCW). The environmental covenant and any additional institutional controls required to assure the protection of human health and the environment and the integrity of the cleanup action shall be outlined in the EDR and documented in the Shallow Soil Cleanup Action Report.

## 7.6 FINANCIAL ASSURANCE

WAC 173-340-440 states that financial assurance mechanisms shall be required at sites where the selected cleanup action includes engineered and/or institutional controls. Financial assurance is required at this Site because institutional controls will be used to assure protection of human health and the environment until CULs are met. The specifics of these requirements will be further defined in a legal instrument implementing this DCAP.

## 7.7 PERIODIC REVIEW

As long as CULs have not been achieved, WAC 173-340-420 states that at sites where a cleanup action requires an institutional control, a periodic review shall be completed no less frequently than every five years after the initiation of a cleanup action. Additionally, periodic reviews are required at sites that rely on institutional controls as part of the cleanup action. Periodic reviews will be required at this Site until CULs have been achieved because institutional controls are a required part of the remedy.

As shown in Table 6, periodic reviews will be performed annually from RTF Year 1 through RTF Year 20. The frequency of the periodic reviews can be revised to every five years with Ecology's approval.

Each periodic review will be a written report that assesses the progress of the cleanup action against the cleanup standards and the 20-year RTF. Each report will include the following:

- A summary of the past year's operations (flow rates and run time for each bioventing and biosparging well, each zone and the entire system, balancing data for push-pull operations),
- A summary of the past year's optimization efforts,

- A summary of performance monitoring data (dissolved oxygen, methane, corrected gauged LNAPL thickness and results from respirometry, viscosity, transmissivity and/or NSZD testing),
- Evaluation of trends in key performance parameters (mobile LNAPL mass, corrected gauged LNAPL thickness, viscosity, transmissivity, degradation rates),
- Weight of evidence evaluation of key performance parameters to assess progress of the cleanup action toward achieving the cleanup standards within the 20-year RTF; and
- Operation Plan for next year, including planned optimization and contingent remedy actions.

The content of the periodic review reports will vary over the course of the project as shown on Table 7. During periodic reviews, Ecology will use:

- Key performance parameters (respiration rate and mobile LNAPL mass) to determine if bioventing and/or biosparging optimization is needed,
- Groundwater monitoring data to determine if treatment of downgradient dissolved-phase groundwater contamination will be implemented; and
- Performance, groundwater, and other data to determine if the CAP and its implementing legal agreement should be reopened and additional cleanup actions undertaken if:
    - Cleanup standards cannot be met within the overall RTF; or
    - If factors not known at the time the CAP and its implementing legal agreement are issued are discovered and present a previously unknown threat to human health or the environment.

Additionally, Ecology will use key performance parameters and the conditions for implementation of the contingent remedy outlined in Section 7 to determine if contingent remedy implementation is needed. An annual evaluation of the ability to terminate active remediation will begin following RTF Year 10. This evaluation process will be based on trends in key performance parameter data and will utilize a weight of evidence approach to allow the PLPs and Ecology to determine whether, when and where active remediation at the Site can be terminated, NSZD can be relied upon to achieve the cleanup standards, and the groundwater monitoring network and analytical parameters can be revised.

## 8.0 References Cited

ERM-West, Inc. (ERM), January, 2013. *Final Remedial Investigation/Feasibility Study Work Plan, BNSF Railway Black Tank Property*.

ERM, March, 2016. *Final Draft Addendum to the RI/FS Project Plan*.

ERM, March, 2017. *Remedial Investigation/Feasibility Study Report, BNSF Railway Black Tank Property*.

GeoEngineers, August, 2010. *Black Tank Supplemental Well Installation and Groundwater Monitoring Report, BNSF Black Tank, Spokane, Washington*.

Interstate Technology & Regulatory Council (ITRC), April, 2009. *Evaluating Natural Source Zone Depletion at Sites with LNAPL*.

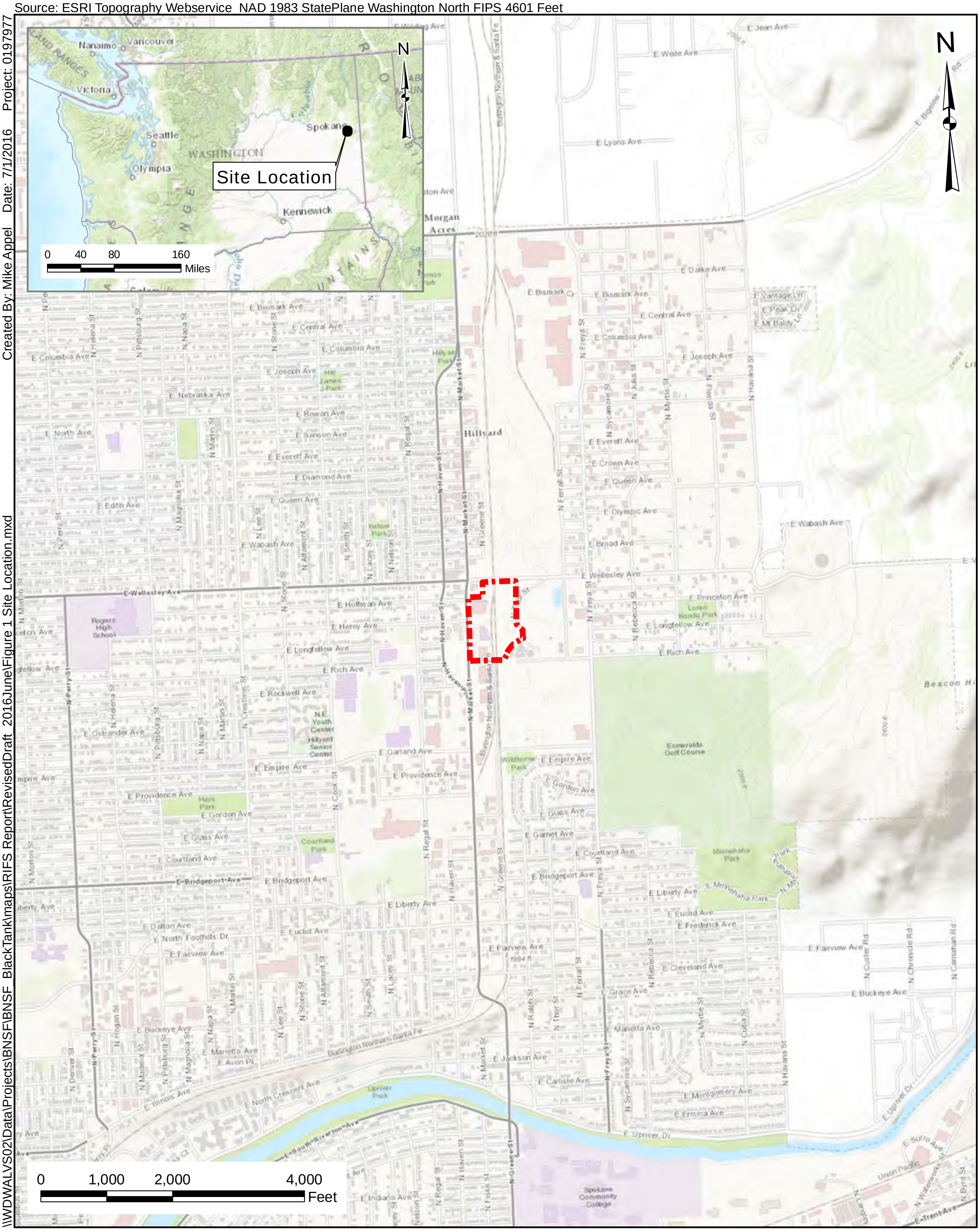
Kahle, S.C. and J.R. Bartolino, 2007. *Hydrogeologic Framework and Ground-Water Budget of the Spokane Valley-Rathdrum Prairie Aquifer, Spokane County, Washington, and Bonner and Kootenai Counties, Idaho.* U.S. Geological Survey Scientific Investigations Report 2007–5041.

Washington State Department of Ecology, 2007. Model Toxics Cleanup Act, Regulation Chapter 173-340 WAC.

Washington State Department of Ecology, July 2015. *BNSF Railway Black Tank Property Site, Ecology Comments on RI/*FS.

Washington State Department of Ecology, January 2017. *BNSF Railway Black Tank Property Site, Ecology Comments on Revised RI/*FS.

Source: ESRI Topography Webservice NAD 1983 StatePlane Washington North FIPS 4601 Feet




\\WDWALVS02\Data\Projects\BNSF\BNSF BlackTank\maps\RIFS Report\RevisedDraft 2016June\Figure 1 Site Location.mxd Created By: Mike Appel Date: 7/1/2016 Project: 0197977

**Legend**

Approximate BNSF Black Tank Property Site Boundary
May be adjusted based on extent of downgradient dissolved-phase groundwater contamination

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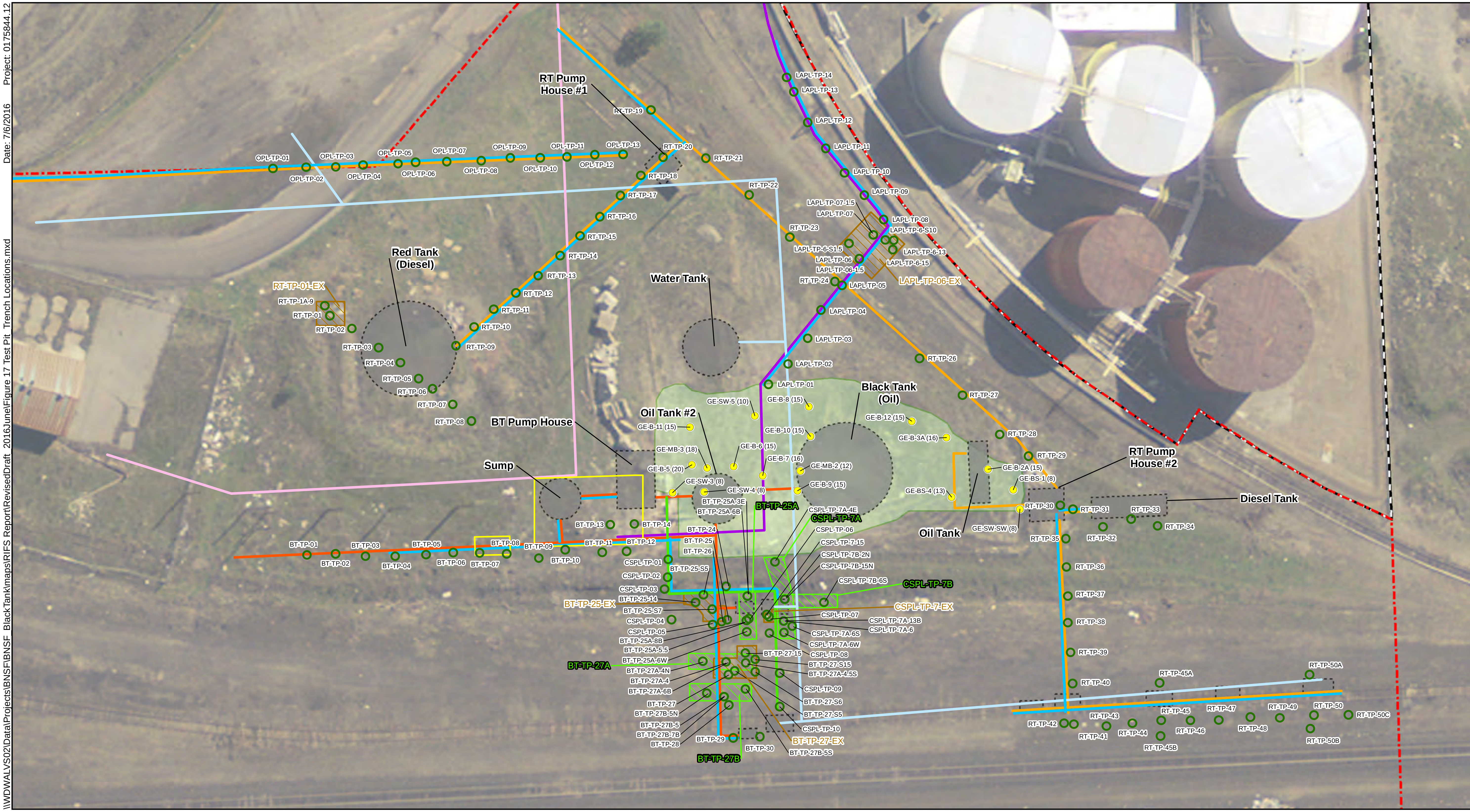
**Figure 1**
*Site Location*
*BNSF Black Tank*
*Spokane, Washington*

\\WDWALVS02\Data\Projects\BNSF\BNSF_BlackTank\maps\RIFS Report\RevisedDraft_2016June\Figure 17 Test Pit_Trench Locations.mxd

Date: 7/6/2016

Project: 0175844.12




## Legend

- Test Pit
- GeoEngineers Black Tank Excavation Confirmation Sample
- Proposed BNSF Black Tank Site Boundary (May be adjusted based on extent of downgradient dissolved-phase groundwater contamination)
- SemMaterials L.P. Spokane Site Boundary
- Confirmed Residual Pipeline Location
- Black Tank Oil Pipeline (1937)
- Red Tank Oil Pipeline (1937)
- Chemical Solution Pipeline (1937)
- Liquid Asphalt Pipeline (1956)
- Steam Pipeline
- Water Pipeline
- ACM Abatement Area
- Historical Aboveground Storage Tank
- Former Black Tank Excavation
- Approximate Outline of 2013 Excavation Trenches
- Approximate Outline of 2014 Excavation Trenches

N

0 25 50 100 Feet

Notes:
ACM = Asbestos Containing Materials
BT = Black Tank System
CSPL = Chemical/Solution Pipeline
LAPL = Liquid Asphalt Pipeline
OPL = Oil Pipeline
RT = Red Tank System
TP = Test Pit
Aerial Photo: USGS, April 2012.

**Figure 2**
*Test Pit and Trench Locations*
*BNSF Black Tank*
*Spokane, Washington*

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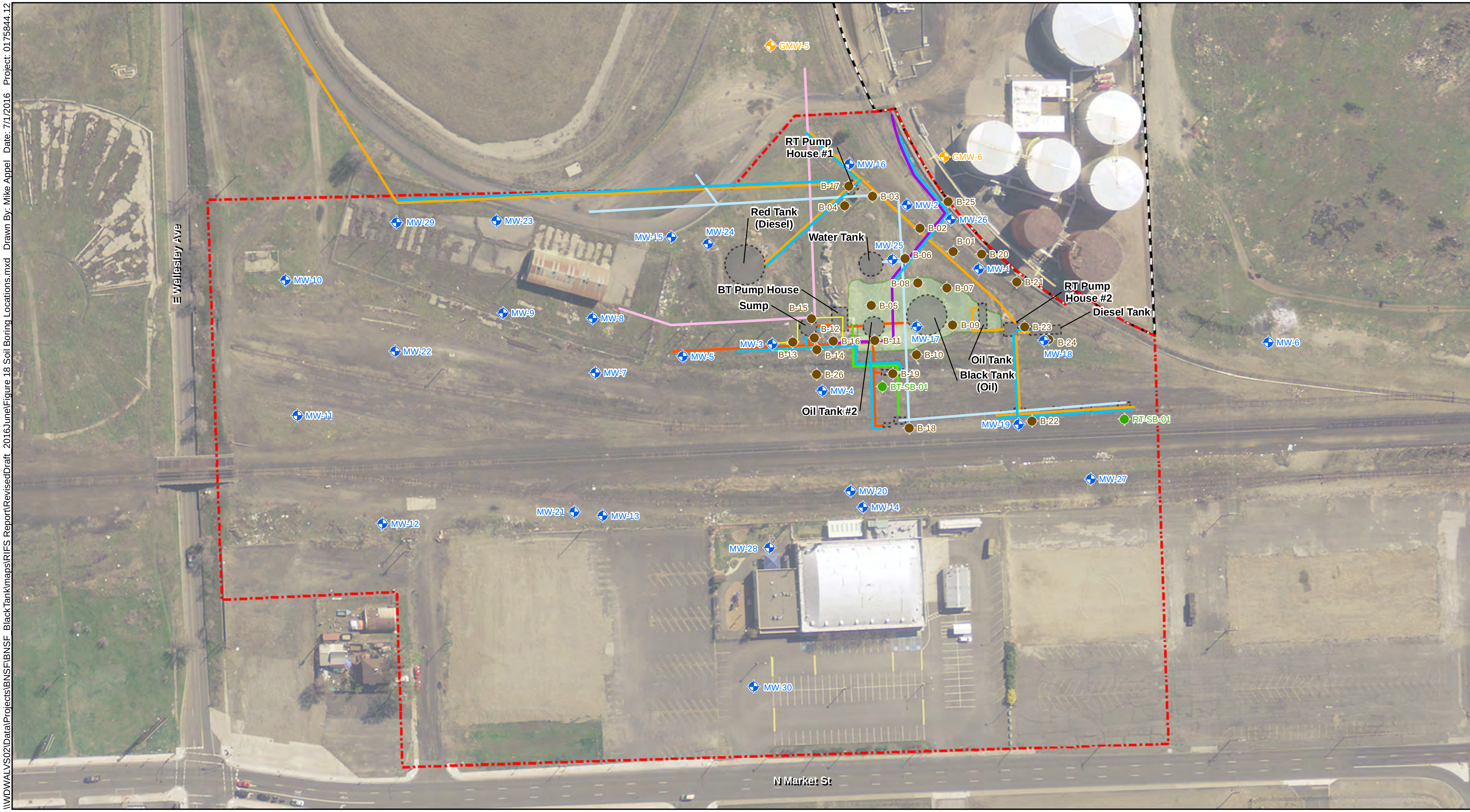
\\WDWALVS02\Data\Projects\BNSF\BNSF_BlackTank\maps\RIFS Report\RevisedDraft_2016June\Figure 18 Soil Boring Locations.mxd Drawn By: Mike Appel Date: 7/1/2016 Project: 0175844.12




## Legend

- Monitoring Well
- SemMaterials Monitoring Well
- GeoEngineers Soil Boring
- ERM Soil Boring
- Confirmed Residual Pipeline Location
- Black Tank Oil Pipeline (1937)
- Red Tank Oil Pipeline (1937)
- Chemical Solution Pipeline (1937)
- Liquid Asphalt Pipeline (1956)
- Steam Pipeline
- Water Pipeline
- ACM Abatement Area
- Historical Aboveground Storage Tank
- Former Black Tank Excavation
- Proposed BNSF Black Tank Site Boundary (May be adjusted based on extent of downgradient dissolved-phase groundwater contamination)
- SemMaterials L.P. Spokane Site Boundary

N

0 60 120 240 Feet

Notes:
ACM = Abestos-containing Material
BT = Black Tank System
CSPL = Chemical/Solution Pipeline
LAPL = Liquid Asphalt Pipeline
OPL = Oil Pipeline
RT = Red Tank System
TP = Test Pit
Aerial Photo: USGS, April 2012.

**Figure 3**
*Soil Boring and Monitoring Well Locations*
*BNSF Black Tank*
*Spokane, Washington*

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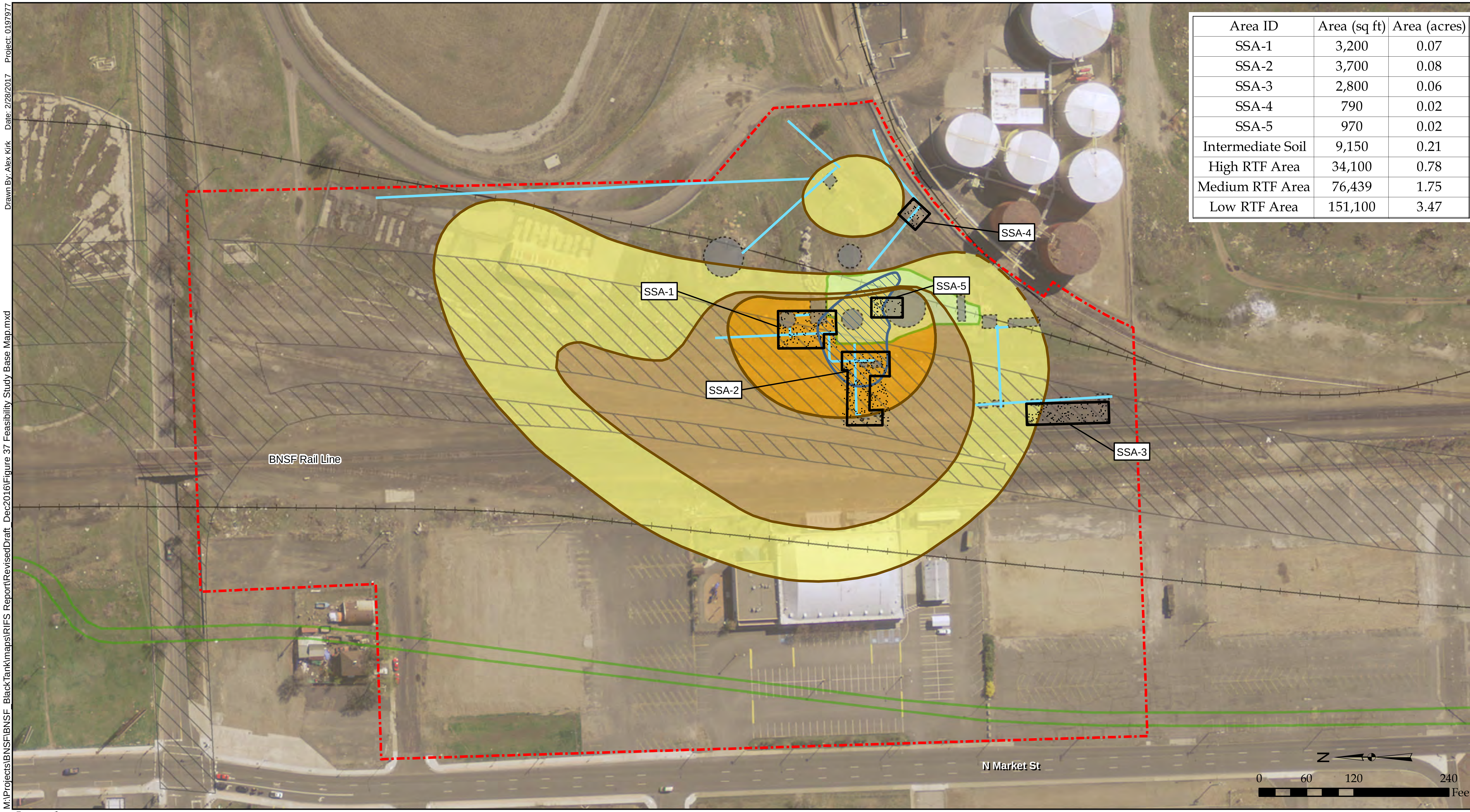
M:\Projects\BNSF\BNSF_BlackTank\maps\RIFS Report\RevisedDraft_Dec2016\Figure 37 Feasibility Study Base Map.mxd Drawn By: Alex Kirk Date: 2/28/2017 Project: 0197977




| Area ID | Area (sq ft) | Area (acres) |
|---|---|---|
| SSA-1 | 3,200 | 0.07 |
| SSA-2 | 3,700 | 0.08 |
| SSA-3 | 2,800 | 0.06 |
| SSA-4 | 790 | 0.02 |
| SSA-5 | 970 | 0.02 |
| Intermediate Soil | 9,150 | 0.21 |
| High RTF Area | 34,100 | 0.78 |
| Medium RTF Area | 76,439 | 1.75 |
| Low RTF Area | 151,100 | 3.47 |

**Legend**

- Existing Piping (Petroleum and Chemical Solution)
- DOT Proposed Railroad Realignment Option - 2014
- Proposed BNSF Black Tank Site Boundary (May be adjusted based on extent of downgradient dissolved-phase groundwater contamination)
- TPH-D/HO in Intermediate Soil Exceeding the Preliminary CUL
- Approximate Lateral Limits of Surface Soil Cleanup Areas
- DOT Proposed Highway Alignment Option - 2014
- DOT Proposed Pedestrian Pathway - 2014
- Former Black Tank Excavation
- Historical Aboveground Storage Tank, Sump or Pump House
- High RTF Area
- Medium RTF Area
- Low RTF Area

Notes:
CUL = Cleanup Level
LNAPL = Light Non-Aqueous Phase Liquid
RTF: Restoration Timeframe
TPH-D/HO = Combined Diesel and Heavy Oil-Range Petroleum Hydrocarbons
Preliminary CUL = 13,600 milligrams per kilogram
Aerial Photo: USGS, April 2012.

**Figure 4**
*Cleanup Action Areas*
*BNSF Black Tank*
*Spokane, Washington*

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Table 1. Groundwater Cleanup Levels

| Analyte | Cleanup Level ug/L | Basis for Cleanup Level |
|---|---|---|
| TPH-D/HO | 500 | MTCA Method A |
| Benzo(a)Pyrene | 0.1 | MTCA Method A |
| Benzo(a)Pyrene TEQ | 0.1 | MTCA Method A |
| LNAPL | No Detectable LNAPL | WAC 173-340-360(2)(c)(ii) |

ug/L = micrograms per liter
TPH-D/HO = total petroleum hydrocarbons as diesel/heavy oil
TEQ = toxic equivalency quotient
LNAPL = light, non-aqueous-phase liquid
MTCA = Model Toxics Control Act

Table 2. Soil Cleanup Levels

| Analyte | Cleanup Level (mg/kg) | Basis for Cleanup Level |
|---|---|---|
| **Surface Soil (surface to 15 feet bgs)** | | |
| TPH-D/HO | 2,000 | MTCA Method A |
| Benzo(a)Pyrene | 0.1 | MTCA Method A |
| Benzo(a)Pyrene TEQ | 0.1 | MTCA Method A |
| Naphthalene | 5 | MTCA Method A |
| Total Naphthalenes | 5 | MTCA Method A |
| **Subsurface Soil (below 15 feet bgs)** | | |
| TPH-D/HO | 5630 | Residual Saturation* |
| **LNAPL** | | |
| LNAPL | No Detectable LNAPL | WAC 173-340-360(2)(c)(ii) |
| | | |

*Residual Saturation was determined empirically as the lowest median soil TPH value from soil borings that contained soil contamination from the ground surface to groundwater

bgs = below ground surface
LNAPL = light, non-aqueous-phase liquid
mg/kg = milligrams per kilogram
MTCA = Model Toxics Control Act
TPH-D/HO = total petroleum hydrocarbons as diesel/heavy oil
TEQ = toxic equivalency quotient
WAC = Washington Administrative Code

Table 3. Applicable or Relevant and Appropriate Requirements For the Cleanup Action

| Jurisdiction | Summary of ARARs | |
|---|---|---|
| City of Spokane | Municipal Code 10.08D | Nuisances (Noise and Dust) |
| | Municipal Code 17E.010 | Critical Aquifer Recharge Areas - Aquifer Protection |
| | Municipal Code 17D.060 | Stormwater Management Regulations |
| | Municipal Code 17D.090 | Land Disturbing Activities (TESC and Grading) |
| State of Washington Regulations | Ch. 18.104 RCW | Water Well Construction |
| | Ch. 173-160 WAC | Min. Standards for Construction and Maintenance of Water Wells |
| | Ch. 173-162 WAC | Rules & Regulations Governing the Licensing of Well Contractors & Operators |
| | Ch. 173-303 WAC | Dangerous Waste Management |
| | Ch. 173-304 WAC | Solid Waste Handling Standards |
| | Ch. 70.105D RCW | Model Toxics Control Act |
| | Ch. 173-340 WAC | MTCA Cleanup Regulation |
| | Ch. 173-350 WAC | Solid Waste Handling Standards |
| | Ch. 43.21C RCW | State Environmental Policy Act |
| | Ch. 197-11 WAC | SEPA Rules |
| | Ch. 70.94 RCW | Washington Clean Air Act |
| | Ch. 43.21A RCW | General Regulations for Air Pollution |
| | Ch. 173-400 WAC | General Regulations for Air Pollution |
| | Ch. 173-460 WAC | Controls for New Sources of Air Pollution |
| | Ch. 173-470 WAC | Ambient Air Quality Standards for Particulate Matter |
| Federal Regulations | 29 CFR 1910 | Occupational Safety and Health Act |
| | 42 USC 7401 | Clean Air Act of 1977 |
| | 40 CFR 50 | National Ambient Air Quality Standards |
| | 40 CFR 141 | Drinking Water Regulations |
| | 40 CFR 260-268 | Hazardous Waste Regulations (RCRA) |

ARAR = applicable or relevant and appropriate requirement
CFR = Code of Federal Regulations
MTCA = Model Toxics Control Act
RCRA = Resource Conservation and Recovery Act
RCW = Revised Code of Washington
SEPA = State Environmental Policy Act
TESC = Temporary Erosion and Sediment Control
USC = U.S. Code
WAC = Washington Administrative Code

Table 4. Evaluation of Deep Contamination Cleanup Action Alternatives[1]

| Criteria | DC-B | DC-C | DC-D | DC-E |
|---|---|---|---|---|
| | Bioventing and Biosparging in the medium and high RTF areas | Bioventing and Biosparging in the medium and high RTF areas, manual LNAPL removal in the high RTF area | Bioventing and Biosparging in the medium and high RTF areas, steam-enhanced extraction in the high RTF area | Smoldering Combustion in the medium and high RTF areas |
| Threshold Requirements | | | | |
| Protection of human health & environment | yes | yes | yes | yes |
| Compliant with cleanup standards | yes | yes | yes | yes |
| Compliant with state & federal laws | yes | yes | yes | yes |
| Provision for compliance monitoring | yes | yes | yes | yes |
| Other Requirements | | | | |
| Use of Permanent Solutions (disproportionate cost analysis) | rank #4[2] | rank #3[2] | rank #2[2] | rank #1[2] |
| Protectiveness | 1 | 2 | 3 | 4 |
| Permanent Reduction | 1 | 2 | 3 | 4 |
| Cleanup Cost (rank) | 4 | 3 | 2 | 1 |
| Cleanup Cost (PLP-estimated) | $5,451,000 | $8,888,000 | $19,500,000 | $25,073,000 |
| Long-term Effectiveness | 1 | 1 | 3 | 4 |
| Short-term Risk | 4 | 3 | 2 | 1 |
| Implementability | 4 | 3 | 2 | 1 |
| Consider Public Concerns | 3 | 4 | 2 | 1 |
| Total Relative Score | 18 | 18 | 17 | 16 |
| Provide Reasonable RestorationTime Frame | yes[3] | yes[3] | yes | yes |
| Consider Public Comments | yes | yes | yes | yes |

[1]This process utilizes a "ranking" method. Each alternative is ranked against the others, with 4 representing the "best" and 1 representing the "worst". Where a tie occurs, the alternatives are ranked the same.

[2]The overall ranking results are based on the assumption that the estimated RTFs stated in the FS can be met. If DC-B cannot attain cleanup levels within the FS-estimated restoration time frame, it would no longer be ranked highest.

[3]While these estimated restoration time frames indicate all DC alternatives would provide for a reasonable restoration time frame, Ecology has concern that DC-B and DC-C can achieve the the projected RTFs.

FS = Feasibility Study
PLP = potentially liable person
LNAPL = light, non-aqueous-phase liquid
RTF = restoration time frame

**Table 5 - Deep Contamination Cleanup Action Summary**

| Action | Area | When[1] (See Timeline on Table 6) | Key Tasks | Performance Data Obtained / Reported | Report/Review Frequency |
|---|---|---|---|---|---|
| **Bioventing/Biosparging** | | | | | |
| ROI Study | High and Medium RTF Area | Year A, Q1 | Determine ROI for bioventing wells and biosparging wells | NA | One time |
| Engineering Design Report and Permitting | High and Medium RTF Areas | Year A, Q2-Q4 | Design base system<br>Permit construction of base system<br>Collect baseline data | Mobile LNAPL mass baseline[2]<br>LNAPL viscosity baseline<br>LNAPL transmissivity baseline<br>DO and methane baseline<br>NSZD rate baseline<br>Dissolved phase TPH-D/HO baseline | One time |
| System Construction, Startup and Shakedown | High and Medium RTF Areas | Year B (and C, as needed) | Install bioventing/biosparging wells<br>Install power<br>Construct and install blower/extraction equipment<br>Startup and test system components<br>Get system operational<br>Balance system flowrates<br>Collect initial performance data | Respiration rate<br>Mobile LNAPL mass<br>DO and methane | One time |
| System Operation and Optimization | High and Medium RTF Areas | RTF Years 1 through 20 | Optimize operation of cleanup through continuous improvement and adaptive management of system. Collect performance monitoring data. Initial optimization activities could include the addition of bioventing and biosparging wells. Additional optimization techniques identified in the FS would be implemented in a stepwise manner, as soon as year 1, if the 20-year RTF is at risk. | Respiration rate<br>Mobile LNAPL mass<br>LNAPL viscosity<br>LNAPL transmissivity<br>DO and methane | Annual |
| System Optimization (Additional Infrastructure) | High RTF Area | RTF Years 6 through 9 | If degradation rates and optimization results indicate the 20-year RTF is at risk, additional infrastructure (biosparging wells, etc.) installed the high RTF area will be constructed as shared infrastructure that could be used for SEE (if SEE is deemed viable from the propagation study). If SEE is not viable, additional infrastructure would not be constructed to accommodate SEE. | NA | NA |
| Performance Reporting/Review | High and Medium RTF Areas | RTF Years 1 through 20; Testing frequency TBD (minimum of annually); Reporting in Q4 | Report and review prior year efforts and performance monitoring data.<br>Establish optimization plan for next year for each zone. | See Table 7 for content of reports | Annual |
| **SEE Contingent Remedy** | | | | | |
| Steam Propagation Study | High RTF Area | Year B; it may be performed earlier if agreed to by the PLPs and Ecology | Install test wells and equipment and perform study. | Temperature gradient in treatment zone<br>Steam injection rate<br>Evaluation of steam propagation in treatment zone<br>Evaluation of injection and extraction well density requirements<br>Changes in LNAPL location and mass<br>Changes in dissolved phase TPH-D/HO concentrations<br>Evaluation of contaminant mobilization | One time |
| Contingent Remedy Consideration - 20-Year RTF at material Risk (if initial viability criteria are met from propagation study) | High RTF Area | RTF Year 5 Q1 through Year 15 Q1 | Evaluate performance of bioventing/biosparging system to determine need for contingent remedy. If data indicates 20-year RTF is not at material risk, continue annual bioventing/biosparging review and optimization evaluation. If data indicates 20-year RTF is at risk and propagation test shows SEE is technically viable, implement contingent remedy if determined neccessary by Ecology. Ecology will adhere to the conditions for contingent remedy consideration in Section 7.3 of the Cleanup Action Plan. | See Table 7 for content of reports | Annually in Q1 from RTF Years 5 through 15. |

**Table 5 - Deep Contamination Cleanup Action Summary**

| Action | Area | When[1] (See Timeline on Table 6) | Key Tasks | Performance Data Obtained / Reported | Report/Review Frequency |
|---|---|---|---|---|---|
| Pilot Study (if needed) | High RTF Area | TBD (RTF Year 5 Q3 through Year 13 Q4; 1 year period); it may be performed earlier if performance data shows catastrophic failure of bioventing/biosparging and agreed to by the PLPs and Ecology | Install, operate and monitor pilot system (one extraction and four steam injection wells). If pilot test shows SEE to be technically viable (injection well ROI at least 60 feet, and mass removal rate greater than bioventing/ biosparging, and the mobilization of contaminants with the potential to migrate offsite can be managed and optimized), contingent remedy construction could begin as early as RTF Year 7 Q3. | Complete study, evaluate performance against viability criteria and, if viable, determine design criteria. | One time |
| Engineering Design Report Supplement and Permitting | High RTF Area | TBD (RTF Years 6 Q3 through Year 14 Q4; 1 year period following pilot study) | Design contingency SEE system<br>Permit construction of SEE system | NA | One time |
| System Construction | High RTF Area | TBD (RTF Year 7 Q3 through Year 15 Q4; 1 year period following design and permitting) | Install steam injection and LNAPL extraction wells<br>Install power<br>Construct and install SEE and LNAPL/water treatment plant | NA | One time |
| Operation and Optimization | High RTF Area | TBD (Up to 3 year period following system construction, unless contamination continues to be removed at a rate that meets the remedial objectives or until the contaminant mass removal rate is less than that of bioventing/ biosparging or the cumulative LNAPL recovery volume becomes asymptotic or if the management of mobilized contaminants cannot be optimized which would result in offsite contaminant migration.) | Operate and optimize contingent remedy and collect performance monitoring data. Conduct optimization evaluations every other quarter. | Evaluate operational parameters to viability criteria. | Annual |
| **Other Monitoring** | | | | | |
| Performance Monitoring | Low RTF Area | All Years | Performance monitoring and reporting. | Dissolved phase TPH-D/HO concentrations<br>Mobile LNAPL mass<br>See Table 7 for content of reports | Annual |

Acronyms:
ROI - Radius of influence
LNAPL - Light nonaqueous phase liquid
SEE - Steam Enhanced Extraction
RTF - Restoration Timeframe (20 years following system shakedown)
NSZD - Natural source zone depletion
TPH-D/HO - Total petroleum hydrocarbons - diesel and heavy oil range
TBD - To be determined
Q - Quarter
PLPs - Potentially responsible persons

Notes:
1 The timeline is based on the assumption that design, permitting, construction and shakedown of the base remedy (bioventing/biosparging) can be completed with no delays resulting from construction of the highway. The timeline includes a 20-year restoration timeframe (RTF Years 1 through 20 on Table 6) that begins immediately following system shakedown (Year B on Table 6).
2 Mobile LNAPL mass will be determined from gauged LNAPL thickness data from monitoring wells in high RTF areas.

Table 6 - Deep Contamination Cleanup Action Implementation Timeline

| Task | Year A[2] | | | | Year B[3] | | | | Year C[3] | | | | Year 1 | | | | Year 2 | | | | Year 3 | | | | Year 4 | | | | Year 5 | | | | Year 6 | | | | Year 7 | | | | Year 8 | | | | Year 9 | | | | Year 10 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| **Restoration Timeframe (RTF)[1]** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Bioventing/Biosparging (High and Medium RTF Areas)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ROI Study | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Design Report and Permitting | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| System construction, startup and shakedown[3] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| System operation and optimization | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Performance monitoring | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **SEE Contingent Remedy (High RTF Area) - if viable per framework agreement** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Steam propagation study[4] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Additional infrastructure in high RTF area constructed as shared/SEE compatible if 20 year RTF at risk | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contingent remedy consideration - 20-year RTF at material risk[5] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pilot study (TBD) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | TBD (~1 Year Duration) | | | | | | | | | | | | | | | | | |
| Engineering Design Report Supplement and Permitting (TBD) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | TBD (~1 Year Duration) | | | | | | | | | | | | |
| System construction (TBD) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | TBD (~1 Year Duration) | | | | | | | | | | |
| System operation (TBD) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | TBD | | | | | | | | |
| Performance monitoring (TBD) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | TBD | | | | | | | | |
| SEE system optimization evaluation (if needed) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Natural Source Zone Depletion** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Low RTF Area | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| High and Medium RTF Area | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Other Monitoring** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Performance monitoring | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Performance Sampling/Reporting/Review[6]** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NSZD evaluation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sampling for optimization evaluation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bioventing/biosparging system optimization evaluation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Treatment of downgradient plume evaluation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Groundwater monitoring program evaluation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Evaluate termination of bioventing/biosparging | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reporting | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Initial performance metrics development
Activity will occur during the period indicated
TBD - Activity may occur during a portion of the period indicated.

Notes:

1 The timeline is based on the assumption that design, permitting, construction and shakedown of the base remedy (bioventing/biosparging) can be completed with no delays resulting from construction of the highway. The timeline includes a 20-year restoration timeframe (RTF Years 1 through 20) that begins immediately following system shakedown (Year B or C).

2 Year A shall start immediately after the execution of the legal agreement that requires work outlined in the Cleanup Action Plan; this work can be completed prior to railroad relocation.

3 The construction schedule assumes no conflicts from highway construction that would result in removal and reinstallation of system infrastructure. It also assumes startup period would begin when full system has been installed and that construction startup and shakedown can be completed in one year (Year B). Up to an additional year (Year C) may be needed for this task due to adverse weather/field conditions and/or operational issues encountered during the shakedown period.

4 This task may be performed earlier if agreed to by the PLPs and Ecology.

5 Subject to contingent remedy "stoppers" in section 7.3 of the CAP.

6 Performance report content and decisions will vary from year to year (See Table 7). For example, treatment of downgradient plume will not be evaluated and reported if testing shows it is not a concern.

Table 6 - Deep Contamination Cleanup Action Implementation Timeline

| Task | Year 11 | | | | Year 12 | | | | Year 13 | | | | Year 14 | | | | Year 15 | | | | Year 16 | | | | Year 17 | | | | Year 18 | | | | Year 19 | | | | Year 20 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 | Q1 | Q2 | Q3 | Q4 |
| **Restoration Timeframe (RTF)[1]** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Bioventing/Biosparging (High and Medium RTF Areas)** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| ROI Study | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Design Report and Permitting | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| System construction, startup and shakedown[3] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| System operation and optimization | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Performance monitoring | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **SEE Contingent Remedy (High RTF Area) - if viable per framework agreement** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Steam propagation study[4] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Additional infrastructure in high RTF area constructed as shared/SEE compatible if 20 year RTF at risk | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Contingent remedy consideration - 20-year RTF at material risk[5] | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pilot study (TBD) | TBD (~1 Year Duration) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Engineering Design Report Supplement and Permitting (TBD) | TBD (~1 Year Duration) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| System construction (TBD) | TBD (~ 1 Year Duration) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| System operation (TBD) | TBD | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Performance monitoring (TBD) | TBD | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| SEE system optimization evaluation (if needed) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Natural Source Zone Depletion** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Low RTF Area | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| High and Medium RTF Area | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Other Monitoring** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Performance monitoring | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Performance Sampling/Reporting/Review[6]** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NSZD evaluation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Sampling for optimization evaluation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Bioventing/biosparging system optimization evaluation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Treatment of downgradient plume evaluation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Groundwater monitoring program evaluation | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Evaluate termination of bioventing/biosparging | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Reporting | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Initial performance metrics development

Activity will occur during the period indicated

TBD - Activity may occur during a portion of the period indicated.

Notes:

1 The timeline is based on the assumption that design, permitting, construction and sh
with no delays resulting from construction of the highway. The timeline includes a 20
immediately following system shakedown (Year B or C).

2 Year A shall start immediately after the execution of the legal agreement that require

3 The construction schedule assumes no conflicts from highway construction that woul
period would begin when full system has been installed and that construction startu
may be needed for this task due to adverse weather/field conditions and/or operatic

4 This task may be performed earlier if agreed to by the PLPs and Ecology.

5 Subject to contingent remedy "stoppers" in section 7.3 of the CAP.

6 Performance report content and decisions will vary from year to year (See Table 7). F
if testing shows it is not a concern.

**Table 7 - Deep Contamination Cleanup Action Performance Review Content Summary**

| RTF Years | Frequency | Content[1] | | | | | | Decisions[1] | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Past year's activities | Past year's performance monitoring data | Past year's optimization efforts | Trends in key performance parameters | Evaluation of key performance parameters | Plan for next year (including key decisions) | Bioventing/Biosparging Optimization | Contingent Remedy Consideration | Treatment of Downgradient Plume (if applicable) | Changes in Groundwater Monitoring Program | Evaluate Termination of Bioventing/biosparging |
| *1 to 4* | Annually | X | X | X | X | X | X | X | | X | X | |
| *5 to 15* | Annually | X | X | X | X | X | X | X | X | X | X | X |
| *16 to 20* | TBD (assumed annually) | X | X | X | X | X | X | X | | X | X | X |

<u>Acronyms:</u>
RTF - Restoration Timeframe (20 years following system shakedown)
TBD - To be determined

Note:

[1] Content and decisions indicated will only be reported if applicable.