SUPERFUND RECORD OF DECISION (ROD)

HAMILTON/LABREE ROADS GROUNDWATER CONTAMINATION SUPERFUND SITE
CHEHALIS, LEWIS COUNTY, WASHINGTON
OPERABLE UNIT 1
INTERIM REMEDIAL ACTION

United States
Environmental Protection
Agency

August 2013

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ACRONYMS

>	greater than
<	less than
%	percent
3-D	three dimensional
AB	auger boring
AES	Architect and Engineering Services
AOC	Administrative Order on Consent
AR	Administrative Record
ARARs	applicable or relevant and appropriate requirements
bgs	below ground surface
BLRA	baseline risk assessment
CC	creek channel
CDI	chronic daily intake
CDM Smith	CDM Federal Programs Corporation
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CG	commercial general
cm/s	centimeters per second
COCs	contaminants of concern
COPCs	chemicals of potential concern
CSM	conceptual site model
CTS	Comprehensive Technology Scenario
CUL	cleanup level
cy	cubic yard
DCE	cis-1,2-Dichloroethylene
DNAPL	dense non-aqueous phase liquid
DNR	Department of Natural Resources
Ecology	Washington State Department of Ecology
E&E	Ecology & Environment, Inc.
EE/CA	engineering evaluation/cost analysis
Emerald RV	Emerald Recreational Vehicles
EPA	United States Environmental Protection Agency
EPC	exposure point concentrations
ERT	Emergency Response Team
EVO	emulsified vegetable oil
°F	degrees Fahrenheit
Farallon	Farallon Consulting, L.L.C.
FOD	frequency of detection

FS	feasibility study
ft/ft	foot per foot
GAC	granular activated carbon
GeoEngineers	GeoEngineers, Inc.
Geo-Recon	Geo-Recon International
GP	Geoprobe
gpm	gallons per minute
H_2O_2	hydrogen peroxide
HDPE	high density polyethylene
HRIA	Hamilton Road Impacted Area
HI	hazard index
HQ	hazard quotient
I-5	Interstate 5
ICs	institutional controls
ICIAP	Institutional Controls Implementation and Assurance Plan
IRIS	Integrated Risk Information System
ISTR	in-situ thermal remediation
kg	kilogram
$KMnO_4$	potassium permanganate
LCDPH	Lewis County Department of Public Health
LDR	land disposal restrictions
L/m^3	liters per cubic meter
MCL	Maximum Contaminant Level
Md	mass discharge
$\mu g/m^3$	micrograms per cubic meter
µg/L	micrograms per liter
mg/kg	milligrams per kilogram
MSL	mean sea level
MTCA	Model Toxics Control Act
MVS	Mining Visualization Systems
MW	monitoring well
$Na_2S_2O_8$	sodium persulfate
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NPL	National Priorities List
O&M	operation and maintenance
OU	operable unit
OU1	Operable Unit 1
OU2	Operable Unit 2
PCE	tetrachloroethylene (also known as perchloroethylene)

PPE	personal protective equipment
ppm-v	parts per million by volume
PRG	preliminary remediation goal
PVC	polyvinylchloride
PW	private well
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RDD	Rural Development District
RfD	reference dose
RI	remedial investigation
RME	reasonable maximum exposure
ROD	record of decision
RSL	Regional Screening Level
SAIC	Science Applications International Corporation
SARA	Superfund Amendments and Reauthorization Act
SB	sediment/soil boring
SF	slope factor
SG	soil gas
Site	Hamilton/Labree Roads Groundwater Contamination Superfund Site
START	EPA Superfund Technical Assistance and Response Team
SVE	soil vapor extraction
SW	surface water
TEG	Transglobal Environmental Geosciences
TCE	trichloroethylene
TRVs	toxicity reference values
U&A	usual and accustomed
UCL	upper confidence limit
UGA	urban growth area
URS	URS Group, Inc.
VOC	volatile organic compound
VF	volatilization factor
WAC	Washington Administrative Code
WDOH	Washington State Department of Health

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I. DECLARATION FOR THE RECORD OF DECISION

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I. DECLARATION FOR THE RECORD OF DECISION

SITE NAME AND ADDRESS

Hamilton/Labree Roads Groundwater Contamination Superfund Site
Operable Unit 1, Hamilton Road Impacted Area
Chehalis, Lewis County, Washington

STATEMENT OF BASIS AND PURPOSE

This Record of Decision (ROD) presents the Selected Interim Remedy for Operable Unit 1 (OU1) of the Hamilton/Labree Roads Groundwater Contamination Superfund Site (Site), in Chehalis, Lewis County, Washington, chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for OU1.

This interim remedy is taken to protect human health and the environment from the threat posed by contamination in sediment, soils, and groundwater in OU1. The State of Washington, as represented by the Washington State Department of Ecology (Ecology), has been the support agency during the remedial investigation/feasibility (RI/FS) study process for OU1. In accordance with 40 Code of Federal Regulations (CFR) 300.430, as the support agency, Ecology has provided input during this process. The State of Washington concurs with the Selected Interim Remedy for OU1.

ASSESSMENT OF THE SITE

The interim response action selected in this ROD is necessary to protect the public health, welfare, or the environment from actual or threatened releases of contaminants from OU1 into the environment. Such a release or threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment.

SCOPE AND ROLE OF THIS OPERABLE UNIT WITHIN THE OVERALL SITE STRATEGY

The Site is about 2 miles south of the City of Chehalis, Washington, near the intersection of North Hamilton Road and Labree Road, west of Interstate 5 (I-5) (**Figure 1-1**). The Site has been divided into two geographical areas, called Operable Units (OUs), to facilitate the identification and cleanup of hazardous substances. The Site includes OU1, also known as the Hamilton Road Impacted Area (HRIA), and Operable Unit 2 (OU2), which includes all other areas outside of OU1 where hazardous substances have come to be located, including the areas referred to as the Breen Property, the Thurman Berwick Creek Area, and the areas west and northwest of Labree Road (**Figure 1-2**). Hazardous substances, primarily tetrachloroethylene (PCE) and its degradation products, have come to be located in both OUs, contaminating sediment, soil, and groundwater.

The United States Environmental Protection Agency (EPA) is addressing contamination at the Site through a phased approach beginning with an interim remedy in OU1. A phased approach to site

remediation is the most appropriate when site characterization is not yet complete, or when site data are not sufficient to develop and evaluate remedial alternatives to address risks posed by the entire site or to determine long-term objectives for the entire site (e.g., restoring groundwater to safe drinking water levels). There appears to be other contamination sources at the Hamilton/Labree Site outside of OU1; however, additional Site-wide data collection and evaluation is needed to develop, select, and implement other response actions for the Site that will achieve long-term protection of human health and the environment.

The scope of this ROD and Selected Interim Remedy is limited to OU1. The OU1 interim remedy is intended to address the known sources of contamination to sediment, soil, and groundwater in the vicinity of Berwick Creek within OU1 and the most immediate risks posed by these sources and to minimize further migration of contaminated groundwater from OU1 to other areas of the Site. This interim remedy will inform other response actions within the Site and is expected to contribute to and be consistent with the final remedy selected for OU1 and the Site.

DESCRIPTION OF THE SELECTED REMEDY

The major components of the Selected Interim Remedy for OU1 include:

- Diversion of Berwick Creek around areas of contamination
- In-situ thermal treatment of sediment and soil with PCE concentrations greater than 10 milligrams/kilogram (mg/kg)
  - ✓ Removal and offsite disposal of any remaining creek bed sediment and surface soil with PCE concentrations greater than 10 mg/kg
  - ✓ Enhanced in-situ bioremediation treatment of any remaining subsurface soil with PCE concentrations greater than 10 mg/kg
- Enhanced in-situ bioremediation of groundwater with PCE concentrations greater than 4,000 micrograms per liter (µg/L)
- Institutional controls within OU1 to prevent the use of contaminated groundwater as a drinking water source and minimize exposure to contaminated sediment, soil, and groundwater
- Monitoring to evaluate performance and protectiveness of the interim remedy

STATUTORY DETERMINATIONS

The OU1 Selected Interim Remedy is protective of human health and the environment commensurate with its scope; complies with federal and state requirements that are legally applicable or relevant and appropriate, except for certain requirements that are waived for this interim action; provides the best balance of tradeoffs with respect to the balancing and modifying criteria, including cost-effectiveness; and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. This interim remedy also satisfies the preference for treatment that reduces toxicity, mobility, or volume as a principal element and is expected to be consistent with the final remedy selected for OU1 and the Site. Because the interim remedy will

result in hazardous substances remaining on site above levels that allow for unrestricted use and unlimited exposure, 5-year Site reviews will be performed as required by statute to evaluate whether the remedy is or will be protective of human health and the environment. A review will be conducted 5 years from the start of the OU1 interim remedy.

DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record for OU1.

- Chemicals of concern and their respective concentrations (Sections 5.5 and 5.6)
- Current and reasonably anticipated future land use assumptions (Section 6)
- Baseline risk assessment represented by chemicals of concern (Section 7)
- Cleanup levels established for chemicals of concern and the basis for those levels (Section 8.2 and **Table 12.2**)
- How source materials constituting principal threats are addressed (Section 11)
- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Sections 12.2, 12.3 and **Table 12-1**).
- Potential land use that will be available at the Site as a result of the selected remedy (Section 12.4)
- Key factors that led to the selection of the interim remedy (Section 13)

AUTHORIZING SIGNATURE

Cami Grandinetti

Cami Grandinetti
Remedial Cleanup Program Manager
U.S. Environmental Protection Agency, Region 10

8/28/13
Date

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STATE OF WASHINGTON
DEPARTMENT OF ECOLOGY
PO Box 47775 • Olympia, Washington 98504-7775 • (360) 407-6300

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OFFICE OF
ENVIRONMENTAL CLEANUP

August 19, 2013

Ms Cami Grandinetti
Remedial Cleanup Program Manager
U.S. Environmental Protection Agency
1200 Sixth Avenue
Seattle, WA 98101-3140

RE: Superfund Record of Decision for Hamilton Labree Roads Operable Unit 1 Interim Remedial Action, State Concurrence

Dear Ms Grandinetti:

The Washington State Department of Ecology (Ecology) has reviewed the Record of Decision (ROD) for the Hamilton Labree Roads Operable Unit 1 Interim Remedial Action, Chehalis, Lewis County, Washington. The purpose of the ROD is to outline the history of the site, provide data regarding the character and extent of the contamination affecting the site and surrounding area, and propose an interim remedial action designed to mitigate the tetrachloroethylene (PCE) contamination in site soils and groundwater. The proposed interim action consists of thermal treatment combined with enhanced bioremediation with possible soil excavation.

In general, Ecology agrees with the approach proposed by the ROD. Ecology notes that Washington State cleanup levels (CULs) for groundwater (WAC 173-340-720) and the Federal Safe Drinking Water Act, as well as the state CULs for soil to be protective of groundwater, were waived in the list of ARARs cited in the ROD. Ecology understands that this was done due to the fact that the Environmental Protection Agency considers this an interim action and the final remedial action has not yet been determined, which is the time at which final ARARs would also be determined and cited.

Ecology recommends that the ROD provide an explanation of this fact and indicate that state ARARs will be determined in conjunction with the final remedy. Ecology concurs with the EPA's ROD.

We look forward to the implementation of an effective cleanup solution for the site. I would also like to thank Tamara Langton for her diligence in pursuing the investigation and remedy selection for the site, as well as her continuing detailed communication with Ecology staff. If you have any questions please contact Marv Coleman at 360-407-6259 or by email at MCOL461@ecy.wa.gov.

Sincerely,

James J. Pendowski, Program Manager
Toxics Cleanup Program

MC/RSL/JP/H L ROD concurrence letter

By Certified Mail: (7012 1010 0003 0195 4857)

cc: Tamara Langton, Region 10 Environmental Protection Agency
Andy Fitz, Ecology Assistant Attorney General
Barry Rogowski, Ecology
Rebecca Lawson, P.E., LHG, Ecology
Marv Coleman, Ecology

II. DECISION SUMMARY

RECORD OF DECISION
OPERABLE UNIT 1 INTERIM REMEDIAL ACTION
HAMILTON/LABREE ROADS GROUNDWATER CONTAMINATION SUPERFUND SITE
CHEHALIS, WASHINGTON

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1.0 SITE NAME, LOCATION, AND DESCRIPTION

Site Name: Hamilton/Labree Roads Groundwater Contamination Superfund Site
Location: Chehalis, Lewis County, Washington
EPA Identification Number: WASFN1002174
Lead Agency: EPA
Support Agency: Washington State Department of Ecology
Source of Cleanup Monies: Superfund Appropriation

The Hamilton/Labree Roads Groundwater Contamination Superfund Site (Site) is about 2 miles south of the City of Chehalis, Washington, near the intersection of North Hamilton Road and Labree Road, west of Interstate 5 (I-5). For a general site map, see **Figure 1-1**. The Site has been divided into two geographical areas, called Operable Units (OUs), to facilitate the identification and cleanup of hazardous substances. The Site includes OU1, also known as the Hamilton Road Impact Area (HRIA), and OU2, which includes all other areas outside of OU1 where hazardous substances have come to be located, including areas referred to as the Breen Property, the Thurman Berwick Creek Area, and the areas west and northwest of Labree Road (**Figure 1-2**). Hazardous substances, primarily tetrachloroethylene (PCE) and its degradation products, have come to be located in both OUs, contaminating sediment, soil, and groundwater.

1.1 Operable Unit 1

OU1 is located at the most upgradient portion of the Site. It is about 10 acres in size (**Figure 1-2)**. It is crossed from northwest to southeast by North Hamilton Road and Berwick Creek. North Hamilton Road was built in 1974.

The portion of OU1 located between North Hamilton Road and I-5 consists of grassy open land that includes Berwick Creek (which flows northwest), overhead power lines, and a wire field fence that prevents access to I-5. Two ditches, referred to as Unnamed Ditch #1 and Unnamed Ditch #2, pass underneath I-5 and intermittently discharge to Berwick Creek. The Washington State Department of Transportation and Lewis County currently own this portion of OU1.

The portion of OU1 west of North Hamilton Road includes property formerly owned by United Rentals Northwest, Inc., which continues to be identified on Site maps as the United Rentals Property. The property is level, with mixed gravel, asphalt, and concrete surfaces, and contains two buildings: the main building and the paint shop. An easement containing buried utilities and a stormwater conveyance system is located between the United Rentals Property and North Hamilton Road.

The United Rentals Property has changed occupants and ownership numerous times since the late 1980s. In 1988, Carl Watson purchased this property, which at the time was a swampy hayfield containing a few old car bodies and empty barrels. The property was graded flat and a layer of fly ash and about 90 truckloads of rocks were imported to build up the footprint for the subsequent buildings. The main building was built during the winter of 1989/1990.

Beginning in June 1990, a transmission rebuilding company operated at the property under the name Westside Trucking Company. In 1991, Westside Trucking Company changed its name to Gear Box, Inc. and operated under that name until October 1992 when the business closed. The property was sold on May 20, 1993, to E.G.W. Machinery, Inc., the owner of High Reach, Inc. High Reach, Inc. rented and serviced specialized aerial construction equipment. A second building, known as the paint shop, was built on this property in 1993.

In 1998, High Reach, Inc. was purchased by United Rentals Northwest, Inc. At this location, United Rentals ran a rental and repair service for a variety of construction equipment. United Rentals also operated a small business that painted heavy equipment until 2009 after which the property was vacated. In April 2012, the property was sold to Visitrade, Inc., and in June 2012, Visitrade leased the property to a building materials store named Builder's Surplus Northwest.

The portion of OU1 west of North Hamilton Road and south of the United Rentals Property includes a gravel access road and an open, steep-sided drainage ditch originally owned by (b) (6) (b) (6). In 2007, (b) (6) sold this property to the McGill Investment Company.

The property south of the McGill property includes a level area covered with gravel and a commercial warehouse next to and south of the gravel area. Up to 4 feet of material, mainly boulders, was used to fill in and level the property before development. The developed property was originally owned by Reginald and Kimberly Hamilton who ran a company named Hamilton Rocking and Contracting Company from the early 1990s to 1997. They shared the property with the Smith Tractor Company until 1997 when Smith Tractor Company became the sole tenant. The Smith Tractor Company rented and sold trucks and construction equipment along with parts for this type of equipment. The company added a wash rack that had a concrete slab floor behind the building in about 1996 and used the gravel area to park tractor-trailers. The property has been sold twice since it was developed and has had a number of tenants. The current owner is Hamilton Road Adventures, which leases the property to Emerald Recreational Vehicles (Emerald RV). Emerald RV buys, sells, and rents RVs and related equipment to the public.

1.2 Operable Unit 2

OU2 includes all other areas outside of OU1 where hazardous substances have come to be located, including areas referred to as the Breen Property, the Thurman Berwick Creek Area, and the area west and northwest of Labree Road (**Figure 1-2**). OU2 is not addressed directly by this Record of Decision (ROD) except to the extent the selected remedy for OU1 addresses sources of groundwater contamination that currently migrate downgradient into OU2.

1.2.1 Breen Property

The Breen Property (part of OU2) is located northwest of OU1 and covers about 11 acres (**Figure 1-2**). The Breen Property was purchased by Sterling (Bud) Breen, Sr., President of the S.C. Breen Construction Company (the Breen Company), in the early 1950s. The property was

used for agricultural purposes before it was developed by the Breen Company. By the early 1970s, most of the Breen Property had been cleared of vegetation.

The Breen Property, originally one tax parcel, was subdivided in 1992. It now consists of two separate tax parcels.[1] The western portion of the Breen Property is still owned by the Breen Company and is made up of about 5.75 acres, which includes several wood-framed, steel-clad buildings with concrete floors and open areas between the buildings used for storing trucks and other heavy equipment and construction materials.

One of these buildings, referred to as Building C in this ROD, was built in about 1960 on the southwest part of the parcel. This building, referred to then as the "Old Shop," served as the Breen Company's main office and truck maintenance shop until the early 1990s. Since then, Building C has been leased to a number of other companies, including the Roy F. Weston Company (now Weston Solutions, Inc.).

North of Building C was the Breen Surplus store, which began operating in the mid-1960s. Breen Surplus bought and sold a variety of equipment, tools, paints, thinners, and solvents. This store and building no longer exist.

Southeast of Building C is a 24 ft x 28 ft cement slab that was used as a heavy equipment wash-down pad. Based on a review of aerial photographs, this wash-down pad appears to have been constructed between 1966 and 1969. Runoff and sediment from the cleaning operation was collected in a pit, about 5 feet deep, which had been excavated next to the concrete pad. This collection pit has never been located; the wash-down pad is no longer being used.

In 1972, another steel-clad building with a concrete floor, referred to as Building A on Site maps, was built on the north end of the Breen Property. In about 1983, a similar building, referred to as Building B, was constructed on the Breen Property southeast of Building A. In 1995, Bulldog Trailers began, and continues today, to operate out of both buildings, making and selling general-purpose utility trailers.

The Breen Company sold the eastern portion of its property to the Chehalis Livestock Market in 1992 (Farallon Consulting, L.L.C. [Farallon] 2003). The parcel is about 4.92 acres in size and is primarily used as a cattle auction facility. It contains a large building, referred to as the Livestock Auction Building, which houses an arena, a café, and offices. Adjacent to this building are livestock pens.

The livestock market opened around 1960. A smaller wood-framed building with a dirt floor is located along the southern boundary (Livestock Shed). This building is mostly used to hold calves and other small livestock before auction. The remainder of this parcel is an unpaved parking area. Berwick Creek runs west along the southern property boundary of this parcel and then runs under North Hamilton Road where it daylights within the Thurman Berwick Creek Area.

[1] For purposes of this ROD, as with earlier Site reports, the term "Breen Property" refers to both tax parcels.

1.2.2 Thurman Berwick Creek Area

The Thurman Berwick Creek Area (part of OU2) is located in the southeast corner of the intersection of North Hamilton Road and Labree Road, west and downgradient of OU1 and south of the Breen Property. The Thurman Berwick Creek Area is divided by Berwick Creek into two portions: the northwest portion, which currently contains a residential structure built in 1930, and the southeast portion, which is undeveloped land. Both portions are currently owned by the Balmelli Family Limited Partnership.

1.2.3 Downgradient Areas West of Labree Road

This portion of the Site (part of OU2) includes the remaining area within the PCE groundwater plume footprint that is downgradient of OU1, the Breen Property, and the Thurman Berwick Creek Area west of Labree Road (**Figure 1-2**). Most of the current land use in this area is farmland, but residential and light commercial uses also occur.

2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

A summary of historical investigations and key findings at the Site is provided in **Table 2-1**. In 1993, a business along North Hamilton Road submitted a public water system application for a commercial well. As part of the approval process, the business was required to perform water quality testing, including a test for volatile organic compounds (VOCs). Test results indicated PCE at 122 micrograms per liter (µg/L) in the water sample (the federal and state drinking water Maximum Contaminant Level [MCL] for PCE is 5 µg/L). The discovery of PCE in groundwater led the Lewis County Department of Public Health (LCDPH) to request the Washington State Department of Health (WDOH) investigate groundwater in private and public water-supply wells in the area (WDOH 1999).

In late 1993/early 1994, WDOH sampled 18 private water-supply wells in the area. PCE was detected in six of the 18 water-supply wells, ranging from 3.3 µg/L to 2,165 µg/L (Washington State Department of Ecology [Ecology] 1999a). In response to the findings, LCDPH informed affected well owners of the sampling results and advised them to obtain alternative sources of drinking water (WDOH 1999). Ecology began supplying bottled water to affected well owners for drinking and cooking. In 1996, WDOH re-sampled five of the six PCE-contaminated water supply wells[2] and found that concentrations had increased from those measured in 1993 and 1994 (PCE ranged from 5.75 µg/L to 3,009 µg/L in the 2006 samples).

In 1996, LCDPH learned from a confidential source that drums containing solvents were buried on the Breen Property. Ecology began an investigation that included a geophysical survey by Geo-Recon International (Geo-Recon 1996) and a subsurface investigation by Science Applications International Corporation (SAIC 1997). Between October 1997 and July 1998, Ecology sampled monitoring wells quarterly. Some of the monitoring wells were installed by SAIC as part of the subsurface investigation, and some were private water-supply wells installed by various local well drillers for individual property owners. In spring 1998, Ecology contracted Transglobal Environmental Geosciences (TEG) Northwest, Inc. to conduct an additional subsurface investigation (Ecology 1999a). Based on results of these investigations (mainly from groundwater sampling results), the drums were suspected to be buried under Building B on the Breen Property.

Also in spring 1998, another source of contamination was found during the subsurface investigation by TEG. This second source area was located between North Hamilton Road and I-5 along Berwick Creek, which is now included within OU1. TEG advanced direct push (i.e., Strataprobe™) borings across OU1 and collected groundwater samples. The highest concentration of PCE (60,000 µg/L) was detected in a boring advanced between Berwick Creek and North Hamilton Road about 40 feet east of the United Rentals Property. PCE concentrations in groundwater from adjacent borings ranged from 22,000 µg/L to 57,000 µg/L. PCE concentrations of 20,000 µg/L or higher in groundwater are potentially indicative of nearby dense non-aqueous phase liquid (DNAPL).

[2] One of the six wells was no longer in service.

In August 1999, the Breen Company entered into an Agreed Order with Ecology to conduct an additional investigation on the Breen Property. This investigation included a geophysical survey by Northwest Geophysical Associates in August 1999 (GeoEngineers, Inc. [GeoEngineers] 2001, Appendix D) and additional subsurface investigation by GeoEngineers in August 1999 (GeoEngineers 2001). Before conducting the geophysical survey in Building B, a part of the concrete floor was broken up and removed to eliminate the wire mesh reinforcing material within the floor that could have interfered with the geophysical instruments. The concrete floor and offices at the north end of Building B and the paint booth at the southern end of Building B were not removed. The geophysical survey identified an anomaly in the south central portion of Building B where the concrete floor had been removed. This anomaly turned out to be a buried drum cache.

All of the drums appeared to contain water, as groundwater had seeped into the leaking drums, as well as a black sludge-like material. The contents of two of the excavated drums were sampled and analyzed. Based on laboratory results, the two drums contained a mixture of lubrication oil, grease, and solvents typically associated with painting and equipment-degreasing activities. PCE, trichloroethylene (TCE), and cis-1,2-dichloroethylene (cis-1,2-DCE) were detected above MCLs in both drums; vinyl chloride was detected above MCLs in one of the drums. The other drums were assumed to contain similar compounds. A total of sixty-six, 55-gallon drums, four 30-gallon drums, and several 1- to 5-gallon containers, as well as 600 tons of PCE and petroleum-contaminated soil were removed from under Building B and taken to nearby treatment and disposal facilities. Groundwater recovered from the excavation was treated using a granular activated carbon (GAC) filter and then taken to the City of Longview's sewage treatment plant for disposal (GeoEngineers 2001).

On July 27, 2000, the Site was added to the EPA National Priorities List (NPL), and EPA took over supplying bottled water to affected well owners from Ecology (EPA 2001a, EPA 2002a). Also in 2000, the EPA Superfund Technical Assistance and Response Team (START) contractor, Ecology and Environment, Inc. (E&E), began a four-phased removal assessment in OU1. Soil borings and new groundwater monitoring wells were installed, and subsurface soil and groundwater samples were taken in and near OU1 to evaluate the extent of impacts to private water-supply systems (E&E 2000, E&E 2001, E&E 2002). The removal assessments resulted in a Time Critical Removal Action to expand the City of Chehalis municipal water-supply system to 18 properties across the Site (15 residential and 3 commercial) (EPA 2002b, EPA 2002c, E&E 2003).

On October 31, 2001, an Administrative Order on Consent (AOC) was signed between EPA and the Breen Company (EPA 2001b). The AOC required the Breen Company to conduct a Site-wide remedial investigation/feasibility study (RI/FS) within the Breen Property, the area downgradient of OU1 and cross gradient of the Breen Property (east of Labree Road), and the area downgradient of the Breen Property (west of Labree Road). The Breen Company investigations did not include the PCE source area within OU1 east of North Hamilton Road or the United Rentals Property west of North Hamilton Road, as these areas were being investigated by EPA.

EPA submitted data collected during the OU1 investigations to the Breen Company for inclusion into Site-wide RI and FS reports.

In accordance with the AOC, the Breen Company (through its consultant, Farallon) began Phase I Investigations in 2002 (Farallon 2002). The overall objective of the Phase I Investigation was to review existing Site data and identify data gaps to guide the development of a Site-wide RI/FS Work Plan. Phase I RI activities based on the Site-wide RI/FS Work Plan were initiated in the summer of 2003 under EPA oversight (Farallon 2003).

In August 2003, EPA contractor URS Group, Inc. (URS) began additional field investigations in OU1 to better define the extent of sediment, soil, and groundwater contamination, including defining the extent of PCE DNAPL in support of an engineering evaluation/cost analysis (EE/CA) report (URS 2004). The purpose of the EE/CA report was to evaluate data collected from previous investigations and alternatives for cleaning up OU1 and support EPA's identification of a preferred removal action alternative for OU1.

In early 2004, the Breen Company requested that work under the AOC be suspended prior to completion in order to negotiate a cash-out settlement with EPA. Negotiations ended in 2007 without reaching an agreement.

Also in 2004, EPA completed the EE/CA field investigations, which revealed that the source of contamination in OU1 appeared to be the result of a spill or direct release of liquid PCE into Berwick Creek. The person or persons who caused this release is unknown. The exact date of the release is also unknown; estimates range from the 1970s to no later than 1990 based on the results of various plume migration analyses that have been conducted, when North Hamilton Road was constructed, and observed contamination patterns along Berwick Creek. See Section 5.6.1 of this ROD for more information on the date of the release.

It appears that most of the spilled or released PCE sank to the creek bottom where it pooled in low areas in the sediment and silt layer. PCE then moved downward into the underlying soil and groundwater below the silt layer where it continued to dissolve and move with the regional groundwater flow to downgradient areas. The preferred removal action alternative presented in the EE/CA report was to use a hydraulic containment technology without removing the silt layer from under Berwick Creek in order to stabilize the contaminated groundwater plume. The EE/CA report also recognized that over the long term, after a Site-wide RI/FS was completed, a more aggressive technology needed to be used to further reduce PCE concentrations within OU1 (URS 2004).

In December 2004, EPA signed a Time-Critical Removal Action Memorandum to build and operate a pump and treat system that would stabilize the contaminated groundwater plume and prevent further migration of PCE from OU1 (EPA 2004). However, due to design and funding issues, the pump and treat system was not implemented.

In 2005 and 2006, with the Breen Phase I RI activities still suspended, EPA assembled all of the available investigation data that had been collected across the Site and released draft Site-wide RI and FS reports (Parametrix 2006a and b). Analysis of the data included in these draft reports led to

the initial conclusion that aggressive source control in the vicinity of Berwick Creek in OU1 was warranted, but contaminated groundwater outside of OU1 would naturally attenuate so that establishment of institutional controls and long-term monitoring of the PCE plume was the appropriate course of action for the rest of the Site (see ROD Section 5.7 for an explanation on natural attenuation processes). However, upon further review of Site-wide data, EPA reconsidered this approach and pursued a more comprehensive strategy that would also consider response actions for other areas of the Site in what is now known as OU2. This decision was made in part because of the identification of a potential source of groundwater contamination at or upgradient of the Thurman Berwick Creek Area which is within OU2.

As part of the more comprehensive Site-wide strategy, Parametrix, on behalf of EPA, performed supplemental groundwater and surface water sampling across the Site in July 2007 (Parametrix 2009). Seventeen existing wells were sampled (eight private wells and nine monitoring wells) in OU1, the Breen Property, the Thurman Berwick Creek Area, and downgradient areas west and northwest of Labree Road. The purpose of the sampling was to evaluate whether significant changes in concentrations had occurred since the previous Site-wide sampling events in 2003/2004. The private wells sampled included five locations on Rice Road beyond the end of the public water-supply line installed in 2002. Results of well sampling showed that PCE concentrations had not changed significantly between 2003/2004 and 2007 and that the contaminated groundwater plume had not reached homes beyond the end of the public water-supply line. In addition to well sampling, two surface water samples were collected from Dillenbaugh Creek, which showed PCE slightly below the PCE MCL. The data from this event were used to further define Site-wide groundwater contamination and to assess contaminant migration and potential groundwater-surface water interaction associated with Dillenbaugh Creek.

In November 2007, EPA's Environmental Response Team (ERT) took air samples in and around private residences and commercial buildings across the Site to assess possible risks to human health from volatilization of contaminants from groundwater to indoor and outdoor (ambient**)** air. A total of 34 samples were collected over a 24-hour time period. Low levels of PCE and TCE were detected inside most of the residential and commercial buildings and in ambient (outdoor) locations; however, the levels were low enough that they do not pose a current health risk (Lockheed Martin 2008, EPA 2008, CDM Federal Programs Corporation [CDM Smith] 2011a).

Finally, in May 2010, EPA measured water levels and assessed the condition of most of the monitoring wells across the Site (EPA 2011). The results of this assessment, including a water level map (Final Report on the May 2010 Water Level Measurement and Monitoring Well Network Assessment, June 15, 2011), are presented in Appendix C of the Draft Site-wide RI Report (CDM Smith 2011b).

In 2011, after review of the additional data collected in 2007 and 2010 and reviewing previous data that had been collected across the Site, EPA determined that an interim remedial action was

warranted for OU1. Additional studies are needed to further define the nature and extent of contamination and determine options for cleaning up the rest of the Site.[3]

More detailed information on previous investigations and findings about the Site can be found in the Draft Site-wide RI Report (CDM Smith 2011b).

[3] On April 23 and 24, 2013, EPA and START Contractor E&E sampled 19 domestic wells along Rice and Hamilton Roads. The purpose of this sampling was to determine if contaminated groundwater from the Hamilton/Labree source areas had migrated to down- and cross-gradient properties not connected to the Chehalis municipal water-supply system. No Site chemicals were found at detectable levels in any of the wells sampled.

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3.0 COMMUNITY PARTICIPATION

EPA has worked with the community since 2000 to ensure that interested parties are kept informed and given an opportunity to provide input on activities performed at the Hamilton/Labree Site. This has been accomplished via website postings, direct mailings, door-to-door visits, community interviews, newspaper notices, and public meetings.

From 2000 to 2007, EPA kept the community informed of EPA activities by first developing a mailing list for the Site, which is regularly updated. EPA announced the Site was listed on the NPL in a May 2000 fact sheet. In August 2000, EPA conducted community interviews to gather information for the Site's Community Involvement Plan. Other fact sheets were issued in September 2001, November 2001, February 2002, June 2002, February 2003, February 2004, January 2005, and June 2007. EPA held public meetings in March and July 2002 to answer community questions about extension of the municipal water-supply line.

In preparation for release of the Proposed Plan for the interim remedy at OU1, EPA released a fact sheet in July 2012 notifying the community of the pending Superfund Site remedial action proposal. A second fact sheet summarizing the OU1 remedial action proposal was released in early October 2012. The Proposed Plan for the Interim Remedial Action at OU1 was released on September 28, 2012 for public comment. The document, along with the Draft Site-wide RI Report (CDM Smith 2011b), Draft Site-wide Baseline Risk Assessment Report (BLRA) (CDM Smith 2011a), and Draft FS Report for OU1 (CDM Smith 2012), were made available to the public as part of the Administrative Record (AR) located in the EPA Region 10 Superfund Records Center in Seattle, Washington, and at the Vernetta Smith Chehalis Timberland Public Library in Chehalis, Washington. The documents were also made available through the EPA Hamilton/Labree Roads Superfund Site website, which may be accessed at:

http://yosemite.epa.gov/R10/cleanup.nsf/sites/HLabree.

The Notice of Availability of these documents was published in the Chehalis Chronicle on October 2, 2012 and in the Town Crier out of Winlock, Washington on October 10, 2012. A public comment period was held from September 28, 2012 to November 9, 2012. A public meeting was held on October 23, 2012. At this meeting, representatives from EPA answered questions about the Site and the interim remedial action alternatives under consideration for OU1. A transcript of the public meeting, part of the AR for OU1, can be reviewed at the EPA Region 10 Superfund Records Center and at the Vernetta Smith Chehalis Timberland Public Library. In addition, a Responsiveness Summary that provides EPA responses to questions raised by the public during the public comment period is included as Part III of this ROD.

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4.0 SCOPE AND ROLE OF THE OU1 SELECTED INTERIM REMEDY

This section briefly describes EPA's intent to address the Hamilton/Labree Site in a phased approach, the early removal actions that have been completed, the scope and role of the OU1 interim remedy selected in this ROD, and plans for conducting additional Site-wide characterization work to address some of the data gaps remaining across the Site while designing and implementing the OU1 interim remedy.

4.1 A Phased Approach to Site Cleanup

As with many Superfund sites, the environmental problems at the Hamilton/Labree Site are complex. As a result, EPA has organized the Site into two geographical areas or operable units (OUs), as described in Section 1, to facilitate study and cleanup.

EPA is also addressing contamination at the Site through a phased approach. A phased approach to site remediation is the most appropriate when site-wide characterization is not yet complete or when site data are not sufficient to develop and evaluate remedial alternatives to address risks posed by the entire site or to determine long-term objectives for the entire site (e.g., restoring groundwater to safe drinking water levels).

The scope of this ROD and Selected Interim Remedy is limited to OU1. The OU1 interim remedy is intended to address the known sources of contamination to sediment, soil, and groundwater in the vicinity of Berwick Creek within OU1 and the most immediate risks posed by these sources and to minimize further migration of contaminated groundwater from OU1 to other areas of the Site. This Selected Interim Remedy will inform other response actions within the Site and is expected to contribute to and be consistent with the final remedy selected for OU1 and the Site.

As discussed in Section 2 of this ROD, Site-wide investigations conducted in the mid-1990s resulted in residences and businesses with contaminated groundwater being supplied with bottled water until the City of Chehalis municipal water-supply system could be extended via an EPA Time-Critical Removal Action. In 1999, buried drums and associated contaminated soil were removed from the Breen Property (now part of OU2) under Ecology oversight. Completing these early removal actions addressed the most immediate risks identified at the Site at that time while investigations continued across the Site as part of a Site-wide cleanup strategy to address contaminated groundwater.

In 2011, based on a review of all data collected across the Site, EPA determined that an interim remedy for OU1 was warranted to address the significant contamination posing unacceptable risks within OU1 and to reduce a source of contamination that migrates into OU2. Although review of OU2 data indicates the likelihood of another contamination source(s) to groundwater in OU2, additional characterization is needed to develop, select, and implement response actions that will address the OU2 source(s) and achieve long-term protection of human health and the environment across the Site.

4.2 Scope and Role of the OU1 Selected Interim Remedy

The scope of the Selected Interim Remedy described in this ROD is limited to OU1. This interim remedy will address the known sources of contamination to sediment, soil, and groundwater in the vicinity of Berwick Creek within OU1 and the most immediate risks posed by these sources and minimize further migration of contaminated groundwater from OU1 to other areas of the Site. The Selected Interim Remedy will also address the principal threat waste, identified as PCE DNAPL, in OU1. This interim remedy will inform other response actions within the Site and is expected to contribute to and be consistent with the final remedy selected for OU1 and the Site.

4.3 OU2

While not part of this Selected Interim Remedy for OU1, EPA plans to initiate additional Site-wide characterization work to address some of the data gaps remaining across the Site (e.g., identifying the leading edge of the downgradient plume) while designing and implementing the OU1 Selected Interim Remedy (Parametrix/CDM Smith 2013). This parallel investigation will start with a groundwater sampling and monitoring program that, at a minimum, will include sampling groundwater at to-be-identified OU2 residences and businesses along Rice and Hamilton Roads that were not connected to the City of Chehalis municipal water-supply system in 2000 and 2001. Information generated from this characterization effort, and from implementation and monitoring of the OU1 interim remedy, will be used to help evaluate additional characterization and response actions needed across the Site.

5.0 SITE CHARACTERISTICS

This section discusses the various characteristics of the Hamilton/Labree Site. It starts with a brief description of the preliminary conceptual site model (CSM) and then discusses the physical characteristics of the Site, the sampling strategy used during Site-wide remedial investigations, the known and suspected sources of Site-wide contamination, and the type or nature of contamination across the Site. This section then shifts from a Site-wide perspective to focus more on OU1 by first summarizing the extent of contamination, followed by a brief discussion of the behavior and movement of contamination (called fate and transport) within OU1.

5.1 Conceptual Site Model

A preliminary CSM has been developed for the Hamilton/Labree Site based on the Site's history (e.g., past uses) and physical characteristics (e.g., topography) and from results of various investigations conducted across the Site. The CSM tells the story of when and where the Site was contaminated, what media were affected, where the contamination migrated (called pathways), and who and what is or can be potentially harmed from the contamination (called receptors). Development of the CSM is an evolving process; as more is learned about the Site, the CSM will be modified to reflect that knowledge.

A graphical "picture" of the Hamilton/Labree CSM is presented in **Figure 5-1**, showing contaminant release areas, transport pathways, and potential receptors. Narrative discussions of contaminate fate and transport are provided in Section 5.7. More detailed information on the pathways and receptors can be found in Section 7 of this ROD (Summary of OU1 Risks).

5.2 Site Physical Characteristics

This section describes the landscape features (topography and surface water drainage), climate, geology, groundwater, and the interaction between surface water and groundwater across the Site.

5.2.1 Site Topography and Local Surface Water Drainage

The Site lies within the Newaukum Prairie, a relatively flat area formed by the Newaukum River. Hills bound the Prairie to the west and east, rising to elevations of 400 to 700 feet above mean sea level (MSL). Site topography ranges from 195 to 210 feet above MSL. Surface water drainage varies from location to location within the area, depending on the proximity of surface water features, such as Berwick Creek, Dillenbaugh Creek, and the Newaukum River. The valley generally slopes down to the northwest towards the Chehalis River. The regional topography and drainages are shown in **Figure 5-2**.

The Newaukum River is west of the Site and flows northwesterly where it joins with the Chehalis River about 5 miles northwest of the Site. Two creeks run through the Site: Berwick Creek and Dillenbaugh Creek (**Figure 1-2)**. The bed of Berwick Creek is located at an elevation of approximately 199 to 200 feet above MSL.

In addition, two ditches with intermittent flows discharge into Berwick Creek within OU1. Both ditches pass under I-5 and flow from east to west. Berwick Creek flows through OU1 from southeast to northwest, turns west at the Breen Property, and follows a mostly channelized reach for approximately 1,500 feet where it then turns towards the north-northwest, meeting Dillenbaugh Creek about 2,100 feet further to the north. Dillenbaugh Creek flows roughly southeast to northwest through the downgradient area of the Site and discharges into the Chehalis River.

5.2.2 Site Climate

Average annual precipitation in the Chehalis area is approximately 47 inches, with December being the wettest month (Western Regional Climate Center 2006). An estimated three quarters of the annual precipitation falls from October through March. The climate of the region includes wet winters and moderately warm, dry summers. The mean average annual temperature for the Chehalis area is about 50 degrees Fahrenheit (°F).

5.2.3 Site Geology

Surface deposits mapped for the Site area consist of alluvium and Newaukum terrace unit glaciofluvial deposits (Weigle and Foxworthy 1962). The alluvial deposits are referred to as the silt cap although some investigators have identified it as a silt and clay cap. Nevertheless, this cap appears to be continuous across the Site and ranges between 1 and 15 feet thick. It creates locally confined groundwater conditions in the underlying Newaukum terrace unit.

The Newaukum terrace unit is a glaciofluvial deposit consisting of sand and gravel in a silty matrix that contains the shallow aquifer. The maximum depth of the shallow aquifer is approximately 50 feet below the ground surface (bgs).

The shallow aquifer is underlain by a non-marine sedimentary unit described as thin-bedded blue clays (with occasional sand and silt lenses). This bluish-gray clayey silt layer is approximately 100 feet thick and hardens with depth (Dames and Moore 1994). This layer is believed to be Miocene-Pliocene in age (Weigle and Foxworthy 1962) and has a fluvial or lacustrine origin. This unit is the aquitard that divides the shallow and deep aquifers. It appears to be continuous beneath the Site, which is consistent with regional geologic information (Ecology 2005).

Below the silt and clay aquitard is a confined aquifer comprised of older Miocene alluvial sediments deposited by a meandering or braided river system. The groundwater in the deep aquifer occurs in sand lenses and channel deposits more than 150 feet deep and ranging from 5 to 70 feet thick in the area of OU1 (Dames and Moore 1994). Wells installed in this aquifer in the Newaukum River valley are typically artesian.

In summary, the current understanding of the Site stratigraphy is as follows:

- Alluvial silt cap from 1 to 15 feet bgs
- Glaciofluvial sand and gravel in a silt and clay matrix from 5 to 50 feet bgs (shallow aquifer)

- Non-marine sedimentary silt to clay 100 feet thick (aquitard) (from approximately 50 to 150 feet bgs)
- Miocene alluvial sediments below the aquitard (greater than 150 feet bgs), thickness unknown (deep aquifer)

5.2.4 Site Groundwater

The groundwater flow direction beneath OU1 is to the west/northwest but becomes northwesterly downgradient of the Breen Property.[4] Historic water levels have ranged between approximately 1.5 and 10 feet bgs. Water levels can vary several feet seasonally; in any individual well, as much as a 6.47-foot difference has been observed. Regional investigations have categorized the shallow aquifer as an unconfined or water table aquifer (Dames and Moore 1994; Ecology 2005). In OU1, however, the shallow aquifer exhibits the characteristics of a confined or semi-confined aquifer, primarily due to the silt cap immediately above the shallow aquifer, and based on water levels measured 4 to 6 feet above the base of this silt cap in December 2003 (URS 2004).

The overall groundwater slope (gradient) beneath OU1 is 0.0063 foot per foot (ft/ft) (URS 2004). A localized steeper gradient (approximately 0.016 ft/ft) is apparent immediately downgradient of North Hamilton Road. At the United Rentals Property, the gradient flattens out such that the average groundwater gradient calculated for the entire Site is 0.0032 ft/ft (E&E 2001).

Site-wide vertical gradients within the shallow aquifer are not well understood. There are only five locations with paired monitoring wells screened in the shallow aquifer, and only four of those locations have surveyed elevation data for both wells to enable calculation of vertical gradients. Of these well clusters, two are in the southwestern area of the Breen Property, one is in the northwestern area of the Breen Property, and one is just south of North Hamilton Road between OU1 and the Thurman Berwick Creek Area. The three locations within 200 feet of Berwick Creek (monitoring well [MW]-20/21, MW-22/23, and MW-29/30) have upward gradients while the cluster located further away (MW-17/18) **(Figure 5-3d**) has a downward gradient.

5.2.5 Site Surface Water and Groundwater Interaction

Surface water monitoring on Berwick Creek was conducted as part of the Breen Company Phase I RI (Farallon 2003). A comparison of surface water and groundwater elevations for corresponding monitoring points measured in September and November 2002 indicated that surface water elevations were at or above the potentiometric surface of the shallow aquifer during both events (Farallon 2003). These data indicate that there is a potential for surface water to seasonally discharge to groundwater in areas where the silt cap below the Berwick Creek bed is thin or permeable. Data for surface water monitoring stations #5 through #10 are shown in **Table 5-1**. Station locations #1 through #4 apparently were not monitored.

Groundwater elevations in monitoring wells adjacent to Berwick Creek within OU1 were above the approximate surface water elevation, indicating a potential for groundwater to seasonally

[4] Groundwater flow in the deep aquifer is not known at this time due to limited available data.

discharge to surface water in this reach of Berwick Creek (URS 2004). However, at all exploration locations near the creek, the silt cap of the shallow aquifer was found to be present between surface water and groundwater. The low vertical hydraulic conductivity (6.3×10^{-7} centimeters per second [cm/s]) of the silt cap probably minimizes the groundwater and surface water interaction within OU1. However, this low conductivity value is based on bulk hydraulic conductivity measurements that do not include local conductivity that may be greater due to fracturing, scouring, or pathways formed by predevelopment vegetation roots.

The flow measurements at stations #5 through #10 in September and November 2002 were qualitatively evaluated to determine whether Berwick Creek was losing or gaining water over the reach covered by the surface water monitoring stations. September 2002 measurements (the end of the dry season) recorded little to no flow at the majority of the stations, with the exception of surface water (SW) stations SW-8 and SW-9, as shown in **Table 5-1**. Flows of approximately 500 and 870 gallons per minute (gpm), respectively, were measured at these two stations. November 2002 measurements demonstrate flows of 1,400 gpm at station SW-8 and 1,250 gpm at station SW-9. Collectively, these measurements suggest the possibility that this reach of the creek discharges groundwater as base flow (gaining) during the summer. However, the data are not sufficient to make a quantitative assessment of summer base flow contribution.

The two surface water samples collected from Dillenbaugh Creek in 2007 showed PCE concentrations (1.7 µg/L and 3.6 µg/L) slightly below the groundwater MCL of 5 µg/L but above the PCE concentrations detected in a location in Berwick Creek downgradient of Labree Road (non-detect to 0.85 µg/L). The higher concentrations at the Dillenbaugh Creek locations indicate that the PCE groundwater plume may be discharging to Dillenbaugh Creek.

5.3 Site Sampling Strategy

The sampling strategy for the Hamilton/Labree Site addressed these key objectives:

- Identify the source(s) of hazardous substances to sediment, soil, groundwater, surface water, and air.
- Characterize the site stratigraphy and hydrogeology and evaluate temporal variations in groundwater and surface water flow and contaminant concentrations.
- Assess potential groundwater-surface water interaction.
- Define the horizontal and vertical extent of hazardous substances in soil, sediment, groundwater, and surface water.
- Determine the extent of DNAPL in the Berwick Creek bed and the shallow aquifer.
- Estimate the PCE mass, volume, and surface area within OU1.
- Assess possible risk to human health from volatilization of contaminants from soil and groundwater to indoor and ambient air.
- Assess risks to ecological receptors from exposure to contaminated media.

5.4 Known and Suspected Site-wide Source Areas

There are two areas where hazardous substances are known to have been released at the Hamilton/Labree Site: OU1 and the Breen Property (OU2). The OU1 source area is discussed in more detail in Section 5.6.1 of this ROD. The known contamination source on the Breen Property, as previously discussed in Section 2, was buried in drums under Building B. The drums were removed in 1999, and since that time, no other sources of contamination to groundwater have been found on the Breen Property although this property has not yet been fully characterized.

Results of groundwater sampling conducted in the areas downgradient of OU1 and south of the Breen Property indicate the presence of a potential source within or upgradient of the Thurman Berwick Creek Area. Additional investigations need to be conducted in the future to better characterize contamination in this area. No source areas have ever been found west of Labree Road.

5.5 Nature of Site-wide Contamination

This section identifies the nature (types and characteristics) of contamination found across the Hamilton/Labree Site and the affected media (e.g., sediment, soil, and groundwater). Section 5.6 then focuses on the extent of contamination found within the various affected media within OU1. Historical OU1 sampling locations are shown on **Figures 5-3a, b, and c.** Historical sampling locations on and adjacent to the Breen Property are shown on Figure 5-3d.

The contaminants of concern (COCs)[5] across the Site are PCE and its degradation products TCE, cis-1,2-DCE, and vinyl chloride, as well as the chemicals tetrahydrofuran and methylene chloride. Of these contaminants, only PCE, TCE, cis-1,2-DCE, and methylene chloride are COCs in OU1. Since PCE has been detected more frequently and at much higher concentrations than other COCs, it is used as the representative or indicator COC in this ROD.

PCE is a manufactured chemical that is widely used for the dry cleaning of fabrics and for metal degreasing. It is a nonflammable liquid at room temperature and is mobile in groundwater. It evaporates easily into the air and has a sharp, sweet odor. The Department of Health and Human Services has determined that PCE is toxic at low levels and may reasonably be anticipated to be a carcinogen. PCE has been shown to cause liver tumors in mice and kidney tumors in male rats. For more information on PCE and the other Site-wide COCs, see **http://www.atsdr.cdc.gov/** .

These COCs are found primarily in sediments and adjacent surface soils within the OU1 Berwick Creek channel bed and banks and in subsurface soils and groundwater across the Site. In general, sediment and surface soils at the Site are defined as 0 to 5 feet bgs. Subsurface soils are at depths greater than 5 feet and start below the silt cap of Berwick Creek. Subsurface soil samples from the Site have typically been collected between 5 feet bgs and about 50 feet bgs, which is the top of the

[5] COCs are those chemicals that are identified as risks to human health or the environment that may warrant a response action at a Superfund site. See ROD Section 7 (Summary of OU1 Risks) for how COCs were identified at the Site.

aquitard. In groundwater, contamination occurs in the shallow aquifer located approximately 5 to 50 feet bgs.

The deep aquifer below the aquitard has not been fully characterized as monitoring wells have not been installed within this aquifer. Minor amounts of PCE have been detected in samples collected from private wells screened in the deep aquifer but not enough to suggest that significant migration of PCE has occurred through the aquitard that separates the shallow aquifer from the deeper aquifer.

5.6 Extent of OU1 Contamination

This section describes the extent of contamination based on the results of investigations conducted within OU1. **Figure 1-2** shows the location of the 10-acre OU1, and **Figures 5-3a through 5-3c** show historical OU1 sampling locations.

5.6.1 Release Area(s)

The source of contamination within OU1 appears to be the result of a spill or direct release of liquid PCE into Berwick Creek. The person or persons who caused this release is unknown. The exact date of the release is also unknown. Estimates range from the 1970s to no later than 1990 based on the results of various plume migration and groundwater modeling studies that have been conducted and on other factors, such as construction of North Hamilton Road.

Regarding the latter, it seems unlikely that the release occurred before the 1974 construction of North Hamilton Road, which runs parallel to and west of Berwick Creek in OU1. The 2004 EE/CA report estimated the volume of release to be between 100 and 700 gallons (URS 2004). Such large volumes would require easy access to the release area. In addition, contamination patterns observed in OU1 indicate the release occurred on the west side of Berwick Creek. Soil gas surveys conducted east of Berwick Creek along I-5, and a review of I-5 accident reports in this area, do not support a release along I-5. These factors all seem to suggest that the release did not occur before 1974 and the construction of North Hamilton Road.

The “no later than 1990” date is based on PCE contamination levels observed in 1993 at private well (PW) -3 located approximately 400 feet from OU1’s Southeastern Hotspot and on the groundwater seepage velocity provided in URS’s 2004 EE/CA report of 0.36 feet/day.

The most likely location of the release is just upstream of where the Unnamed Ditch #1 enters Berwick Creek near MW-602 and MW-603, an area referred to as the Southeastern Hot Spot (**Figure 5-4**). PCE concentrations as high as 5,220 milligrams per kilogram (mg/kg) were detected in creek bed sediment and bank surface soils, which strongly point to a single release at this location, but multiple releases may have occurred along a 400-foot reach of Berwick Creek. Data supporting this latter assumption include PCE concentrations as high as 8,800 µg/L in groundwater identified in an area referred to as the Northwestern Hot Spot, which begins approximately 80 feet downstream of Unnamed Ditch #1 (**Figure 5-4**) (CDM Smith 2011b). PCE contamination within these Hot Spots is discussed further in the below sections.

5.6.2 Creek Bed Sediment/Bank Surface Soil

Currently, the only identified sediment and surface soil in OU1 with PCE concentrations indicative of DNAPL are in the bed and banks of the Berwick Creek channel within the Southeastern Hot Spot. During the August 2003 EE/CA investigations, URS collected 39 samples from creek bed sediment and bank soil along Berwick Creek and both unnamed ditches in OU1. The maximum PCE concentration detected was 5,220 mg/kg in creek bed sediment/soil boring (SB) sample SB-409, located at the upper boundary of the Southeastern Hot Spot (**Figure 5-5**), at a depth between 0.5 and 1 feet bgs. Concentrations indicative of DNAPL in sediment and soil are those that exceed the soil saturation limit of PCE, which in OU1 is 38 mg/kg of PCE. Other creek bed sediment and bank soil sample locations indicating PCE DNAPL were at SB-410 (1,650 mg/kg between 0.5 and 1 feet bgs) and at SB-411 (685 mg/kg between 0.2 and 1 feet bgs) (URS 2004). These two soil borings are also located in the Southeastern Hot Spot.

PCE concentrations in creek bed and bank samples within and slightly north of the Northwestern Hot Spot ranged from non-detect to 0.0887 mg/kg at SB-403 between depths of 0.33 and 1 feet bgs (URS 2004). No creek bed sediment and bank soil samples have been collected in the area between MW-R4 in the Northwestern Hot Spot and further northwest at MW-5/MW-33 (**Figure 5-3b**). Farallon, on behalf of the Breen Company, collected one creek channel (CC) sample in the very north of OU1 just south of the Chehalis Livestock Auction building, but no PCE was detected.

5.6.3 Subsurface Soil

PCE concentrations high enough to indicate the presence of DNAPL have been observed in subsurface soils beneath the apparent PCE release area in the Southeastern Hot Spot of Berwick Creek. The highest PCE concentration, 3,220 mg/kg, was detected at Geoprobe (GP) boring location GP-502 at a depth of 28 feet bgs (**Figure 5-4**). As described earlier, sediment and soil concentrations greater than 38 mg/kg of PCE indicate the presence of DNAPL in OU1 (URS 2004). Other elevated subsurface soil PCE concentrations were found at GP-501 (858 mg/kg at 12 feet bgs), auger boring (AB) 650 (136 mg/kg at 21 feet bgs), and GP-503 (151 mg/kg at 28 feet bgs) **(Figure 5-3a**) and at MW-9 (53 mg/kg at 43 feet bgs) and MW-602 (399 mg/kg at 15 feet bgs) **(Figure 5-4**). These subsurface soil samples are also located within or immediately adjacent to the Southeastern Hot Spot. The MW subsurface soils samples were taken when these groundwater monitoring wells were installed.

5.6.4 Groundwater

The maximum PCE concentration in groundwater of 2,720,000 µg/L was detected at MW-602 at a depth of 14.5 feet bgs within the Southeastern Hot Spot in November 2003. This concentration exceeds the solubility limit of PCE in groundwater (200,000 µg/L), clearly indicating the presence of DNAPL. Concentrations that exceed 10 percent (%) of a contaminant's solubility limit in groundwater are potentially indicative of nearby DNAPL. Therefore, concentrations of 20,000 µg/L or higher in groundwater define the potential extent of the PCE DNAPL source area.

Maximum PCE concentrations in groundwater within the Northwestern Hot Spot were detected in February and November 2003 at MW-R4 at 5,300 µg/L and 8,800 µg/L, respectively, at a depth of 21 feet bgs. Dissolved PCE in groundwater appears to have migrated northwest of the Northwestern Hot Spot based on data collected by Farallon for the Breen Company (Farallon 2004). A groundwater sample collected at MW-33, located northwest of the Northwestern Hot Spot, detected PCE at 1,100 µg/L in April 2004 at a depth of 19 feet bgs.

Groundwater data within OU1 suggest stratification of PCE within the shallow aquifer. The upper zone of the shallow aquifer, at or above 25 feet bgs, shows higher PCE concentrations than in the lower zone of the shallow aquifer (25 feet bgs down to the top of the silt and clay aquitard). The 20- to 30-foot zone appears to be a transition or mixing zone often characterized by intermediate concentrations.

Multi-level sampling was conducted to assess the potential stratification of the PCE plume in groundwater at the Southeastern Hot Spot and the area immediately downgradient. Results at MW-R8 showed significantly higher PCE concentrations in the upper zone as compared to the lower zone. PCE concentrations ranged from 4,700 µg/L at 15 feet bgs to 360 µg/L at 48.5 feet bgs. Multi-level sampling in MW-R11 did not indicate a significant variation in PCE concentrations in groundwater samples collected at varying depths; however, PCE concentrations were relatively low at approximately 25 µg/L.

Multi-level samples were also collected from all of the MW-600-series wells when they were installed in October and November 2003. The most dramatic stratification was observed in MW-602, which had 2,720,000 µg/L PCE in the 14.5-foot sample, 203,000 µg/L in the 35-foot sample, and 4,980 µg/L in the 41-foot sample.

Stratification also appears to be evident downgradient of OU1. The contour lines in **Figure 5-6** show the maximum concentrations detected in the upper zone of the shallow aquifer from OU1 to the Thurman Berwick Creek Area and to the southwest corner of the Breen Property. **Figure 5-7** shows the maximum concentrations detected at sampling points in the lower zone of the shallow aquifer from OU1 to the Thurman Berwick Creek Area and the southwest corner of the Breen Property. A comparison of the two figures suggests that contamination in the upper zone declines significantly by the OU1 western boundary whereas contamination in the lower zone of the shallow aquifer extends well beyond the OU1 boundary. In the Thurman Berwick Creek Area and the southwest corner of the Breen Property, PCE in the upper zone has been observed at concentrations greater than 2,000 µg/L while lesser PCE concentrations have been observed in the lower zone of the shallow aquifer. The maximum extent of PCE in groundwater downgradient and west of Labree Road has not been fully delineated. **Figure 1-2** shows the Site-wide estimated extent of PCE based on limited available data. After crossing under Labree Road, the plume turns in a north-northwesterly direction, essentially following Berwick and Dillenbaugh Creeks. As stated earlier, additional studies are required to fully characterize the Site, including understanding the extent of the downgradient groundwater plume.

5.6.5 Surface Water

Two of the 10 surface water sampling stations are located downgradient of the Southeastern Hot Spot (SW-3 and SW-7) and at the downstream portion of the Unnamed Ditch #1 west of I-5, (SW-5) as shown on **Figure 5-5**. The SW-5 and SW-7 locations were sampled four times between July 2002 and November 2003, and the SW-3 location was sampled once in July 2008. The detections and concentrations of PCE in surface water samples at these locations have varied considerably, and no clear seasonal trend has been identified. The highest concentrations of PCE at SW-5 (40 µg/L) and SW-7 (12 µg/L) occurred in November 2002, typically a high precipitation month. However, the PCE concentration at SW-3 in July 1998 was similarly high at 15 µg/L although this station was only sampled once and the other stations were not sampled on this date.

Two additional stations are located upstream of OU1. SW-4, located in the upstream portion of Unnamed Ditch #1 east of I-5, was sampled once by Ecology in December 1998; PCE was not detected. SW-6, located near the upstream limit of known contamination in Berwick Creek soils, was sampled four times between July 2002 and February 2003. PCE was detected at concentrations less than 1 µg/L in July 2002 and November 2003 but was not detected during the other two sampling events.

No surface water sampling has been completed in Berwick Creek in the northern portion of OU1 between MW-R4 and MW-5/MW-33. High PCE concentrations of 8,800 µg/L and 1,100 µg/L have been detected in groundwater at MW-R4 (Northwestern Hot Spot) and MW-33, respectively. It is unknown if contaminated groundwater near these wells discharges to surface water. Additional investigations to determine this will be conducted during the OU1 Selected Interim Remedy.

5.6.6 Soil Gas

A soil gas survey was conducted in OU1 in August 2003. Analytical results of soil gas surveys can be used to identify source areas, focus soil and groundwater sampling efforts, and potentially qualify risk to indoor air from subsurface contamination. The majority of the soil gas survey was conducted along Berwick Creek to assess whether PCE was present as a result of a spill that may have occurred along I-5. For the Berwick Creek area, the soil gas samples were collected at 4 feet bgs except for two individual samples collected at 5 and 10 feet bgs. Soil gas concentrations of PCE in this area ranged from non-detect to 3.2 parts per million by volume (ppm-v). Three samples contained 1 ppm-v or greater PCE, and one contained 0.19 ppm-v PCE. PCE concentrations in the remaining 29 samples were all less than 0.1 ppm-v. All four samples with greater than 0.1 ppm-v PCE were located within the Southeastern Hot Spot. Overall, the soil gas survey results did not support the scenario of a release along I-5.

Two additional soil gas (SG) samples, SG-204 and SG-205, were collected on the west side of North Hamilton Road at the southeast corner of the United Rentals Property. These two samples, collected at depths of 10 and 7 feet bgs, contained PCE concentrations of 4 and 18 ppm-v, respectively. Soil data from nearby borings confirmed the presence of PCE. A 10.5 foot soil

sample collected from GP-505 near SG-204 contained 1.97 mg/kg PCE. A 16 foot soil sample collected from GP-4 near SG-205 contained 13 mg/kg PCE.

5.6.7 Indoor and Ambient Air Quality

In November 2007, EPA's ERT conducted air sampling in and around private residences and commercial buildings to determine whether vapors from volatilization of contaminants in the shallow aquifer were intruding into indoor and ambient air at the Site. Samples were collected from indoor air, ambient air, and sub-slab soil vapors. Sample locations are shown on **Figure 5-8**.

PCE was detected in all four samples collected within OU1. The ambient air PCE concentration was 0.14 micrograms per cubic meter (µg/m3). The two indoor air samples taken on the United Rentals Property contained PCE at concentrations of 0.14 µg/m3 (paint shop) and 0.21 µg/m3 (main building). As a comparison, the EPA Regional Screening Level (RSL) for PCE in residential air is 9.4 $\mu g/m^3$, and the RSL for industrial air is 47 $\mu g/m^3$ (EPA 2012a). The sub-slab sample collected at the paint shop building contained 25 $\mu g/m^3$ PCE; the EPA target sub-slab soil gas concentration is 94 $\mu g/m^3$, which is extrapolated from the RSL for residential indoor air based on a generic attenuation factor of 10 (EPA 2012b).

5.6.8 Estimates of PCE Mass, Volume, and Surface Area within OU1

Three dimensional (3-D) modeling using Ctech's Mining Visualization Systems (MVS) Version 9.13 was used to help better define the vertical and lateral extent of PCE contamination within OU1 and to help provide estimates for PCE mass, volume, and surface area. **Table 5-2** lists the estimated amount of contaminant mass at various contaminant levels in OU1 creek bed sediment, soil, and groundwater. It also tabulates the estimated total plume volume and the surface area for each concentration level. Within OU1, a total PCE mass of 686 kilograms (kg) in soil is estimated to be distributed across a volume of 639,000 cubic yards (cy), with 339,260 square feet of surface area. Approximately 87% of the mass in groundwater and subsurface soil exists within the volume defined by the 4,000 µg/L isoconcentration line. Additionally, PCE was found in the creek bed sediments at concentrations above 5,000 mg/kg, which may indicate that residual DNAPL still exists in the pores of the sediment.

5.7 OU1 Contaminant Fate and Transport

This section discusses the behavior and migration of PCE in OU1 that was released into Berwick Creek bed sediment and bank surface soil. As previously indicated, a graphical representation of the Hamilton/Labree CSM is presented in **Figure 5-1.**

Berwick Creek is a low-velocity stream for most of the year, except when heavy rains or major flooding events occur. Assuming the creek was at a low velocity when the PCE was released, most of it likely sank to the bottom of the creek bed, spread downstream and a little way upstream (due to localized stream topography), and pooled in low areas.

In OU1, the fine-grained material in the Berwick Creek sediments (containing a high fraction of organic carbon), and to a lesser extent, the thin layer of silty/clay immediately beneath it, have

sorbed PCE and slowed its migration into the sand and gravel aquifer. However, it appears that the large volume of PCE spilled in the creek overwhelmed the capacity of the creek bed and silty/clay layer to contain the spill, and the PCE in turn migrated into the subsurface soil and shallow aquifer.

The sand and gravel matrix of the shallow aquifer is highly permeable, facilitating the vertically downward and laterally downgradient migration of the dissolved-phase plume. The PCE appears to have continued to move downward and laterally in an irregular pattern within the aquifer matrix, preferentially following lenses of higher permeability soils. The soil and groundwater data suggest that the PCE mass has tended to be absorbed by and pooled on top of the occasional, discontinuous lower permeability silt lenses in the upper zone of the shallow aquifer, thus, impeding PCE migration. PCE concentrations generally (but not always) decrease with depth.

Very little natural attenuation of PCE has occurred in OU1 soil and groundwater. Natural attenuation is the process whereby contaminants are removed from soil or groundwater by means other than human intervention. Natural attenuation occurs by both chemical and biological transformation. Chemical transformation occurs by dispersion, dilution, sorption, and volatilization. Biological transformation (biodegradation) occurs by aerobic and anaerobic microbial processes.

PCE is biologically transformed by a process called reductive dechlorination. During reductive dechlorination, chlorine atoms are sequentially stripped away. As each chlorine atom is removed, PCE becomes TCE, TCE becomes DCE, DCE becomes vinyl chloride, and finally vinyl chloride degrades to non-toxic ethylene and ultimately carbon dioxide and water. At many sites, biological transformation of PCE is evidenced by the presence of these degradation products. The process is strictly anaerobic and can occur under sulfate-reducing redox conditions but is most efficient (i.e., results in ethylene generation) under methanogenic redox conditions. A factor limiting the biological transformation of chlorinated ethylenes is typically the lack of sufficient electron donor to drive the dechlorination process, or in some cases, the lack of bacteria capable of carrying out the complete transformation process to ethylene (*Dehalococcoides* is the only genus of bacteria demonstrated to reduce DCE to vinyl chloride and ethylene).

At OU1, PCE degradation products are nonexistent for the most part, indicating that natural attenuation via biodegradation is an insignificant degradation pathway. The aquifer geochemistry results presented in the EE/CA (URS 2004) indicate that the high concentration groundwater is generally aerobic (indicated by the presence of oxygen), with some pockets of mildly reducing conditions (indicated by low oxidation reduction potential and depleted sulfate and nitrate). Based on the geochemistry results, conditions within these areas are not optimal for anaerobic degradation of contaminants.

PCE concentrations in the groundwater are high enough to indicate that the release to the creek was of sufficient quantity to have resulted in DNAPL conditions within the shallow aquifer based on a few groundwater detections exceeding the solubility limit of PCE (200,000 µg/L) and numerous detections exceeding 10% of the solubility limit (20,000 µg/L). In some areas below the

release area, low concentrations of PCE were detected in the upper material of the silty/clay aquitard found at 50 feet bgs, but the presence of DNAPL has never been indicated.

PCE dissolving from pooled DNAPL and desorbing from the lower permeability layers will act as continuing sources of PCE to the aquifer. The predominant transport direction appears to have been towards the northwest, following the regional groundwater gradient. Without the occurrence of a significant rate of biological transformation, a PCE plume can potentially migrate hundreds to thousands of feet before the chemical transformation processes are significant enough to have attenuated the PCE to below drinking water standards.

6.0 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

This section of the ROD discusses the current and reasonably anticipated future land and resource uses at the Hamilton/Labree Site. This information was obtained from Lewis County and City of Chehalis land use planning websites, from discussions with the City of Chehalis community development department, and from searches of state and federal water type and wildlife websites and databases. More detailed information on this topic can be found in the Land Use Evaluation Technical Memorandum, July 14, 2011 (Parametrix/CDM Smith 2011) included in Appendix C of the Draft Site-wide RI Report (CDM Smith 2011b).

6.1 Current Land and Resource Uses

The Site is located in a rural region used for a mix of agricultural, residential, and commercial uses, with OU1 used primarily for commercial/industrial and transportation purposes (roads). An estimated 1,200 people live within 4 miles of the Site and have been identified by EPA as living within the potential area for adverse effects from PCE contamination from groundwater (E&E 2000). The commercial district of the City of Chehalis is located about 2 to 2.5 miles northwest of the Site.

The boundary between the City of Chehalis and unincorporated Lewis County bisects the Site roughly north to south along Labree Road. OU1 and the portion of OU2 that is east of Labree Road are located within the City of Chehalis' urban growth area (UGA) and are zoned Commercial General (CG). The Breen Property and the United Rentals Property are used for commercial purposes. The Thurman Berwick Creek Area, however, is used for commercial and residential purposes. Property west and north of Labree Road is outside of the Chehalis UGA. Current land uses within these areas consist primarily of rural open (Class B Farmlands) and residential (Rural Development District [RDD]-20) uses, although some commercial uses are evident.

The shallow aquifer is a potential source of drinking water in OU1 but is not currently used for that purpose; however, cross- and downgradient of OU1 the shallow aquifer is used as a drinking water source for properties not connected to the City of Chehalis municipal water-supply system. In addition to drinking water, the shallow aquifer in these areas is used for cooking, bathing, irrigation, and stock watering by residences, commercial businesses, and farms. About 250 private water-supply wells are located within 4 miles of OU1 and the Breen Property (Farallon 2003).

The Site is designated as within the Usual and Accustomed (U&A) area for the Confederated Tribes of the Chehalis Reservation, the Cowlitz Indian Tribe, and the Quinault Indian Nation.[6]

Within the Site, Berwick Creek is classified as a Type F stream by the Washington State

[6] EPA has kept all three Tribes informed of Site plans and activities via the methods discussed in Section 3 of this ROD and offered to consult with each Tribe prior to publishing the OU1 Proposed Plan. None of the three tribes wished to consult; however, they did request to be kept informed of future plans and activities at the Site.

Department of Natural Resources (DNR) (DNR 2010). A Type F stream is known to be used by fish or meets the physical criteria to be potentially used by fish. Fish streams may or may not have flowing water all year. There are no use designations specifically for Berwick Creek in Ecology's Water Quality Standards for Surface Waters of the State of Washington (Washington Administrative Code [WAC] 173-201A-602, Table 602) (Ecology 2006a). Ecology lists Berwick Creek as a Category 4A water body in the Water Quality Assessment 303(d) list due to exceedances of fecal coliform (go to **http://apps.ecy.wa.gov/wats/SearchResults.aspx** and select Berwick Creek under Waterbody Name).

Dillenbaugh Creek is classified as a Type F stream by DNR upstream of where it merges with Berwick Creek. Downstream of this area, however, the creek is classified as Type S. A Type S stream is designated "shorelines of the state." There are no use designations specifically for Dillenbaugh Creek in WAC 173-201A-602, Table 602. Ecology lists Dillenbaugh Creek as a Category 4A and 5 water body in the 2004 Water Quality Assessment 303(d) list. The Category 4A listing is due to exceedances of fecal coliform. The creek is listed as a Category 5 water body due to an exceedance of dioxin in fish tissue in a section of the creek downstream from the confluence with Berwick Creek (go to **http://apps.ecy.wa.gov/wats/SearchResults.aspx** and select Dillenbaugh Creek under Waterbody Name).

A variety of animals (e.g., birds, mammals, fish) and plants inhabit or use, or have the potential to inhabit or use, the creeks and land across the Site. Birds, such as the bald eagle, the American Robin, and various ducks, such as the Mallard, visit the Site. A wide range of mammals, including the short-tailed shrew, raccoon, and white-tailed deer, also frequent the Site.

Searches of wildlife databases and inquiries with regulatory agencies were conducted to determine if any threatened and endangered species and environmentally important animals and plants are likely to be present at the Site, especially near Berwick Creek. A bald eagle (*Haliaeetus leucocephalus*) nest has been documented about 0.5 mile west of the Site near the Newaukum River. It is possible that bald eagles in the area obtain food from Berwick Creek. Bald eagles were recently delisted under the Federal Endangered Species Act but are still protected under the Migratory Bird Treaty Act and the Bald and Golden Eagle Protection Act.

Berwick and Dillenbaugh Creeks are designated as essential fish habitat for the Chinook (*Oncorhynchus tschawytscha*) and Coho (*Oncorhynchus kisutch*) salmon under the Magnuson-Stevens Act. Chinook salmon has not been documented in Berwick Creek but has the potential to access it and the Site. Coho salmon is a federal candidate for the Endangered Species Act. Berwick Creek was identified as having Coho salmon spawning and rearing habitat in its lower reaches, which would include areas both downstream and upstream of OU1 (URS 2004). Bull trout (*Salvelinus confluentus*) is listed as threatened in the Endangered Species Act, and although it has not been documented in Berwick Creek, it has the potential to access it and the Site.

The small flowered trillium (*Trillium parviflorum*) is listed as "sensitive" by Washington State and had been documented approximately 0.35 mile upstream of the Site near Berwick Creek.

6.2 Potential Future Land and Resource Uses

Future land and resource uses east of Labree Road (all of OU1 and portions of OU2) are anticipated to be similar to current uses. A freeway interchange was built several years ago within this area northeast of the Breen Property, increasing the use of Labree and North Hamilton Roads as a transportation corridor. Because of this increased access, additional commercial use is planned for the area south of the Breen Property and west of OU1.

Future land and resource uses in the area north and west of Labree Road (part of OU2) are also anticipated to be similar to current uses (agricultural and residential) unless it becomes part of the Chehalis Urban Grown Area. There are no plans, however, to change the current uses and designation for this area of OU2.

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7.0 SUMMARY OF OU1 RISKS

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) requires EPA to protect human health and the environment from current and possible future exposures to hazardous substances at Superfund sites. Towards that end, a BLRA was initiated for the Site, and a report was drafted in October 2011 (CDM Smith 2011a). The BLRA estimates risks to human health and the environment if no action were taken. It provides the basis for taking action and identifies the contaminants and exposure pathways that need to be addressed by the remedy.

7.1 Human Health Risks

This section summarizes how risks to human health from contaminated media in OU1 were identified.

Note: Human health toxicity data for PCE, TCE, cis-1,2-DCE, and methylene chloride have been revised since publication of the draft 2011 Site-wide BLRA Report and the 2012 Proposed Plan. EPA Region 10 risk assessors have updated the risk calculations using the new toxicity data. The revised risk evaluation results are presented in the following ROD sections and in ***Table 7-1****.*

7.1.1 Identification of Human Health Chemicals of Potential Concern and Exposure Point Concentrations

One of the first steps in the risk assessment process is to identify the chemicals of potential concern (COPCs) in contaminated media at a site and the exposure point concentrations (EPCs) of each COPC.

Data Quality

Investigations were conducted across the Site between 1993 and 2010 by a number of entities, often for different purposes. As part of the Site-wide RI effort and prior to initiating the Site-wide BLRA, environmental data collected from these numerous investigations were carefully reviewed for quality and usability. Some data were rejected during the review, e.g., duplicate samples. In general, however, most of the reviewed data were found to be acceptable for use in preparation of the draft RI report and conducting the BLRA (Parametrix 2009, Site Data Usability Review Technical Memorandum).[7]

Chemicals of Potential Concern

Data that were found to be valid were then used to identify COPCs within each of the OU1 contaminated media discussed in Section 5 of this ROD.

Summary statistics for each chemical were prepared by media. Statistics included minimum and maximum concentrations and the frequency of detection (FOD) for each chemical. Chemicals

[7] The 2009 Site Data Review Usability Technical Memorandum states that all soil samples taken across the Site appear not to have been preserved using the protocols under EPA Method 5035A, leading to the possibility that VOC analytical results are biased low especially for samples collected from the gravelly materials that comprise the shallow aquifer. However, EPA has since learned that OU1 soil sampling conducted by URS in 2003 did use this method.

were generally excluded from further analysis if they were never detected or detected at a frequency of less than 5% (when at least 20 samples were collected). An exception to this is if a chemical was known to be associated with historic practices or releases at the Site, it was included for further analysis.

Chemicals that were detected at or greater than a FOD of 5%, or the exception noted above, were then compared to available risk screening level benchmarks. Human health risk screening benchmarks consisted primarily of EPA RSLs for residential soil and groundwater (EPA 2012b).[8] For chemicals in groundwater without RSLs, EPA MCLs (**http://water.epa.gov/drink/contaminants/index.cfm**) or Ecology Model Toxics Control Act (MTCA) Method B cleanup levels for residential use (Ecology 2006b) were used to screen contaminants. For chemicals in surface water, EPA National Recommended Water Quality Criteria (**http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm**) or MTCA Method B cleanup levels (Ecology 2006a) were used to screen contaminants. Summary statistics for each chemical by media and by Site are presented in Tables 2-3, 2-4, and 2-5 of the draft 2011 Site-wide BLRA report (CDM Smith 2011a).

A COPC was then identified for human health if the maximum concentration exceeded the appropriate risk screening benchmark. The OU1 human health COPCs were:

- PCE (surface water, sediment, soil, groundwater, air)
- TCE (soil, groundwater, air)
- cis-1,2-DCE (groundwater)
- Methylene chloride (groundwater, air)

Exposure Point Concentrations

EPCs were then identified for each OU1 COPC. EPCs are the concentrations that are used to estimate the exposure and risk from each COPC by media. Generally, the 95% upper confidence limit (UCL) on the arithmetic mean concentration for a chemical is used as the EPC. However, for sites with limited amounts of data or extreme variability in the data, the highest concentration (i.e., the maximum value) is commonly used as a default EPC in risk assessments. EPCs for OU1 were calculated based on grouping contaminant data by medium for each of the COPCs. **Table 7-2a** includes the range of OU1 COPC concentrations that were detected, the risk screening benchmark value, the FOD, the EPCs, and how the EPCs were derived for each OU1 COPC by media. As indicated on this table, PCE is the most frequently detected COPC in OU1 where it is primarily found in sediment, soil, and groundwater.

[8] Residential soil-screening levels were also used to evaluate chemical concentrations in sediment. COPCs in air were identified based on the results of the screening-level risk assessment of soil and groundwater.

7.1.2 Exposure Assessment

Conceptual Site Model

An early step in the exposure assessment is the development of the CSM first discussed in Section 5.1 of this ROD. **Figure 5-1** provides a graphical presentation of the Site-wide CSM, summarizing contaminant release areas, transport pathways, and potential receptors. **Figure 7-1** provides a more detailed CSM that includes all of the pathways and receptors considered in the risk assessment. Only those scenarios with potentially complete exposure pathways were quantitatively addressed in the risk assessment.

Exposed populations

Exposed populations (i.e., human receptors) are those people who may be exposed to contaminated media at or near a site currently or in the future. The potentially exposed human receptors identified for OU1 are current and future commercial/industrial workers, current and future construction/utility (trench) workers, current and future trespassers, and current and future adults and children who recreate in Berwick Creek within OU1. Since the current and reasonably anticipated future land use for OU1 is primarily for commercial, industrial, and transportation uses and to a lesser extent recreational uses around the Creek, and groundwater in OU1 is not used as a drinking water source, a residential exposure scenario was not quantitatively evaluated.

Groundwater downgradient of OU1, in areas of OU2 west of Labree Road, is currently used as a drinking water source by residents and commercial businesses not connected to the Chehalis municipal water-supply system. Although OU2 is not a focus of this ROD, one of the ROD objectives is to minimize the further migration of contaminated groundwater from OU1 to other areas of the Site. Restoration of groundwater to its most beneficial use as a drinking water supply will be an objective of the final remedy for the Site.

Exposure Pathways

After likely human receptors are identified, the next step is to identify potentially complete and significant exposure pathways for the receptors. An exposure pathway describes a manner by which receptors are assumed to contact COPCs. EPA defines a complete exposure pathway in terms of four components:

1. A source and mechanisms of chemical release, e.g., a release of COPC to groundwater
2. A retention or transport medium, e.g., groundwater
3. A receptor at a point of potential exposure to a contaminated medium, e.g., construction/utility worker digging a trench located above the groundwater plume
4. An exposure route at the exposure point, e.g., inhalation of vapors

If any of these four components are not present, then a potential exposure pathway is incomplete and is not evaluated further in a risk assessment. If all four components are present, a pathway is considered complete and may be quantitatively evaluated.

The potentially complete exposure pathways in OU1 are listed in **Table 7-3**. The major assumptions about exposure frequency, duration, and other exposure factors that were included in

the exposure assessment can be found in Tables 2-8a, 2-8b and 2-8c of the 2011 Draft Site-wide BLRA Report (CDM Smith 2011a).

7.1.3 Toxicity Assessment

Toxicity assessment is the process of characterizing the relationship between the dose[9] of a chemical and the anticipated incidence of an adverse health effect. For human health risk assessment purposes, toxic chemical effects are separated into two categories: carcinogenic effects and non-carcinogenic effects.

For carcinogens, it is assumed that any level of exposure has a finite possibility of causing cancer; therefore, there is no threshold dose for carcinogenic effects. That is, a single exposure to a carcinogenic chemical may, at any level, result in an increased probability of developing cancer.

For chemicals exhibiting non-carcinogenic effects, it is believed that humans have protective mechanisms that must be overcome before an adverse effect occurs; therefore, there is a threshold dose for these effects. This threshold concept view of non-carcinogenic effects holds that a range of exposures up to some defined threshold can be tolerated by humans without appreciable risk of harm.

Toxicity criteria used in the Hamilton/Labree risk assessment were obtained from EPA's Integrated Risk Information System (IRIS) database. If criteria were not available from IRIS, toxicity criteria were obtained from the California Environmental Protection Agency Office of Environmental Health Hazard Assessment database or the Agency for Toxic Substances and Disease Registry Toxicological profiles.

A summary of the carcinogenic and non-carcinogenic toxicity data used to calculate the risks of each COPC are in **Tables 7-4 and 7-5**. The non-carcinogenic summary table also includes the primary target organs and health effects of concern for each COPC.

7.1.4 Human Health Risk Characterization and Chemicals of Concern

Risk characterization combines exposure assessment and toxicity assessment to estimate potential cancer and non-cancer risks for the various exposure pathways and receptors. For carcinogens, risks are generally expressed as the incremental probability of an individual developing cancer over a lifetime as a result of exposure to the carcinogen. Individual excess lifetime cancer risk is calculated from the following equation:

Risk = CDI x SF

Where: risk = a unitless probability (e.g., 2×10^{-5}) of an individual developing cancer
CDI = chronic daily intake averaged over 70 years (mg/kg-day)
SF = slope factor, expressed as (mg/kg-day)-1.

[9] See pages 18 through 20 in the 2011 Draft Site-wide BLRA Report for information on dose estimates used in this risk assessment.

These risks are probabilities that usually are expressed in scientific notation, e.g., 1×10^{-6}. An individual excess lifetime cancer risk of 1×10^{-6} indicates that an individual experiencing the reasonable maximum exposure (RME) estimate has a 1 in 1,000,000 chance of developing cancer as a result of site-related exposures. This is referred to as an excess lifetime cancer risk because it would be in addition to the risks of cancer individuals face from all other causes, such as smoking or exposure to too much sun. The chance of an individual developing cancer from all other causes has been estimated to be as high as one in three. EPA's generally acceptable human health risk range for site-related exposures is 1×10^{-4} to 1×10^{-6}.

The potential for non-carcinogenic effects is evaluated by comparing an exposure level over a specified time period, e.g., lifetime, with a reference dose (RfD) derived for a similar exposure period. An RfD represents a level that an individual may be exposed to that is not expected to cause any deleterious effect. The ratio of exposure to toxicity is called a hazard quotient (HQ). An HQ < 1 indicates that a receptor's dose of a single contaminant is less than the RfD and that toxic non-carcinogenic effects from that chemical are unlikely. The hazard index (HI) is generated by adding the HQs for all COPCs that affect the same target organ, e.g. liver, or that act through the same mechanism of action within a medium or across all media to which a given individual may reasonably be exposed. An HI < 1 indicates that, based on the sum of all HQs from different contaminants and exposure pathways, toxic non-carcinogenic effects from all contaminants are unlikely. An HI > 1 indicates that site-related exposures may present a risk to human health.

The HQ is calculated as follows:

$$\text{Non-cancer HQ} = \text{CDI}/\text{RfD}$$

Where:

CDI = chronic daily intake
RfD = reference dose

CDI and RfD are expressed in the same units and represent the same exposure period, i.e., chronic, subchronic, or short-term (acute).

The estimated carcinogenic risks and non-cancer hazards for four categories of human receptors that may be exposed to contamination within or near OU1 are described below.

Commercial/Industrial Workers

Individual excess lifetime cancer risk and non-cancer hazards were estimated for a long-term commercial/industrial employee working indoors for 250, 8-hour days per year for 25 years at either the main building or the paint shop on the United Rentals Property, and doing incidental maintenance outside of the buildings on this property. Exposures to contaminants in soil, indoor and outdoor air, and groundwater were evaluated.

Under the current use scenario, the estimated individual excess lifetime cancer risk and non-cancer HI are 3×10^{-6} and 0.9, respectively, for commercial/industrial workers from ingestion and inhalation of soil contaminated with PCE and TCE in OU1.

The current risk to commercial/industrial workers from inhalation of indoor air contaminated with PCE, TCE, and methylene chloride are as follows: the main building estimated individual excess lifetime cancer risk and non-cancer HI are 1 x 10^{-7} and 0.01, respectively, and the paint shop estimated individual excess lifetime cancer risk and non-cancer HI are 3 x 10^{-8} and 0.01, respectively. The estimated individual excess lifetime cancer risk to commercial/industrial workers from inhalation of PCE, TCE, and methylene chloride in outdoor air is 4 x 10^{-8}, and the non-cancer HI is 0.01.

Currently, groundwater in OU1 is not being used for drinking water or other purposes, such as showering; therefore, there is no significant current risk from this pathway. If chemical concentrations persist in groundwater and it is used for drinking water or for other purposes in the future, over time the estimated individual excess lifetime cancer risk for commercial /industrial workers would be 2 x 10^{-3} from ingestion, inhalation, and dermal contact with PCE, TCE, and methylene chloride. The non-cancer HI would be 386 from inhalation of PCE, TCE, and methylene chloride, and ingestion and dermal contact with all four OU1 COPCs. The United Rentals Property is currently on the City of Chehalis municipal water-supply system, which makes this an unlikely future scenario.

Construction/Utility (Trench) Worker

Individual excess lifetime cancer risk and non-cancer hazards were also estimated for a short-term construction/utility worker working outside for 20, 8-hour days per year for 1 year within OU1. Exposure to contaminants in soil, air, and groundwater were evaluated.

Under current uses, the estimated individual excess lifetime cancer risk and non-cancer HI are 3 x 10^{-6} and 0.90, respectively, from ingestion and inhalation of soil contaminated with PCE and TCE. The inhalation pathway is the most current significant exposure route for short-term construction and utility workers who work in trenches within OU1, primarily from inhalation of PCE and TCE in groundwater vapors. Based on estimates of trench air concentrations at three OU1 subareas (Table 7-2b) and assuming that a worker will have a total exposure time of 500 hours over 1 year (125 days/year at 4 hours/day), the estimated individual excess lifetime cancer risk ranges from 6 x 10^{-8} to 1 x 10^{-9}, and the non-cancer HI ranges from 7.5 to 457.[10]

If chemical concentrations persist in groundwater and it is used as a drinking water source in the future, over time, the estimated individual excess lifetime cancer risk to construction/utility workers would be 4 x 10^{-6} from ingestion, inhalation, and dermal contact with PCE, TCE, and methylene chloride. The non-cancer HI would be 23.6 from inhalation of PCE, TCE, and

[10] In the Draft 2011 Site-wide BLRA Report, the estimated individual excess lifetime cancer risks ranged from 2 x 10^{-3} to 4 x 10^{-5}, and the non-cancer HIs ranged from 1.3 to 121. The differences between the 2011 estimates and those presented in this ROD are due to the following: (1) the air EPCs used in the 2011 trench scenario risk calculations were derived by modeling whereas the recalculated values presented in this ROD are based on groundwater concentrations as stipulated in the "Box Model" approach (Andelman 1985 and EPA 1999), which calculates the concentration of a chemical in trench air (µg/m^3) by multiplying the groundwater concentration (µg/L) by the volatilization factor (VF) [Liters per cubic meter (L/m^3)] and, (2) new toxicity data for PCE, TCE, cis-1, 2-DCE, and methylene chloride published in EPA RSL Tables (EPA 2012a).

methylene chloride and from ingestion and dermal contact with all four OU1 COPCs. Due to the transient nature of construction and utility work, this future exposure scenario is unlikely.

Trespasser

The individual excess lifetime cancer risk and HI for a trespasser at OU1 currently exposed to soil and outdoor air were estimated to be less than that of a short-term construction/ utility worker (less than 3×10^{-6} and 0.9, respectively). This was based on the assumption that a trespasser would be exposed for a shorter period of time.

Berwick Creek Recreator

Current and future individual excess lifetime cancer risks and non-cancer HIs were estimated for adults and children recreating infrequently at Berwick Creek within OU1. The estimated individual excess lifetime cancer risk is 4×10^{-6} for both adults and children, which was predominately driven by ingestion and inhalation of PCE in creek bed sediment and bank surface soil. The non-cancer HI from ingestion and inhalation exposure to PCE in sediment and soil for both adults and children was less than 1.0.

The estimated individual excess lifetime cancer risk from ingestion and dermal contact with PCE and TCE in surface water within OU1 is 8×10^{-8} for both adults and children. The non-cancer HI for both adults and children was less than 1.0 from ingestion and dermal contact with PCE, TCE, and cis-1,2 DCE.

Human Health Contaminants and Media of Concern

The COPCs identified in the BLRA that significantly contribute to an exposure pathway (e.g., inhalation of groundwater vapors) in a use scenario for a receptor (e.g., current construction/utility worker) that either (a) exceeds a 1×10^{-4} estimated individual excess lifetime cancer risk or (b) exceeds a non-carcinogenic HI of 1 become human health COCs that may warrant a response action at a Superfund site.

Based on the results of the risk evaluation, the OU1 human health COCs and media of concern are:

- PCE (sediment, soil, groundwater)
- TCE (groundwater)
- cis-1,2-DCE (groundwater)
- Methylene chloride (groundwater)

7.1.5 Human Health Risk Assessment Uncertainties

Analysis of uncertainty associated with exposure assessment, toxicity assessment, and risk characterization is an important part of a risk assessment. Although uncertainties are inherent in the risk assessment process, this should not imply that the results are not useful. The uncertainty analysis lends perspective to quantitative results that can assist risk management decisions. It should be noted that many assumptions made in the risk assessment are intentionally conservative

so that risks are likely to fall at or even above the upper range of risks that are possible; therefore, risk estimates are unlikely to underestimate risks even for sensitive populations. Below are uncertainties with the OU1 human health risk assessment.

Influence of High Analytical Detection Limits

In some cases, sampling resulted in chemicals not being detected; however, for some of these, the detection limits were higher than what can typically be achieved using standard analytical techniques. In some of these cases, the concentration of PCE was so high that the sample had to be diluted. This allowed the concentration of PCE to be quantified, but dilution of the sample also resulted in higher detection limits. Although elevated detection limits in these cases imparts uncertainty in the precision of the exposure assessment, the overall effect is likely insignificant.

Groundwater Data Limitations

A large body of groundwater data exists for the Site, but it is unevenly distributed both horizontally and vertically. Groundwater data more recent than 2003 were limited, and wells that were sampled were not all sampled with the same frequency and timing. Limitations in groundwater data reduce confidence in the conclusions of the risk assessment. Risks associated with exposure to groundwater may be either under- or overestimated, and the magnitude of this is difficult to discern. Fortunately, in OU1, groundwater is unlikely to be used for drinking or showering since land use is primarily for commercial and industrial purposes, properties are on the City of Chehalis municipal water-supply system, and future land and resource uses are not likely to change.

Sediment Data Limitations

Exposure point concentrations, particularly for sediment exposure pathways, are uncertain due to limited data. Available data for sediment in Berwick Creek consisted of only PCE measured in the top 0 to 12 inches of the bedded sediment and soil near the PCE source on OU1. Thus, a worst-case exposure was evaluated for sediment associated with the PCE source area. It is unlikely that children would recreate near the PCE source area, which is located on OU1 property across from I-5. PCE concentrations greater than 40 feet downstream of the PCE spill area were orders of magnitude lower or non-detected (0.01 to 0.09 mg/kg) compared to samples at the spill area. Thus, recreators downgradient of the PCE spill area are likely not at risk from PCE in sediments. The exposure and risk characterization for the recreator scenario is likely overestimated due to its basis on limited sediment data.

7.2 Ecological Risks

This section summarizes how risks to ecological receptors from contaminated media in OU1 were identified.

7.2.1 Identification of Ecological Chemicals of Potential Concern and Exposure Point Concentrations

As discussed in Section 7.1, identification of COPCs and EPCs are one of the first steps in the risk evaluation process.

Data Quality

The same data that were used in the human health risk assessment were also used in the ecological risk assessment; however, the ecological risk assessment focused on sediment, soil, and surface water. Groundwater and air data were not used.

Contaminants of Potential Concern

The chemical parameters available for the ecological risk assessment consist of maximum chemical concentrations (primarily volatile organic compounds [VOCs]) identified in the ecological media of concern.

All chemicals detected at a frequency of 5% or greater were included in a risk-based screening for identifying ecological COPCs across the Site, including OU1. Chemicals were excluded from further evaluation if they were not detected or detected at a frequency of less than 5% (when at least 20 samples were collected). An exception to this is if a chemical was known to be associated with historic practices or releases at the Site, it was included for further analysis.

Chemicals that were detected at or greater than a FOD of 5% or the exception noted above were then compared to a variety of ecological risk-based screening level benchmarks, including EPA Ecological Soil Screen Levels, MTCA Cleanup Levels, and Screening Benchmarks for Ecological Risk Assessments from the Oak Ridge National Laboratory. Summary statistics for each chemical by media are presented in Tables 3-1 through 3-3 of the Draft Site-wide BLRA Report (CDM Smith 2011a).

A COPC was then identified for ecological receptors if the maximum concentration exceeded appropriate benchmarks. OU1 ecological COPCs are:

- PCE
- TCE
- cis-1,2-DCE

These three VOCs were evaluated for impacts to ecological receptors in three media (sediment, soil, and surface water) except where appropriate toxicity/effects criteria were not available. This approach was taken even though screening levels were not always exceeded in each medium. This approach is consistent with common ecological risk assessment practice under EPA guidance and policy and helps ensure that no significant ecological risks are ignored. A limited number of samples were analyzed for inorganic constituents and petroleum organics (e.g., gasoline), and in a few instances, these samples were detected at a FOD greater than 5% and/or exceeded relevant screening values. However, inorganic constituents have not been associated with OU1 releases and therefore were not evaluated further in the risk assessment.

Exposure Point Concentrations

Concentrations of COPCs are the same as those used in the human health risk assessment. These concentrations represent the RME based on an upper 95th percentile of the environmental sampling data.

7.2.2 Exposure Assessment

Conceptual Site Model

As previously discussed in Section 7.1.2 of this ROD, the CSM developed for the Hamilton/Labree Site summarizes the contaminant release areas, transport pathways, and potential receptors. The ecological setting and land and resource uses associated with the Site are discussed in Sections 5 and 6 of this ROD. Only those ecological receptors with potentially complete exposure pathways were quantitatively addressed in the ecological risk assessment.

Receptor Populations

Potential ecological receptor populations are delineated by two groups of animals (wildlife, aquatic life) and one group of plants that inhabit or use, or have potential to inhabit or use, the aquatic and terrestrial habitats of the Site. Within the wildlife group, there are the avian receptors (bald eagle, American robin, mallard duck) and the mammalian receptors (short-tailed shrew, raccoon, white-tailed deer). Within the aquatic life group there are salmon receptors (Coho salmon, rainbow trout) and benthic receptors (aquatic invertebrates associated with creek sediment). The only species of special concern that uses certain reaches of Berwick Creek is the Coho salmon. No specific plant species were selected for evaluation. Rather, available plant toxicity data were selected from EPA's ECOTOX database to identify concentrations that are likely to adversely affect plant growth or reproduction. Concentrations of COPCs were then compared to the available toxicity data to characterize risks to plant species.

Exposure Pathways and Assessment Endpoints

Exposure pathways were evaluated based on potential adverse impacts from chemical stressors (using PCE and TCE as indicator contaminants) on each group of ecological receptor. These ecological receptors are also referred to as assessment endpoints in the BLRA. Measures of exposure include sediment, soil, and surface water data collected across the Site. Measures of effect, although not site-specific, include the ecological risk-based screening values or toxicity values. The potentially complete exposure pathways in OU1 for each receptor and the ecological risk-based screening toxicity values are listed in the Draft Site-wide BLRA Report, Tables 3-6, and 3-9, respectively (CDM Smith 2011a).

7.2.3 Ecological Effects Assessment

Chemical exposure concentrations or doses to receptors were then quantified. For wildlife receptors, COPC concentrations in all three media of concern were used to estimate doses (COPC per kg body weight per day, or mg/kg-day). For salmon (an aquatic receptor), the COPC concentrations in sediment and surface water were used. For plants, the COPC concentrations in soil were used directly to estimate exposures.

Toxicity reference values (TRVs) were then identified for comparison to the COPC exposure doses for each receptor group. Wildlife receptor group TRVs were obtained from scientific literature on long-term studies that evaluated effects on survival, growth, or reproduction. Although no salmon toxicity data for PCE or TCE were identified in EPA's AQUIRE database, toxicity data were available on rainbow trout (a salmonoid) and a variety of other fish and aquatic invertebrates. This toxicity data were largely from acute studies, but limited chronic toxicity data were also identified. EPA's ECOTOX database was searched for COPC toxicity data for all plant species. Standard growth and reproduction tests were identified for plant species grown in soil or soil solutions containing those COPCs. Soil solution data were compiled to compare to groundwater data. See pages 43 to 46 of the Draft 2011 Site-wide BLRA Report regarding estimated doses and TRVs used in the ecological risk assessment (CDM Smith 2011a).

7.2.4 Ecological Risk Characterization and Chemicals of Concern

The estimated risks to ecological receptors that may be exposed to contamination within or near OU1 are described below.

Wildlife Receptors

Risks to wildlife receptors were estimated in terms of HQs(See **ROD Table 7-6**). The acceptable target hazard level is an HQ of less than 1.0. Wildlife receptors evaluated in OU1 included several types of birds (bald eagle, American robin, mallard duck) and mammals (short-tailed shrew, raccoon, white-tailed deer). No elevated risks for bald eagles were identified. However, risks for American robins (HQs = 2 to 11) and mallard ducks (HQ = 3) were elevated for PCE primarily due to their high sediment/soil ingestion rate and the elevated PCE concentrations identified in Berwick Creek sediments. Elevated risks were also found for short-tailed shrews in OU1 primarily from inhalation of PCE-contaminated soil in burrow air (HQ = 50). Both raccoons (HQs = 8.6 to 43) and deer (HQs = 1.3 to 6.6) had elevated risks primarily from the high PCE concentrations found in Berwick Creek sediments.

Aquatic Receptors

Direct contact risks to aquatic receptors (e.g., rainbow trout) were evaluated by comparing the mean (95% UCL) PCE and TCE concentrations in Berwick Creek surface water to available toxicity data for aquatic life (see Figures 3-1 and 3-2 in the Draft Site-wide BLRA Report [CDM Smith 2011a]). This comparison shows that surface water PCE and TCE concentrations are well below existing acute and chronic toxicity studies values for aquatic receptors. Accordingly, potential PCE and TCE risks to these receptors are negligible.

Benthic Receptors

Benthic organisms live at the bottom of water bodies and are important links in the food chain, providing a food source for fishes, birds, and mammals. Due to the lack of biologically relevant creek bed sediment samples taken in Berwick Creek, HQs were not able to be estimated. However, given that the maximum PCE concentrations measured in Berwick Creek exceed sediment quality benchmarks by 3 to 4 orders of magnitude, it is possible that benthic organisms are negatively impacted by contamination within OU1.

Terrestrial Plants

The terrestrial plant HQs from exposure to soils did not exceed 1.0 for any exposure area or COC. However, the terrestrial plant HQ from exposure to PCE in groundwater within the OU1 exceeded 1.0 (see **ROD Table 7-7**). This suggests that plants with root systems deep enough to encounter PCE-contaminated groundwater may be adversely affected.

Ecological Contaminants and Media of Concern

The COPCs identified in the BLRA that significantly contribute to an exposure pathway (e.g., ingestion of sediment) for a receptor (e.g., raccoon) that equal or exceeds an HQ of 1.0 become ecological COCs that may warrant a response action.

Based on the results of the risk evaluation, the OU1 ecological COCs and media of concern are:

- PCE (sediment, soil)
- TCE (soil)

7.2.5 Uncertainties

There are several key uncertainties associated with the ecological risk assessment for the Site that should be recognized because these have bearing on the accuracy of risk predictions. For some of these uncertainties, it is unknown whether they are likely to result in the under-prediction of risk. For others, it is likely that risks are over-predicted, to the extent possible, as assumptions made in the ecological risk assessment erred on the side of conservatism. The key uncertainties are summarized below:

Exposure Assessment Methods

Exposure assessment methods used in the ecological risk assessment were consistent with standard ecological risk assessment guidance although some assumptions likely introduce different levels of uncertainty. The receptors selected for evaluation in the analysis do not represent every bird, mammal, or aquatic organism that may use the Site. Instead, they represent potential receptors based on their importance to local ecosystems or possess behaviors that make them more likely to be exposed to a chemical stressor.

Sediment Concentrations

There is considerable uncertainty in the PCE risk estimates for ecological receptors because the exposure concentration is driven by a sample collected from the suspected spill or release area in OU1. PCE concentrations in sediment rapidly decline immediately downstream from the spill area, so estimated risks from this pathway are not widespread throughout the Site. In addition, the sediment sample in which the maximum concentration was measured was a 12-foot core sample that is not representative of the surface sediment to which ecological receptors are typically exposed.

Estimation of Burrow Air Concentrations

There is uncertainty in the inhalation-based risk characterization for the short-tailed shrew. Chemical concentrations are assumed to be in equilibrium with soil, and soil moisture concentrations may be conservative because the burrow is connected to the soil surface, thereby allowing for air exchange.

7.3 Basis for Action

An action under CERCLA is generally warranted at a Superfund site when one of the following is true:

- MCLs are exceeded for potential drinking water sources.
- The BLRA indicates that a cumulative site risk to an individual using RME assumptions for either current or future land use exceeds the 1×10^{-4} estimated individual excess lifetime cancer risk.
- The BLRA indicates the non-carcinogenic risks to human health exceed an HI of 1.0.
- The BLRA indicates that risks to ecological receptors exceed an HQ of 1.0.

In OU1, PCE concentrations in groundwater far exceed the MCL, and results of the BLRA indicate exceedances of both human health and ecological acceptable risks. Currently, for example, inhalation of PCE-contaminated groundwater vapors in trench air by utility workers could pose a significant risk with a non-cancer HI range of 7.5 to 457. There are also elevated risks to short-tailed shrews primarily from inhalation of PCE-contaminated soil in burrow air (HQ = 50), and to raccoon (HQs up to 43) and deer (HQs up to 6.6) from ingestion of sediment and soil within the Berwick Creek channel. The BLRA also indicated if PCE concentrations persist in groundwater and it is used as a drinking water source in the future, over time the individual excess lifetime cancer risks to human health (e.g., commercial/industrial workers) would be approximately 2×10^{-3} from ingestion, inhalation, and dermal contact with, PCE, TCE, and methylene chloride in groundwater. The non-cancer HI would be 386 from inhalation of PCE, TCE, and methylene chloride, and ingestion and dermal contact with groundwater contaminated with all four OU1 COPCs. The OU1 human health risk evaluation results are presented in **Table 7-1**. The site-wide ecological risk evaluation results are presented in **Tables 7-6** and **7-7,** and in the Draft Site-wide BLRA Report [CDM Smith 2011a]).

In addition to the above, PCE in OU1 groundwater contributes to contamination of the downgradient shallow aquifer in OU2. Of concern are those OU2 residences and commercial businesses that are not on the Chehalis municipal water-supply system and use the shallow aquifer as a drinking water source. Although to date PCE and its degradation products have not been detected in these downgradient private wells, there is concern that the contaminated groundwater plume may reach these wells in the future if action is not taken.

The interim response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of contaminants from OU1 into the

environment. Such a release or threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment.

8.0 REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) provide a general description of what a remedial action is intended to accomplish in terms of contaminants and media of concern, potential exposure pathways, and remediation goals. Preliminary remediation goals (PRGs) are the more specific statements of what the remedial action's endpoint concentrations or risk levels, for each exposure route, are to be in order to provide adequate protection of human health and the environment. RAOs and PRGs are developed and refined during the RI/FS based on federal and state environmental laws and the results of the remedial investigations, including the human health and ecological risk assessments, to guide the development and evaluation of remedial alternatives. The PRGs used in the RI/FS and presented in the Proposed Plan have now been refined to reflect the latest information on toxicity published by EPA and are now replaced and selected in this ROD as the final cleanup levels (CULs) and performance measures for this OU1 interim remedy. This section discusses the basis for the OU1 CULs and the related performance measures that will also be used to evaluate progress towards achieving the RAOs.

8.1 OU1 RAOS

As indicated in Section 7.0, the following COCs and media of concern have been identified for OU1:

For Human Health

- PCE (sediment, soil, groundwater)
- TCE (groundwater)
- cis-1,2-DCE (groundwater)
- Methylene chloride (groundwater)

For Ecological Receptors

- PCE (sediment, soil)
- TCE (soil)

The following RAOs are defined for the OU1 interim remedy:

1. Prevent human exposure to groundwater in OU1 containing COCs above levels that are protective of drinking water.
2. Prevent human exposure to COCs in OU1 sediment and soil above levels that are protective of commercial/industrial workers, construction/utility (trench) workers, and recreational users.
3. Prevent ecological exposure to COCs in OU1 sediment and soil above levels that are protective of ecological receptors.

4. Reduce the DNAPL contaminant mass and subsurface soil contamination within OU1 to minimize further migration of COCs from OU1 to downgradient groundwater.

These RAOs and the associated CULs and performance measures discussed below address COCs (primarily PCE) in sediment, soil, and groundwater and the risks associated with these contaminants within OU1 as identified in the risk assessment. Taking action to address these RAOs is also expected to reduce or eliminate OU1 sources of contamination to downgradient groundwater. These RAOs also address the principal threat waste in the OU1, identified as PCE DNAPL.

8.2 Cleanup Levels, Basis for CULs, and Risks Addressed by RAOs and CULs

Cleanup levels are developed based on applicable or relevant and appropriate requirements (ARARs) from federal and state environmental standards. Where standards do not exist or provide an inadequate level of protection, CULs are based on risk-based calculations of acceptable exposure levels. CERCLA Section 121 requires that remedial actions at Superfund sites must achieve a level which, at a minimum, ensures protection of human health and the environment. CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) also require remedial actions to comply with the substantive provisions of ARARs during and at the completion of remedial actions unless legal waivers are documented in a ROD or other remedy decision document in accordance with waiver provisions of CERCLA Section 121 and NCP Section 300.435f)(1)(ii)(c). The interim remedy is intended to achieve the sediment and soil cleanup levels documented in **Table 12-2** and to be consistent with and contribute to the efficient performance of the final remedy for OU1 and the Site. This interim remedy, however, will not achieve all cleanup levels.

8.2.1 Key ARARs and Other Factors Considered in Development of OU1 Cleanup Levels

Key factors for setting OU1 CULs include ARARs, risk-based calculations, and the decision to proceed with an interim remedy at this time.

The key ARARs for establishment of groundwater cleanup levels and points of compliance for this interim remedy and the Site include the Safe Drinking Water Act Maximum Contaminant Levels (MCLs), and the substantive provisions of Ground Water Cleanup Standards in Section 720 of the State of Washington's Model Toxic Control Act (MTCA) (WAC 73-340-720). MCLs apply to drinking water at the tap but are relevant and appropriate for groundwater that is a potential source of drinking water; therefore, these must be met or waived by completion of a remedial action. See **Table 12-2** for a listing of the MCLs for the four OU1 groundwater COCs (PCE, TCE, cis-1,2-DCE, and methylene chloride).

Another section of MTCA that is considered an ARAR for establishing groundwater cleanup levels is WAC 173-340-747 (Deriving soil concentrations for groundwater protection). This section requires soil cleanups to achieve levels that will not cause an exceedance of groundwater cleanup levels and will not result in the accumulation of non-aqueous phase liquid on or in groundwater. The interim remedy selected in this ROD will address the significant sources of

groundwater contamination located within OU1 to the maximum extent practicable, but full compliance with groundwater ARARs, such as those identified above, is beyond its scope. Groundwater ARARs, therefore, are being waived pending selection of the final remedy for the Site.

The key ARARs considered in the establishment of a sediment and soil CUL for this interim remedy include MTCA Section 705 (WAC 173-340-705 [Use of Method B]) and MTCA Section 740 (WAC 173-340-740 [Unrestricted land use soil cleanup standards]). Applying unrestricted soil cleanup levels is more appropriate than the less stringent industrial levels under MTCA Method C (WAC 173-340-706) because the current and reasonably anticipated future land use includes recreational uses (e.g., swimming in Berwick Creek) in addition to commercial and industrial uses. For both sediment and soil at this Site, the substantive requirements in these sections of MTCA, to the extent they are more stringent than federal requirement, are considered ARARs such that CULs must be established at:

- Concentrations that are estimated to result in no acute or chronic toxic effects on human health as determined using a hazard quotient (HQ) of 1 (this requirement is equivalent to the NCP requirement)
- Concentrations for which the upper bound on the estimated excess cancer risk is less than or equal to one in one million (1×10^{-6}) for individual known or suspected carcinogens
- Concentrations of individual hazardous substances that are adjusted downward to take into account exposure to multiple hazardous substances and/or exposure resulting from more than one pathway of exposure, if, without these adjustments, the hazard index (HI) would exceed 1 or the total excess cancer risk would exceed one in one hundred thousand (1×10^{-5})

Other key factors that form the basis for the CULs include:

- The Superfund program goal and expectations in the NCP Section 300.430(a)(iii)(F) is “to return usable groundwaters to their beneficial uses, wherever practicable, within a timeframe that is reasonable given the circumstances of the site. When restoration of groundwater to beneficial uses is not practicable, EPA expects to prevent further migration of the plume, prevent exposure to contaminated groundwater, and evaluate further risk reduction.” The selected remedy for OU1 would do the latter.
- Baseline Risk Assessment (BLRA) and Regional Screening Levels (RSLs): The BLRA was used to identify exposed populations and exposure pathways by media and protective site-specific levels where adequate data were available. Where adequate data were not available, RSLs were used to help evaluate risk and set a conservative CUL and performance measures. RSLs are risk-based, contaminant-specific levels or concentrations that set concentration limits based on an estimated risk of 1×10^{-6} for human carcinogens and an HI of 1.0 for human and ecological exposure to systemic contaminants under specific exposure conditions. Based on the RSLs, a PCE soil concentration of 22 mg/kg

would be protective of humans from exposure via ingestion and inhalation of sediments and soils and would be even more protective than the MTCA Method B standard method value of 480 mg/kg for protection from direct contact. The most sensitive ecological receptor of concern from ingestion and inhalation exposures to soil contamination is the short-tailed shrew, a terrestrial ecological receptor, which according to EPA RSLs faces an unacceptable risk from PCE concentrations above 10 mg/kg. Based on the requirements for protectiveness of human and terrestrial ecological receptors within OU1, the selected sediment and soil CUL for PCE for this interim remedy is 10 mg/kg as shown on **Table 12-2**.[11] Achievement of this CUL, in conjunction with the performance measure for sediment identified below, will address RAOs 2 and 3.

8.2.2 Performance Measures

In addition to the sediment and soil CUL, this ROD establishes two performance measures to guide and evaluate the performance of the selected remedy.

8.2.2.1 Creek Bed Sediment/Bank Surface Soil Remediation Performance Measure

The sediment and soil CUL of 10 mg/kg PCE is protective of humans and terrestrial ecological receptors. This cleanup level, however, is not necessarily protective of aquatic organisms living in the sediment and nearby soil of the OU1 Berwick Creek channel. EPA's fresh water RSL for protection of aquatic organisms from contact with and ingestion of PCE-contaminated sediment and soil is 0.468 mg/kg based on an HI of 1.0.

Figure 8-1 shows the area where creek bed sediment and bank surface soil within the OU1 Berwick Creek channel are currently contaminated with PCE at levels equal to or greater than 0.468 mg/kg. Although not a CUL, the selected remedy uses this RSL as a design performance measure to guide the restoration of the creek channel to better protect fresh water organisms. Reconstruction of the OU1 creek channel in accordance with this performance measure, and achievement of the 10 mg/kg sediment and soil CUL for protection of human and terrestrial ecological receptors, will further address RAOs 2 and 3.

8.2.2.2 Subsurface Soil and Groundwater Remediation Performance Measure

Figure 8-2 shows the area in OU1 where subsurface soil at depths between 5 to 50 feet bgs are contaminated with PCE levels greater than 10 mg/kg. This figure also shows the area where groundwater at depths between 5 to 50 feet bgs is contaminated with PCE levels greater than 4,000 µg/L. The 4,000 µg/L level was chosen based on the potential for DNAPL to be present and because approximately 87% of the contaminant mass in subsurface soil and groundwater found in OU1 is within the > 4,000 µg/L isocontour.

Remediation of contaminated subsurface soil to the 10 mg/kg PCE CUL will address RAO 2 and is

11 The EPA RSL for protection of terrestrial ecological receptors from TCE in sediment and soil is 12.4 mg/kg, and it is 0.91 mg/kg protection of humans under a residential use scenario. The currently identified maximum TCE level in OU1 creek bed sediment and bank surface soil is 0.19 mg/kg, which is below both RSLs.

one of the ways to evaluate achievement towards RAO 4. As stated earlier, RAO 4 calls for the reduction of DNAPL contaminant mass and subsurface soil contamination within OU1 to minimize further migration of COCs from OU1 to downgradient groundwater.

Concentration-based data can be used to measure contaminant levels in soil and groundwater at specific locations at a given point in time; however, it does not address the amount of contaminants that are being mobilized from OU1 to the downgradient areas. A more direct way to measure this migration is by measuring the mass discharge (Md) of contaminants from the DNAPL source area across a set boundary. Md combines chemical data, groundwater flow velocity, and discharge area into a single measurement (expressed as mass/time or grams/day) to provide important information about source strength, aquifer attenuation rates, to what extent and/or areas a contaminant mass is moving, and the performance of source treatment. Generally, it can be expected that a one order of magnitude reduction in contaminant Md can be achieved with targeted DNAPL source treatment with most commonly used technologies. For OU1, a 90% reduction in PCE mass discharge across the 4,000 μg/L isocontour should be achievable based on reductions in organic compound concentrations achieved at similar sites where DNAPL source treatment was conducted (McDade et al. 2005, McGuire et al. 2006).

A contaminant Md reduction of 90% is expected to significantly reduce contaminant source strength, thereby reducing the continued discharge of contaminants. In addition, concentrations in the downgradient dissolved-phase plume are expected to decrease although no specific goal has been specified yet for these downgradient areas. Even so, a reduction of PCE mass discharge across the 4,000 μg/L boundary will result in a greater understanding of the relationship between the OU1 DNAPL source area and the downgradient plume response that can help shape future remedial decision-making.

Although not a cleanup level, a 90% reduction of contaminant Md across the 4,000 μg/L PCE boundary will be used to measure performance of the selected remedy. This measure will address and evaluate progress towards achieving RAO 4 as it pertains to subsurface soil, DNAPL, and high concentration groundwater in OU1. It also will contribute to, but not fully achieve, RAO 1.

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9.0 DESCRIPTION OF ALTERNATIVES

This section describes the remedial alternatives and comprehensive treatment scenarios that were developed for the OU1 interim remedy.

9.1 Remediation Target Zones

All of the remedial alternatives were developed to best achieve the OU1 RAOs and address OU1 contamination in the context of the following three, media-specific remediation target zones within OU1:

- Creek Bed Sediment/Bank Surface Soil Zone (creek bed sediment and bank surface soils at depths less than or equal to 5 feet bgs within the Berwick Creek channel with PCE concentrations > 0.468 mg/kg) (**Figure 8-1**)
- Subsurface Soil Zone (subsurface soils at depths between 5 to 50 feet bgs contaminated with PCE concentrations > 10 mg/kg) (**Figure 8-2**)
- High Concentration Groundwater Zone (groundwater at depths between 5 to 50 feet bgs with PCE concentrations > 4,000 µg/L) (**Figure 8-2**)

9.2 Development of Remedial Alternatives and Comprehensive Technology Scenarios

The remedial alternative development process began during the FS with the identification and screening of a number of general response actions (e.g., removal, treatment, containment), technology types (e.g., excavation, thermal treatment, hydraulic containment through pumping), and process options (e.g., back-hoe, thermal conductive heating, extraction wells) to address OU1 contaminated media. The retained technology types and process options were then combined into remedial alternatives for each remediation target zone and evaluated individually and comparatively using nine criteria described in CERCLA Section 121(b) and NCP Section 300.430(e)(9)(iii), and outlined in Section 10 of this ROD. These criteria address statutory requirements and considerations for remedial actions in accordance with CERCLA, the NCP, and additional technical and policy considerations that have proven to be important for selecting among remedial alternatives (EPA 1988).

The remedial alternatives retained from the above phase were then assembled under what is referred to in this ROD as “Comprehensive Technology Scenarios” or CTSs. Two of the three CTS identify a combination of retained remedial alternatives to address OU1 contaminated media by remediation target zone (the other CTS is the “no action” alternative). A summary of the major remedy components of the three CTSs is listed in Section 9.3; more detailed descriptions are provided in Sections 9.3 and 9.4. Details on the entire remedial alternative and CTS development process can be found in the Final OU1 FS Report (CDM Smith 2013).

9.3 Summary of CTS Remedy Components

The major remedy components of each CTS are summarized below.

9.3.1 CTS-1

This is the no action alternative. A no action alternative is required by Section 300.430(e)(6) of the NCP as a baseline to compare other alternatives.

Under CTS-1, no action would be taken to remedy the contaminated creek bed sediment/bank surface soil, subsurface soil, or high concentration groundwater in OU1. Five-year site reviews would be performed as required by the NCP to evaluate whether adequate protection of human health and the environment is provided. Monitoring (consisting solely of visual inspections) would be performed as necessary to complete the 5-year site reviews.

9.3.2 CTS-2 (Selected Remedy; *see Figure 9-1*)

For the Creek Bed Sediment/Bank Surface Soil and Subsurface Soil Remediation Target Zones:

- Diversion of Berwick Creek around areas of contamination, in-situ thermal treatment of contaminated sediment and soil, removal and offsite disposal of any contaminated sediment and surface soil remaining after thermal treatment, and enhanced in-situ bioremediation of any contaminated subsurface soil remaining after thermal treatment

For the High Concentration Groundwater Remediation Target Zone:

- Enhanced in-situ bioremediation of contaminated groundwater

9.3.3 CTS -3 (*See Figure 9-2*)

For the Creek Bed Sediment/Bank Surface Soil and Subsurface Soil Remediation Target Zones:

- Diversion of Berwick Creek around areas of contamination, in-situ thermal treatment of contaminated sediment and soil, removal and offsite disposal of contaminated sediment remaining after thermal treatment, and in-situ chemical oxidation of any contaminated subsurface soil remaining after thermal treatment

For the High Concentration Groundwater Remediation Target Zone:

- In-situ chemical oxidation of contaminated groundwater

9.4 Common CTS Components

As revealed in the above sections, CTS-2 and CTS-3 have several remedy components in common. More details on these common elements are provided below.

9.4.1 Diversion of Berwick Creek around Areas of Contamination

Under CTS-2 and CTS-3, a section of Berwick Creek would be diverted around the areas of contamination prior to starting remedial actions in OU1. This diversion may be temporary or permanent. A temporary diversion would consist of routing the creek through a 48-inch diameter high density polyethylene (HDPE) pipe around the remediation target zones and back into Berwick Creek downstream of these zones. Upon completion of the interim remedial action, the original creek channel would be reconstructed and habitat restored, and the temporary diversion removed. A permanent diversion of the creek would involve creation of a new creek channel and habitat prior to initiating remedial actions in OU1. Habitat considerations include the planting of native vegetation and installation of fish habitat, such as spawning gravel.

Whether constructing a new creek channel prior to initiating OU1 remedial actions or reconstructing the current creek channel after remedial actions are completed, design specifications for the channel will need to meet requirements that are protective of aquatic receptors (e.g., 0.468 mg/kg PCE) based on EPA's RSLs for protection of benthic and freshwater organisms living in creek bed sediments. The design specifications for the creek diversion, creek channel construction, and habitat restoration would be completed in consultation with the appropriate natural resource agencies. Diversion of Berwick Creek would be conducted during a seasonally dry period within Washington State's in-stream work window to lessen the impacts to fish species at critical life stages.[12]

9.4.2 In-Situ Thermal Treatment of Contaminated Sediment and Soil

Under CTS-2 and CTS-3, an in-situ thermal treatment technology would be used to remedy contaminated creek bed sediment and bank surface soil within the current creek channel and on other surface soil and subsurface soil within OU1. Thermal treatment is expected to reduce PCE concentrations to 10 mg/kg or less to ensure removal of DNAPL. Substantial reductions in PCE DNAPL in sediment and soil would also decrease PCE concentrations in groundwater within and downgradient of OU1.

A full suite of thermal technologies (e.g., steam injection, steam extraction, electrical heating) would be considered during remedial design. Thermal treatment methods work by heating contaminated sediment, soil, and groundwater. The heat volatilizes chemicals, which are then extracted using multi-phase (liquid and vapor) and/or vapor collection wells. Collection wells capture the harmful chemicals in liquids and/or gases and pipe them to the ground surface for treatment. Construction of the in-situ thermal treatment system would be accomplished using conventional construction equipment and services, with contractors that specialize in this innovative technology. During operation, temperature, groundwater quality, vapor emissions, and condensate/discharge would be monitored.

[12] The State of Washington limits construction actions within and near fresh water fish-bearing streams from July 1 through September 30 when stream water levels are the lowest.

9.4.3 Removal and Offsite Disposal of Any Remaining Contaminated Creek Bed Sediment and Surface Soil

Under both CTS-2 and CTS-3, confirmation sampling will be conducted in sediment and soil after in-situ thermal treatment to evaluate compliance with the 10 mg/kg PCE CUL. Although it is anticipated that thermal treatment would be effective at reducing the high levels of PCE found in OU1 sediment and soil, it is possible that it will not be reduced to the CUL in all locations. The reasons for this are varied, e.g., Site geology and/or hydraulic conditions may restrict some of the PCE from being pushed up through the heated soil to collection wells, or in some locations, the starting PCE concentrations may be so high that even a 99% reduction in concentration still leaves > 10 mg/kg in the soil. To address these potential situations, a compliance sampling plan will be developed during remedial design that includes decision criteria on whether further remediation is required, e.g., removal (excavation) and offsite disposal.

Both CTS-2 and CTS-3 assume that a small volume of sediment and surface soil will require excavation after in-situ thermal treatment. Contaminated sediments and soils will be excavated and consolidated within OU1 prior to disposal. Excavated soils will be placed on an impermeable liner and the stockpile covered to minimize the risk of contaminants leaking into the underlying soil and groundwater until waste characterization testing can be completed and the material is transported off site to an approved disposal facility.

If further treatment is required prior to offsite disposal (based on landfill restrictions), a chemical would be injected or mixed into the contaminated materials to help destroy or oxidize the PCE. Typical chemical oxidants include hydrogen peroxide (H_2O_2), sodium persulfate ($Na_2S_2O_8$), and potassium permanganate ($KMnO_4$). Soil sampling and testing would be required to determine the best chemical oxidant and dosage needed to effectively reduce contaminants in the excavated material. The excavated sediment and surface soil, whether treated on or off site, would then be loaded into dump trucks and transported to a licensed disposal facility.

9.4.4 Institutional Controls

A variety of institutional controls (ICs) will be implemented as part of the OU1 interim remedy under both CTS-2 and CTS-3; the details of which will be described in an Institutional Controls Implementation and Assurance Plan (ICIAP) developed during remedial design. EPA defines ICs as non-engineered instruments, such as legal restrictions, covenants, or easements on property, and governmental and/or administrative controls, such as zoning requirements and building codes, that are used as part of a remedial action to help prevent or minimize the potential for human exposure to hazardous substances, pollutants, or contaminants and protect the integrity of the remedial action.

The objectives of the ICs for OU1 include preventing the use of groundwater as a drinking water source and minimizing exposure to contaminated sediment, soil, and groundwater. The general types of ICs to meet these objectives include activity and use restrictions through proprietary (e.g., easements, covenants) and/or governmental controls (e.g. ordinances to restrict well drilling, controls on materials handling during excavation and disposal of contaminated soils to protect

workers, ordinances with a “call before you dig” requirement, revised building codes that prevent or restrict the construction of houses or commercial buildings over residual contamination) and information devices (e.g., warning signs, advisories, additional public education, deed notices, Notices of Environmental Contamination) to inform people of the presence of any residual contamination and the risks such contamination may pose. Implementation, monitoring, and enforcement of the ICs would be the responsibility of some combination of property owners, local government, Ecology, and/or EPA as described in the ICIAP.

9.4.5 Monitoring

Under CTS-2 and CTS-3, monitoring (consisting of surface water, sediment, soil, groundwater, and/or air sampling) will be performed before, during, and after the OU1 interim remedy to ensure protection of human health and the environment and to evaluate the need for any additional remedial actions in the future. Future remedy decisions within OU1 will also take into account results from future OU2 investigations in order to support a Site-wide groundwater plume management strategy.

9.4.6 ARARs Waiver

Because a comprehensive, Site-wide groundwater remedial action is beyond the scope of this interim remedy, both CTS-2 and CTS-3 were developed with the assumption that ARAR waivers would be necessary for certain requirements. The ARAR waivers are set forth in Section 13.

9.4.7 Timeframes

CTS-2 and CTS-3 have the same timeframes to achieve the following major milestones:

- Diversion of Berwick Creek: Up to 6 months.
- Design, construct, operate in-situ thermal treatment system, and achieve sediment and soil CUL: 18 months.
- Design, pilot test, construct, and operate enhanced in-situ bioremediation or in-situ chemical oxidation treatment, and achieve high concentration groundwater performance measure: 4 years.
- Total estimated timeframe to achieve both the sediment and soil CUL and the high concentration groundwater performance measure: 5 years. This assumes there will be an overlap of in-situ thermal and enhanced bioremediation or in-situ chemical oxidation treatments and that thermal treatment will achieve the 10 mg/kg PCE or less CUL. If the additional remedial components described for CTS-2 and CTS-3 (i.e., additional excavation, treatment and offsite disposal of sediment/surface soil, and/or bioremediation or chemical oxidation polishing in subsurface soils not meeting the CUL following thermal treatment) are needed to achieve the 10 mg/kg PCE CUL in sediment and soil, the total estimated timeframe may be different.

9.4.8 Green Remediation

In addition to the common elements discussed above, and consistent with the RAOs, opportunities will be sought during implementation of the interim remedy to reduce its environmental footprint as defined in EPA Office of Solid Waste and Emergency Response Principles for Greener Cleanups (**http://www.epa.gov/oswer/greenercleanups/principles.html**) and the Region 10 Clean and Green Policy (**http://yosemite.epa.gov/R10/extaff.nsf/programs/greencleanups**).

9.5 Distinguishing CTS Components

CTS-2 and CTS-3 also have several unique or distinguishing remedy components as described below.

9.5.1 Treatment of Remaining Contaminated Subsurface Soil

As with creek bed sediment/bank surface soil and other surface soil (0 to 5 feet bgs) within OU1, it is anticipated that in-situ thermal treatment will achieve PCE levels of 10 mg/kg or less in the subsurface soil remediation target zone (5 to 50 feet bgs).

However, if after post-thermal confirmation sampling PCE concentrations above 10 mg/kg remain in the subsurface soil (5 to 50 feet bgs), additional treatment would be applied to further reduce concentrations. Under CTS-2, the treatment would be enhanced in-situ bioremediation; under CTS-3, the treatment would be in-situ chemical oxidation. See Section 9.5.2 for more information on these two treatment technologies.

9.5.2 Treatment of High Concentration Groundwater Remediation Target Zone

Under CTS-2**,** enhanced in-situ bioremediation would be used to treat groundwater in the zone with PCE concentrations greater than 4,000 µg/L. Bioremediation is expected to reduce mass discharge (Md) of PCE contamination by 90% from the high concentration groundwater remediation target zone to the downgradient dissolved-phase plume as quickly as technically achievable. Residual contamination in subsurface soils would also be reduced. Implementation of bioremediation and thermal treatment technologies would likely overlap.

Bioremediation has been described as a technology that uses natural processes to reduce the concentration or toxicity of a hazardous substance. Microbes that live in soil and groundwater, such as bacteria or fungi, will eat certain harmful chemicals. When microbes completely digest these chemicals, they change them into water and harmless gases, such as carbon dioxide. In order for microbes to clean up harmful chemicals, the right temperature, nutrients, and amount of oxygen must be present in the soil and groundwater. In order to boost or enhance this natural process, certain organic materials can be injected into the soil and groundwater. Examples of these amendments include whey, lactate, emulsified vegetable oil (EVO), and suspensions of zero-valent iron. Testing would be done during remedial design to determine the best amendment or combination of amendments to use and to determine where injection wells are to be placed. This testing area would be located in the area of highest PCE concentrations along the most downgradient boundary of the 4,000 µg/L PCE high concentration groundwater remediation target zone.

Under CTS-3, contaminated groundwater in the zone exceeding 4,000 µg/L would be treated by injection of chemical oxidants via wells into the subsurface soil and groundwater. Chemical treatment is also expected to reduce the mass discharge of PCE from the high concentration zone to the dissolved-phase PCE groundwater downgradient areas by 90%. Each injection point cluster would be installed to allow oxidant injection at three different 10-foot depth intervals. Several injection events would likely be required; cost estimates assume three injection events over a 36-month period. CTS-3 assumes the use of $KMnO_4$ as a representative oxidant at OU1 based on the following chemical reaction:

$$KMnO4 + 3C_2Cl_4 + 4H_2O \longrightarrow 6CO_2 + 4MnO_2 + 4K^+ + 12Cl^- + 8H^+$$

A different oxidant or oxidants could be selected during the design phase based on the results of treatability testing. Bench-scale testing would be required to determine the optimum chemical oxidant dosage needed to achieve contaminant destruction and to determine whether a pilot test is required prior to full-scale implementation.

9.5.3 Estimated Costs

The estimated costs for CTS-2 are:

- Capital Cost: $8.6 million
- Annual Operation and Maintenance (O&M) Cost: $209,000
- Net Present Worth Cost: $9.8 million

The estimated costs for CTS-3 are:

- Capital Cost: $10.5 million
- Annual O&M Cost: $209,000
- Net Present Worth Cost: $11.7 million

Cost estimates are expected to be accurate within a range of +50 to -30%. The present worth (aka present value) analysis was performed on the remedial alternatives under CTS-2 and CTS-3 using a 7% discount (interest) rate over the period of evaluation. Inflation and depreciation were not considered in preparing the present worth costs.

There are many factors that could impact the estimated costs of implementing the remedial alternatives under both CTS-2 and CTS-3. For example, issues with obtaining enough power from the local power grid to implement in-situ thermal treatment of contaminated sediment and soil could negatively impact the above cost estimates. In addition, while the cost estimates for CTS-2 and CTS-3 assume a small volume of sediment and soil would need to be excavated and disposed of after thermal treatment, additional costs could be realized if a larger volume of sediment and soil require excavation if thermal treatment does not achieve the 10 mg/kg PCE CUL or if there is not an available licensed disposal facility relatively close to the Site. Costs could also increase if more injections of biological amendments or chemical oxidizers are needed to meet the high

concentration groundwater performance measure or if additional injections or injection points are needed to polish the in-situ thermal treatment zone and achieve the 10 mg/kg PCE CUL in subsurface soil.

10.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

The three CTSs and their associated remedial alternatives were evaluated individually and comparatively using the same nine criteria as mentioned in Section 9. This section first defines the nine criteria and then provides a comparison of the CTS's remedial alternatives, identifying the relative tradeoffs between the alternatives in terms of the nine criteria.

10.1 The Nine Criteria

The nine evaluation criteria are separated into three groups, as outlined in **Table 10-1,** that establish a priority for evaluating the remedial alternatives under each CTS. Threshold criteria are standards that an alternative must meet to be eligible for selection as a remedial action unless an ARAR waiver is used. Balancing criteria weigh the tradeoffs among alternatives. Modifying criteria consider comments received on the Proposed Plan.

10.1.1 Threshold Criteria

The threshold criteria include:

- **OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT.** This criterion evaluates whether an alternative eliminates, reduces, or controls risks to public health and the environment through treatment, engineering, or institutional controls.
- **COMPLIANCE WITH ARARS.** This criterion evaluates whether an alternative meets federal, state, and tribal environmental statutes, regulations, and other requirements that pertain to the site and/or whether a waiver is justified. If the evaluation indicates an ARAR will not be met, then the basis for justifying one of the six ARAR waivers allowed under CERCLA is discussed.

10.1.2 Balancing Criteria

The balancing criteria include**:**

- **LONG-TERM EFFECTIVENESS AND PERMANENCE.** This criterion considers an alternative's ability to protect human health and the environment over time.
- **REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT.** This criterion evaluates an alternative's use of treatment technologies to reduce the harmful effects of principal contaminants (e.g., principal threat wastes), their ability to move in the environment, and the amount of contamination present.
- **SHORT-TERM EFFECTIVENESS.** This criterion considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during construction and implementation of a cleanup action.
- **IMPLEMENTABILITY.** This criterion considers the technical and administrative feasibility of implementing an alternative, including factors such as the availability of goods and services.

- **COST.** This criterion includes estimated capital, annual O&M, periodic, and present worth costs. Costs are expected to be accurate within a range of +50 to -30%.

10.1.3 Modifying Criteria

The modifying criteria include:

- **STATE ACCEPTANCE**. This criterion considers whether the state agrees with EPA's analyses and recommendations.
- CO**MMUNITY ACCEPTANCE.** This criterion considers whether the local community agrees with EPA's analyses and the preferred alternative.

10.2 Comparative Analysis

In this section, the three CTSs and their associated remedial alternatives are comparatively evaluated against the two threshold criteria and five balancing criteria. The results of this evaluation are presented in **Table 10-2** and discussed below.

10.2.1 Overall Protection of Human Health and the Environment

Protection of human health and the environment is one of two threshold criteria that each CTS and their associated remedial alternatives must meet in order to be further evaluated as a potential remedial action (the other being compliance with ARARs).

CTS-1 (no action) would not address any risks and therefore is not protective of human health and the environment and does not achieve this criterion.

The remedial alternatives under both CTS-2 and CTS-3 would achieve the criterion of overall protection of human health and the environment within the scope of the interim action by removing or substantially reducing the amount of contaminant mass, including DNAPL, and through implementation of ICs to prevent the use of OU1 groundwater for drinking. The soil CUL of 10 mg/kg PCE under both scenarios was selected to ensure protection of terrestrial ecological receptors, e.g., short-tailed shrew, from ingestion and inhalation of surface soil in burrow air, and it equates to a risk level that is even more protective than the 1×10^{-6} level that is required for protection of human direct contact exposure with PCE-contaminated soil, assuming residential use (22 mg/kg). To further ensure protectiveness, these two CTSs include a requirement that when the impacted creek channel is relocated or reconstructed, the maximum allowable concentration of PCE cannot exceed EPA's RSL of 0.468 mg/kg for protection of benthic and freshwater organisms in creek bed sediment and bank surface soil.[13]

A reduction in contaminant mass would also result in a reduction of source material and contaminant migration to areas downgradient of OU1, thereby increasing the likelihood of

[13] The EPA RSL for protection of terrestrial ecological receptors from TCE in sediment and soil is 12.4 mg/kg, and it is 0.91 mg/kg protection of humans under a residential use scenario. The currently identified maximum TCE level in OU1 creek bed sediment and bank surface soil is only 0.19 mg/kg.

achieving protection of human health and the environment across more areas of the Hamilton/Labree Site.

10.2.2 Compliance with ARARs

Compliance with ARARs is the second of the two threshold criteria that each CTS and their associated remedial alternatives must meet in order to be further evaluated as a potential remedial action unless one of the ARARs is waived.

The no action alternative associated with CTS-1 does not implement any action and therefore would not achieve this criterion. Because CTS-1 does not meet either of the threshold criteria **(**overall protection of human health and the environment and compliance with ARARs), it is not evaluated further in this comparative analysis and is no longer considered as a potential remedial action for OU1.

The remedial alternatives under both CTS-2 and CTS-3 would comply with most of the ARARs that pertain to the OU1 Selected Interim Remedy (see **Table 13-1**). In particular, both scenarios would comply with the MTCA Method B requirement for cleanups to attain the 1×10^{-6} risk level for protection of human direct contact exposure with PCE-contaminated soil. The PCE concentration, which equates to a 1×10^{-6} risk from direct contact, is 22 mg/kg assuming residential use, 110 mg/kg assuming industrial/commercial and construction/utility (trench worker) use, and 924 mg/kg assuming recreational use within the HRIA Berwick Creek bed sediment and bank surface soil. The PCE soil CUL under both CTS-2 and CTS-3 is 10 mg/kg PCE, which far exceeds the 1×10^{-6} protection level.

Because a comprehensive, Site-wide groundwater cleanup is beyond the scope of the interim remedy, CTS-2 and CTS-3 are not expected to fully attain MCLs or the Ground Water Cleanup Standards in MTCA Section 720 (WAC 173-340-720). These requirements are relevant and appropriate to Site-wide (including OU1) groundwater for which the beneficial use is a source of drinking water. Another section of MTCA that is considered an ARAR is WAC 173-340-747 (Deriving soil concentrations for groundwater protection), which requires soil cleanups to achieve levels that will not cause an exceedance of groundwater cleanup levels and will not result in the accumulation of non-aqueous phase liquid on or in groundwater. The PCE CUL of 10 mg/kg in soil is well above PCE soil concentrations that would be protective of groundwater, so attaining this soil ARAR is also beyond the scope of this interim action.

The remedial alternatives under CTS-2 and CTS-3 would address the significant sources of groundwater contamination located within OU1 to the maximum extent practicable for the scope of the selected remedy but are not expected to fully attain protection of groundwater ARARs. Therefore, the selected remedy is an interim remedy and invokes the waiver provided for in CERCLA Section 121(d), as discussed further in Section 13 of this ROD.

10.2.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence is the first of the five balancing criteria that weigh the tradeoffs between alternatives.

The remedial alternatives under both CTS-2 and CTS-3 would provide a high degree of long-term effectiveness and permanence by substantially reducing sediment, soil, and groundwater contaminant concentrations and mass, including DNAPL, which is a principal threat waste, from OU1. This reduction in source material would also reduce contaminant Md to areas downgradient of OU1 over the long term.

The valley in which the Hamilton/Labree Site is located is prone to flooding every few years, which could negatively impact the effectiveness of equipment employed for long-term treatment. The treatment technologies considered under both CTS-2 and CTS-3, however, would be equally impacted by these events over the short and long terms.

One tradeoff to be considered relates to the physical characteristics of the shallow aquifer found across the Site. Low permeability silt zones and clay seams in the shallow aquifer would not reduce the effectiveness of enhanced in-situ bioremediation proposed under CTS-2 as much as it would for chemical oxidation proposed under CTS-3 since dechlorination conditions and bacteria would stay in the subsurface longer than chemical oxidizers. It has also been observed that rebound effects (initial reductions in contamination followed by increases) are far less prevalent at sites implementing enhanced bioremediation compared to chemical oxidation.

10.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Reduction of toxicity, mobility, or volume through treatment is the second of the five balancing criteria.

The remedial alternatives under both CTS-2 and CTS-3 would provide a high level of reduction in toxicity, mobility, or volume of contaminated materials and satisfy the statutory preferences for treatment of principal threat wastes. The remedial alternatives under CTS-2 and CTS-3 would also be effective at reducing contaminant mass and discharge and result in a substantial reduction in contaminant mobility. Toxicity would be decreased in the long term by lowering PCE concentrations in the sediment, soil, and groundwater.

One tradeoff to be considered is the use of amendments to enhance reduction of contaminants. Under CTS-2, enhanced bioremediation would entail injection of non-toxic food grade materials into the subsurface soil and groundwater. Under CTS-3, chemical oxidants would be injected. Some chemical oxidants can create toxic byproducts, which may increase toxicity in the short run; however, the potential for this to happen could be mitigated during the design of this alternative. Different chemical oxidants will be evaluated in bench scale and/or pilot treatability studies to evaluate performance, including creation of toxic byproducts and those products tracked over time. Oxidants will be selected based on the ability to achieve CULs and minimize formation of undesirable byproducts.

10.2.5 Short-Term Effectiveness

Short-term effectiveness is the third of the five balancing criteria.

CTS-2 and CTS-3 have the same timeframes to achieve the following major milestones:

- Diversion of Berwick Creek: Up to 6 months.
- Design, construct, operate in-situ thermal treatment system, and achieve sediment and soil CUL: 18 months.
- Design, pilot test, construct, and operate enhanced in-situ bioremediation or in-situ chemical oxidation treatment, and achieve high concentration groundwater performance measure: 4 years.
- Total estimated timeframe to achieve both the sediment and soil CUL and the high concentration groundwater performance measure: 5 years. This assumes there will be an overlap of thermal and enhanced bioremediation or in-situ chemical oxidation treatments and that thermal treatment will achieve the 10 mg/kg PCE or less CUL. If the additional remedial components described for CTS-2 and CTS-3 (i.e., additional excavation, treatment, and offsite disposal of sediment/surface soil and/or bioremediation or chemical oxidation polishing in subsurface soils not meeting the CUL following thermal treatment) are needed to achieve the 10 mg/kg PCE CUL in sediment and soil, the total estimated timeframe may be different.

Many issues can impact the timeline; the most significant impact on the timeline is if diversion of Berwick Creek, a remedy component under both CTS-2 and CTS-3, is delayed. This remedy component must be scheduled in compliance with the State of Washington's in-stream work window. In-stream work windows have been established for all waters of the State of Washington and are in place to protect fish species at critical life stages. For Berwick Creek, the in-stream work window is July 1 to September 30. It may be possible, however, to obtain a waiver from the State in order to work outside the work window. If the work window is missed and a waiver cannot be obtained, the project will be delayed from the start since Berwick Creek needs to be relocated prior to initiating remediation.

Implementation of the remedial alternatives under CTS-2 and CTS-3 should not subject members of the community that reside or work near OU1 to significant risks. Potential risks during remediation can be mitigated by preventing the use of OU1 groundwater for drinking, implementing dust control measures during excavation and offsite transport of soils to minimize inhalation risk, using conventional traffic controls to minimize car/truck accidents, and controlling access by fencing off the construction and treatment areas and posting warning signs to prevent swimming in Berwick Creek. In addition to risks, there are no anticipated adverse socio-economic impacts from implementing CTS-2 or CTS-3, as efforts will be made during implementation to not hinder transportation and commerce.

Remedial alternatives implemented under CTS-2 and CTS-3 could pose moderately high risks to

onsite remediation workers. Treatment involves placement of delivery systems for injection of thermal, chemical, or biological substances into soil and groundwater and collection of vapors. This poses physical risks, as well as direct contact and inhalation risks from contaminants. Digging and working in a trench, such as when relocating or reconstructing the Berwick Creek channel or installing horizontal soil vapor extraction wells for in-situ thermal treatment, poses an increased inhalation risk from volatilization of contaminants from the soil and shallow groundwater table. Additional short-term issues associated with these activities include increased noise levels and fugitive dust emissions associated with the use of heavy equipment for excavation and/or disposal of materials. Controls, such as requiring cleanup workers to wear personal protection equipment (PPE) to include air monitoring devices; minimizing the exposed work area; working in cooler weather; using standard construction practices, such as dust suppression with water, foam, or a vacuum manifold to capture emissions; covering truck loads that are transported off the Site; using conventional traffic controls to minimize accidents; and effectively capturing vapors created during treatment, will be used to minimize air pollutants and risks to remediation workers.

Short-term impacts to the environment also exist with excavation and temporary stockpiling of contaminated sediment and soils under both CTS-2 and CTS-3. To minimize the impacts to the environment, excavated soils will be placed on an impermeable liner and the stockpile covered to minimize the risk of contaminants leaking into the underlying soil and groundwater until waste characterization testing can be completed and the material is transported off site to an approved disposal facility.

There could also be short-term energy impacts associated with in-situ thermal treatment of contaminated sediment soil under both CTS-2 and CTS-3. Thermal technologies often require significantly large amounts of energy as compared to other treatment technologies. Of particular concern is if the existing power grid cannot accommodate the power needs at the Site. Thermal treatment, however, is particularly effective on DNAPLs. By using a thermal treatment technology, DNAPL mass is substantially reduced within a relatively short time period. A secondary benefit to thermal technology is that the warmed sediment and soil can enhance bioremediation in groundwater as is being proposed under CTS-2. To combat thermal energy impacts, the thermal treatment area can be minimized to focus only on DNAPL-impacted sediment and soil, energy efficient equipment can be used to minimize energy consumption, and alternative fuels could be used to minimize greenhouse gas emissions. In addition, renewable energy sources, such as solar panels, could be used to help power onsite auxiliary systems.

Short-term impacts must also be considered depending on which technology is used in treating the high concentration groundwater. Enhanced bioremediation under CTS-2 proposes the use of food-grade amendments, such as emulsified vegetable oil (EVO) minimizing the negative impacts to drinking water wells and the environment. In contrast, under CTS-3, treatment by injecting chemicals may produce unfavorable toxic byproducts in the short-run, such as manganese oxide which could be harmful to human health and the environment. However, as stated in Section 10.2.4, the type and effect of various oxidants would be evaluated during remedial design.

10.2.6 Implementability

Implementability is the fourth of the five balancing criteria.

As stated above, the use of in-situ thermal technology to treat contaminated sediment and soil is proposed under both CTS-2 and CTS-3. Using a thermal technology would be technically and administratively implementable; however, very few vendors are able to provide the proprietary technology needed for this type of treatment. On the other hand, those that are available are very experienced at using this innovative technology to effectively reduce contaminants, including DNAPL.

Using a thermal treatment technology would potentially increase the volatilization of contaminants; therefore, installing an effective vapor recovery system is essential. Installing and implementing such a system, however, may be challenging due to the impermeable silt cap below Berwick Creek and the shallow groundwater table across OU1. In order to achieve sufficient pneumatic capture and control through the silt cap, the installation of a series of trenches containing horizontal soil vapor extraction (SVE) wells may be necessary. Horizontal soil vapor extraction is more expensive to install than the more common vertical wells. The shallow groundwater table presents an additional challenge to vapor recovery as it is possible that the SVE wells in the trenches could flood with contaminated groundwater if water levels fluctuate at the Site. The regulatory and substantive permitting requirements associated with installation of electrode or SVE wells, laying piping, constructing the treatment system, and securing approval for air emissions are considered to be moderately intensive. Heat retention and transport within and downgradient of the target treatment zone are also uncertain. Impacts on heat transfer to Berwick Creek should be considered and evaluated to minimize any undesirable impacts. A pilot test may be necessary prior to full-scale implementation of in-situ thermal treatment to mitigate these issues.

In regards to the high concentration groundwater remediation target zone, the enhanced in-situ bioremediation treatment included in CTS-2 is relatively standard, and several contractors are available that have the necessary experience with this technology. Treatment of volatile contaminants like PCE in groundwater, using enhanced in-situ bioremediation, is a proven technology. However, to facilitate the proper application of the technology, the installation may need to proceed in phases in order to obtain key engineering design parameters (e.g., feasible injection rates, preferential pathways, area of influence from an injection point). The results of the first phase would be used to help guide subsequent phases.

The chemical treatment technology included as part of CTS-3 is also well established and can be implemented at OU1 within the high concentration groundwater remediation target zone. Chemical oxidants would be delivered to the subsurface using readily available, conventional construction equipment. Testing would be required to determine the type and dose of chemical oxidant required. Testing may also be necessary prior to full scale implementation in order to obtain key engineering design parameters (e.g., feasible injection rates, preferential pathways, area of influence from an injection point, longevity of oxidant).

10.2.7 Cost

Cost is the last of the five balancing criteria. Cost estimates were prepared according to *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA 2000). These are order of magnitude cost estimates expected to be accurate within a range of +50 to -30%. The level of detail employed in making the estimates is considered conceptual but is considered appropriate for making choices between remedies.

CTS-2 and CTS-3 include design and treatment components that could be completed within 5 years and monitoring for a 30-year period. The capital cost for CTS-2 is $8.6 million, the annual O&M cost is $209,000, and the net present worth cost is estimated at $9.8 million. The capital cost for CTS-3 is $10.5 million, the annual O&M cost is $209,000, and the net present worth cost is estimated at $11.7 million.

The present worth analysis was performed on the remedial alternatives under CTS-2 and CTS-3 using a 7% discount (interest) rate over the period of evaluation. Inflation and depreciation were not considered in preparing the present worth costs.

There are many factors that could impact the estimated costs of implementing the remedial alternatives under both CTS-2 and CTS-3. For example, issues with obtaining enough power from the local power grid to implement in-situ thermal treatment of contaminated sediment and soil could negatively impact the above cost estimate. In addition, while the cost estimates for CTS-2 and CTS-3 assume a small volume of sediment and soil would need to be excavated and disposed of after thermal treatment, additional costs could be realized if a larger volume of sediment and soil require excavation if thermal treatment does not achieve the 10 mg/kg PCE CUL or if there is not an available licensed disposal facility relatively close to the Site. Costs could also increase if more injections of biological amendments or chemical oxidizers are needed to meet the high concentration groundwater performance measure or if additional injections or injection points are needed to polish the thermal treatment zone and achieve the 10 mg/kg PCE CUL in subsurface soil.

10.2.8 State Acceptance

The State of Washington (Ecology) has reviewed the Administrative Record and Proposed Plan and concurs with the remedial actions selected in this ROD.

10.2.9 Community Acceptance

A public comment period was held from September 28 through November 9, 2012. An open house and public meeting was held on October 23, 2012 to review the Proposed Plan for the OU1 interim remedy and solicit comments and questions. Comments received during the public comment period were generally supportive of the proposed remediation. None of the questions or comments received were significant enough, or brought new information to consider, for EPA to alter any of the remedial alternatives for OU1 that were considered in the Proposed Plan, including the proposed preferred alternatives under CTS-2.

Concern was expressed, however, about the need to sample private water-supply wells cross-and

downgradient of the OU1 and OU2 source areas. To address this concern, on April 23 and 24, 2013, EPA sampled 19 private water-supply wells along Rice and Hamilton Roads that were not connected to the municipal water-supply system. No Site COCs were found at detectable levels in any of the wells sampled. EPA will likely conduct at least one more round of sampling of these wells, or a subset of these wells, until an adequate groundwater monitoring program is implemented at the Site.

See this and other comments and EPA responses in the attached Responsiveness Summary (Part III of this ROD).

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11.0 PRINCIPAL THREAT WASTE

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (40 Code of Federal Regulations [CFR] §300.430(a)(1)(iii)(A)). This expectation is derived from CERCLA Section121 (Cleanup Standards). Identifying the principal threats combines concepts of both hazard and risk. In general, principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be contained in a reliable manner or would present a significant risk to human health or the environment should exposure occur. The manner in which principal threats are addressed generally will determine whether the statutory preference for treatment as a principal element is satisfied.

The DNAPL present in the contaminated sediment and soil in OU1 is considered a principal threat waste. Note that contaminated groundwater generally is not considered to be source material; however, DNAPL in groundwater may be considered as source material and therefore as a principal threat waste (EPA 1991). The Selected Interim Remedy addresses the principal threat wastes present in OU1 though in-situ thermal treatment and enhanced in-situ bioremediation. Thus, the interim remedy for OU1 satisfies the statutory preference for remedies employing treatment that reduces toxicity, mobility, or volume as a principal element.

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12.0 OU1 SELECTED INTERIM REMEDY

As described in Section 10, EPA used nine criteria, as required by CERCLA and the NCP, to evaluate the remedial alternatives and comprehensive technology scenarios (CTSs) that were developed in the 2012 Draft FS Report (CDM Smith 2012) for OU1 of the Hamilton/Labree Superfund Site. The remedial alternatives under both CTS-2 and CTS-3 were intended to address the known sources of contamination to sediment, soil, and groundwater in the vicinity of Berwick Creek within OU1 and the most immediate risks posed by these sources and to minimize further migration of contaminated groundwater from OU1 to other areas of the Site. Based on this evaluation and consideration of comments on and discussions of the Proposed Plan, EPA has selected the Preferred Alternatives under CTS-2 from the Proposed Plan as the interim remedy for OU1.

This section summarizes the rationale for selecting the OU1 interim remedy and provides a detailed description of the remedy and the expected outcomes from implementation.

12.1 Summary of the Rationale for the OU1 Selected Interim Remedy

The OU1 Selected Interim Remedy is protective of human health and the environment commensurate with its scope; complies with federal and state requirements that are legally applicable or relevant and appropriate except for certain requirements that are waived for this interim action; provides the best balance of tradeoffs with respect to the balancing and modifying criteria, including cost-effectiveness; and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. This interim remedy also satisfies the preference for treatment that reduces toxicity, mobility, or volume as a principal element and will be consistent with the final remedy selected for OU1 and the Site.

The OU1 Selected Interim Remedy was preferred over the other protective remedy (CTS-3) for the following reasons:

- Long-term effectiveness: The synergistic effects of in-situ thermal and enhanced in-situ bioremediation treatments are expected to be more effective than in-situ thermal and in-situ chemical oxidation treatments.
- Short-term effectiveness and reduction of toxicity: Bioremediation is expected to produce less negative impacts than the chemical treatment alternative, which could produce toxic byproducts.
- Cost: The selected remedy is the most cost-effective protective remedy.

12.2 Detailed Description of the OU1 Selected Interim Remedy

EPA is addressing contamination at the Site through a phased approach, beginning with an interim remedy in OU1. The interim remedy was developed and selected to best achieve the OU1 RAOs and address the contaminated media in the context of three, media-specific remediation target zones within OU1. These zones are:

- Creek Bed Sediment/Bank Surface Soil Zone (creek bed sediment and bank surface soils at depths less than or equal to 5 feet bgs within the Berwick Creek channel with PCE concentrations > 0.468 mg/kg)
- Subsurface Soil Zone (subsurface soils at depths between 5 to 50 feet bgs contaminated with PCE concentrations > 10 mg/kg)
- High Concentration Groundwater Zone (groundwater at depths between 5 to 50 feet bgs with PCE concentrations > 4,000 µg/L)

The OU1 Selected Interim Remedy includes the following components by remediation target zone.

For the Creek Bed Sediment/Bank Surface Soil and Subsurface Soil Zones:

- ***Diversion of Berwick Creek around areas of contamination.***

  Berwick Creek will be diverted around the areas of contamination prior to starting remedial actions in OU1. This diversion may be temporary or permanent. A temporary diversion would consist of placing earthen berms upstream and downstream of the diversion and re-routing an estimated 300-foot portion of creek through a 48-inch diameter HDPE pipe around the OU1 remediation target zones and back into Berwick Creek downstream of these zones. Upon completion of the interim remedy, the original creek channel would be reconstructed and habitat restored and the temporary diversion removed. A permanent diversion of the creek would involve creation of a new creek channel and habitat prior to initiating remedial actions in OU1. Habitat considerations include the planting of native vegetation and installation of fish habitat, such as spawning gravel.

  Whether constructing a new creek channel prior to initiating the OU1 remedial actions or reconstructing the current creek channel after remedial actions are completed, the 0.468 mg/kg PCE performance measure selected in this ROD for protection of benthic and freshwater organisms living in creek bed sediments will be a required element in the design specifications. The design specifications for the creek diversion, creek channel construction, and habitat restoration will be completed in consultation with the appropriate natural resource agencies.

  Up to 6 months is assumed to complete the diversion of Berwick Creek. This will be conducted during a seasonally dry period within Washington State's in-stream work window to lessen the impacts to fish species at critical life stages.

- ***In-situ thermal treatment of sediment and soil with PCE concentrations greater than 10 mg/kg.***

  In-situ thermal treatment will be used on contaminated creek bed sediment and bank surface soil within the current creek channel and on other surface soil and subsurface soil within OU1. Thermal treatment is expected to reduce PCE concentrations to 10 mg/kg or

less to ensure protectiveness and substantial reductions, if not complete removal, of DNAPL. Substantial reductions in PCE DNAPL in sediment and soil are expected to significantly decrease PCE concentrations in groundwater within and downgradient of OU1.

Construction of the in-situ thermal treatment system will be accomplished using conventional construction equipment and services, with contractors that specialize in this innovative technology. A full suite of thermal technologies (e.g., steam injection, steam extraction, electrical heating) will be considered as part of the remedial design.[14] Prior to implementation, existing monitoring wells that were not constructed to withstand the high temperatures from thermal treatment will be abandoned consistent with Washington State well decommissioning procedures.

Thermal treatment methods work by heating contaminated sediment, soil, and groundwater. The heat volatilizes chemicals that are then extracted using multi-phase (liquid and vapor) and/or vapor collection wells. Certain thermal technologies may also degrade contaminants directly in the subsurface through hydrous pyrolysis oxidation, hydrolysis at lower temperatures, oxidation or pyrolysis at higher temperatures, and/or by stimulating the growth of microbes that biodegrade contaminants.

Collection wells capture the harmful chemicals in liquids and/or gases and pipe them to the ground surface for treatment. This component of the remedy consists of the installation of electrodes, temperature monitoring points, and vertical vapor recovery wells below the silt cap of Berwick Creek and horizontal vapor recovery piping above the silt cap. Vapor collection may be complicated due to the impermeable silt cap and shallow groundwater table across the Site (including in OU1); therefore, installation of a series of permeable trenches may be necessary to achieve sufficient pneumatic capture and control for the vapor extraction system. Impacts on heat transfer to Berwick Creek, and heat retention and transport within and downgradient of the sediment and soil remediation target zones, will be evaluated to minimize any undesirable impacts. A pilot test may be necessary prior to full-scale implementation of in-situ thermal treatment to mitigate these issues. Hydraulic control would be implemented during thermal treatment to minimize the flux of cold groundwater in the remediation treatment zones during heating.

The collected vapors will be treated using granular activated carbon (GAC) prior to release to the atmosphere. Thermal treatment may increase toxicity levels in the short term by enhancing the chemical breakdown of PCE to vinyl chloride, a more toxic compound. If vinyl chloride is observed, then a catalytic oxidizer or chemical oxidant would be used in place of GAC since vinyl chloride does not effectively adsorb to carbon.

Groundwater collected from multi-phase extraction wells or condensed from steam formed during in-situ thermal treatment will need to be treated prior to discharge or transported for

[14] Electrical Resistance Heating was used as the representative technology in the FS Report (CDM Smith 2013).

offsite treatment/disposal. If groundwater collected as part of thermal treatment will be discharged to surface water, it will be treated consistent with the substantive requirements of a NPDES permit prior to discharge.

The total time estimated to achieve reductions of PCE concentrations to 10 mg/kg or less is estimated to be 18 months, including design, construction, startup, and operation of the thermal treatment system.

- ***Removal and disposal of any remaining creek bed sediment and surface soil with PCE concentrations greater than 10 mg/kg.***

  If Site geology and/or hydraulic conditions result in target heat distribution and/or design treatment temperatures not being achieved, or if Site conditions result in inefficient liquid/ vapor collection, there may be portions of the creek bed sediment/bank surface soil remediation target cone (0 to 5 feet bgs) where in-situ thermal treatment does not reduce PCE levels to 10 mg/kg or less. In other locations, starting PCE concentrations may be so high that even a 99% reduction in concentration still leaves greater than 10 mg/kg in the soil. To address these potential situations, a compliance sampling plan will be developed during remedial design that includes decision criteria on whether further remediation is required, e.g., removal (excavation) and offsite disposal.

  The OU1 Interim Remedy assumes that a small volume of sediment and surface soil will require excavation after in-situ thermal treatment. [15] Contaminated sediment and soil will be excavated with conventional construction equipment, and consolidated within OU1 prior to disposal. Excavated soils will be placed on an impermeable liner and the stockpile covered to minimize the risk of contaminants leaking into the underlying soil and groundwater until waste characterization testing can be completed and the material is transported off site to an approved disposal facility.

  If further treatment is required prior to offsite disposal (based on RCRA landfill disposal restrictions), a chemical will be injected or mixed into the contaminated materials to help destroy or oxidize the PCE. Oxidizing chemicals helps change harmful chemicals into harmless ones, like water, carbon dioxide, and diluted hydrochloric acid. Typical chemical oxidants include hydrogen peroxide (H_2O_2), sodium persulfate ($Na_2S_2O_8$), and potassium permanganate ($KMnO_4$). Soil sampling and testing will be required to determine the best chemical oxidant and dosage needed to effectively reduce contaminants in the excavated

[15] Limited excavation may also be required prior to thermal treatment. For example, excavation would be considered if results of additional site characterization conducted during pre-design or remedial design indicate isolated hotspots of elevated PCE levels in sediment and/or surface soil outside of the zones currently planned for thermal treatment. Rather than extending the thermal treatment grid, it may be more efficient to excavate the hotspots and either place within the thermal treatment zones or dispose of at an off site facility.

material. The excavated sediment and surface soil, whether treated on or off site, will then be loaded into dump trucks, covered, and transported to a licensed disposal facility.

- ***Enhanced in-situ bioremediation treatment of any remaining subsurface soil with PCE concentrations greater than 10 mg/kg***.

  As with creek bed sediment/bank surface soil and other surface soil (0 to 5 feet bgs) within OU1, it is anticipated that in-situ thermal treatment will achieve PCE levels of 10 mg/kg or less in the subsurface soil remediation target zone (5 to 50 feet bgs); however, if PCE concentrations above 10 mg/kg remain in this zone after thermal treatment, enhanced in-situ bioremediation would be employed to further reduce concentrations in subsurface soil.

For the High Concentration Groundwater Zone:

- ***Enhanced in-situ bioremediation of groundwater with PCE concentrations greater than 4,000 µg/L.***

  Enhanced in-situ bioremediation will be used on groundwater with PCE concentrations greater than 4,000 µg/L. Bioremediation is expected to reduce the mass discharge of PCE in groundwater from the high concentration DNAPL zone to the dissolved-phase in downgradient areas by 90%. As mentioned above, residual contamination in subsurface soils would also be reduced. Implementation of enhanced in-situ bioremediation activities would overlap with in-situ thermal treatment of contaminated sediment and soil.

  Enhanced in-situ bioremediation is a technology that uses microorganisms to reduce the concentration or toxicity of a hazardous substance to non-toxic end products. Enhanced bioremediation has been shown to be highly effective for chlorinated solvents because under conditions where oxygen is absent (termed anoxic), microbes use chlorinated ethylenes as alternative electron acceptors (analogous to how people use oxygen during respiration). This process is termed reductive dechlorination or halorespiration. During this process, chlorine atoms are removed from chlorinated ethylenes sequentially, resulting in the ultimate formation of ethylene, a non-hazardous byproduct. In order for enhanced bioremediation to be efficient, conditions must be strongly reducing as indicated by the absence of oxygen, depletion of sulfate, formation of ferrous iron and methane. Therefore, electron donors (e.g., EVO or cellulose) are added to deplete oxygen and create sufficiently reducing conditions to drive halorespiration. In order to boost or enhance this natural process, certain amendments can be injected into the soil and groundwater. Examples of amendments include whey, lactate, EVO, and suspensions of zero-valent iron.

  PCE, TCE, cis-1,2-DCE, and methylene chloride are expected to be effectively biodegraded through biotic and/or abiotic reductive mechanisms under anaerobic conditions. The shallow aquifer chemistry results for OU1 presented in the EE/CA Report (URS 2004) indicate that the groundwater in the high concentration groundwater remediation target zone is generally aerobic (indicated by the presence of oxygen) with

some pockets of mildly reducing conditions (indicated by low oxidation-reduction potential and depleted sulfate and nitrate). Based on these geochemistry results, conditions in this remediation target zone are not optimal for anaerobic degradation of contaminants and would need to be driven to strongly reducing conditions through injection of amendments. In addition, it is possible that bioaugmentation also may be necessary to deliver contaminant-degrading bacteria (e.g., *Dehalococcoides* spp.) to this zone.

The injection wells will be constructed with 2-inch diameter schedule 40 polyvinylchloride (PVC)**,** and each well cluster will include wells screened across three different 10-foot depth intervals across the approximate thickness of the shallow aquifer. Wells will be aligned such that amendments will be delivered into the subsurface and travel through the remediation target zone following the hydraulic gradient. This technique establishes proper conditions for microbial degradation while taking advantage of the groundwater flow velocities and gradients.

Seven rows of wells are currently estimated. The optimal well spacing within each row depends on a variety of factors, including formation, drilling costs, amendment costs, desired injection period, and the vertical thickness of the remediation target zone. The injection well rows will be installed starting along the downgradient edge of the high concentration groundwater remediation target zone to cut off contaminant mass discharge to the larger dissolved-phase plume as quickly as possible (i.e., in effect creating a barrier first). Injection well installation would proceed from the most downgradient first to the most upgradient injection well row. This strategy will help mitigate any enhanced flux that occurs during injection of amendments in areas that contain residual contaminant mass (either through desorption or dissolution of sorbed/residual mass into the aqueous phase).

Testing will be done during remedial design to determine the best amendment or combination of amendments to use and where injection wells are to be placed. The testing area will be located in the area of highest PCE concentrations along the most downgradient boundary of the 4,000 µg/L PCE remediation target zone.

Once the injection wells have been installed, the initial injection event will occur one row at a time. Temporary aboveground piping and hoses would be used to distribute the amendment to the injection wells. Once injection to all rows of wells has been completed, the temporary injection equipment would be removed, and no activity would be required other than periodic groundwater monitoring. It is assumed that an additional full-scale injection event would take place approximately 18 months after the first injection.

Institutional Controls

A variety of ICs will be implemented as part of the OU1 selected interim remedy. EPA defines ICs as non-engineered instruments, such as legal restrictions, covenants or easements on property, and governmental and/or administrative controls, such as zoning requirements and building codes that are used as part of a remedial action to help prevent or minimize the potential for human exposure

to hazardous substances, pollutants, or contaminants and protect the integrity of the remedial action.

The objectives of the ICs for OU1 include preventing the use of groundwater as a drinking water source and minimizing exposure to contaminated sediment, soil, and groundwater. The general types of ICs to meet these objectives include activity and use restrictions through proprietary (e.g., easements, covenants), and/or governmental controls (e.g. ordinances to restrict well drilling, controls on materials handling during excavation and disposal of contaminated soils to protect workers, ordinances with a "call before you dig" requirement, revised building codes that prevent or restrict the construction of houses or commercial buildings over residual contamination), and information devices (e.g., warning signs, advisories, additional public education, deed notices, Notices of Environmental Contamination) to inform people of the presence of any residual contamination and the risks such contamination may pose.

The specific types of ICs to be implemented will be described in an Institutional Controls Implementation and Assurance Plan (ICIAP) developed during remedial design. The OU1 ICIAP will be developed by EPA in collaboration with state and local jurisdictions. Affected property owners and the general public may also be invited to help develop the ICIAP. Implementation, monitoring, and enforcement of the ICs will be the responsibility of some combination of affected property owners, local government, Ecology, and/or EPA as documented in the ICIAP. Information on ICs and the ICIAP document will be made available to the public.

Monitoring

Monitoring, including sampling of surface water, sediment, soil, groundwater, and/or indoor and outdoor air, will be performed before, during, and after implementation of the interim remedy. The monitoring program will include components for vapor intrusion monitoring and monitoring outside of OU1 to assess the full impacts of the interim remedy. A monitoring plan will be prepared during the remedial design phase. Other components of the monitoring program will include the following:

- Sampling of surface soils outside of the current Berwick creek channel will be conducted prior to diverting the creek to confirm the extent of contamination that is greater than 10 mg/kg PCE.
- After re-routing Berwick Creek, additional sampling will be conducted within the bed and banks of the current Berwick Creek channel to confirm the extent of contamination that is greater than 10 mg/kg, the thickness and continuity of the silt cap below the creek, and the depth of the groundwater table. This sampling will be needed in part because heavy flooding over the past 5 years may have swept away some of the original contaminated material. In locations where flooding has occurred, sediment and surface soil within the bed and banks of the current creek channel may now be clean, thereby reducing the volume of materials that require treatment, excavation, and/or habitat restoration.
- During operation of the in-situ thermal treatment system, temperature, groundwater quality, vapor emissions, and condensate/discharge will be monitored.

- Confirmation sampling will be conducted in sediment and soil after thermal treatment to evaluate compliance with the 10 mg/kg PCE CUL and to guide any additional actions (e.g., more treatment and/or excavation and offsite disposal) needed to meet the PCE-contaminated soil CUL throughout OU1.
- Monitoring, consisting of groundwater sampling and water level measurements, will be performed during bioremediation to document mass removal and contaminant mass discharge reduction and to ensure that protection of human health is maintained. Monitoring parameters will include chlorinated VOCs, ethylene, ethane, methane, sulfate, iron, alkalinity, total organic carbon, and water quality parameters (dissolved oxygen, conductivity, temperature, oxidation reduction potential, and pH) in groundwater and would be performed for 30 years following injections.

  To evaluate the PCE mass discharge high concentration groundwater performance measure, monitoring wells will be established. **Figure 8-2** shows the proposed Md measurement plane and the wells that may be used to measure discharge relative to the remediation target zones and the PCE contaminant plume. The location of the proposed plane has been chosen to incorporate the following considerations:

  - ✓ Near the downgradient edge of the high concentration groundwater remediation target zone.
  - ✓ Screened in the upper and lower zones of the shallow aquifer where groundwater contamination is located.

  Exact placement and screened intervals of the Md wells may be changed once additional data are collected during the remedial design to characterize the vertical and lateral hydraulic system more fully. It is also important to note that groundwater samples will be collected in wells that correspond to the Md analysis and analyzed for contaminant concentrations using standard analytical procedures. These data will be used to compare standard analytical contaminant concentration changes as another line of evidence for Md reductions that are observed. In addition, groundwater analytical results will be used to determine when to conduct a Md assessment. For instance, if a 90% reduction in contaminant concentrations is observed at the discharge wells, an assessment of Md may be conducted to verify corresponding reductions in contaminant mass discharge from OU1 to downgradient areas of the Site.

Timeframe

The OU1 Selected Interim Remedy is expected to achieve the following:

- Diversion of Berwick Creek: Up to 6 months
- Design, construct, and operate in-situ thermal treatment system and achieve sediment and soil CUL: 18 months
- Design, pilot test, construct, and operate enhanced in-situ bioremediation treatment and achieve high concentration groundwater performance measure: 4 years

- Total estimated timeframe to achieve both the sediment and soil CUL and the high concentration groundwater performance measure: 5 years. This assumes there will be an overlap of thermal and enhanced bioremediation treatments and that thermal treatment will achieve the 10 mg/kg PCE or less CUL. If the additional remedial components described for the selected remedy (i.e., additional excavation, treatment and offsite disposal of sediment/surface soil, and/or bioremediation or chemical oxidation polishing in subsurface soils not meeting the CUL following thermal treatment) are needed to achieve the 10 mg/kg PCE CUL in sediment and soil, the total estimated timeframe may be different.

Green Remediation

In addition to the remedy components discussed above, and consistent with the RAOs, opportunities will be sought during implementation of the interim remedy to reduce its environmental footprint as defined in EPA Office of Solid Waste and Emergency Response Principles for Greener Cleanups (**http://www.epa.gov/oswer/greenercleanups/principles.html)** and the Region 10 Clean and Green Policy (**http://yosemite.epa.gov/R10/extaff.nsf/programs/greencleanups**).

The combination of technologies assembled for the OU1 Selected Interim Remedy allows for a multi-component approach that couples aggressive mass removal in the creek bed sediment/bank surface soil and subsurface soil remediation target zones with more green and sustainable treatment in the high concentration groundwater remediation target zone. In addition, synergies between the technologies can be maximized such that the beneficial impacts of aggressive treatment (e.g., thermal treatment) in the smaller contaminated sediment and soil footprint can be taken advantage of to augment or enhance treatment effectiveness of the less aggressive technologies (e.g., bioremediation) employed in the larger contaminated groundwater footprint.

12.3 Summary of the Estimated Remedy Costs

The costs for the selected remedy are:

- Capital Cost: $8.6 million
- Annual O&M Cost: $209,000
- Net Present Worth Cost: $9.8 million

Capital costs include costs for the following: engineering; mobilization; supplemental investigations; treatability studies; dewatering, diversion, and restoration of Berwick Creek; infrastructure construction; in-situ thermal treatment; excavation; enhanced bioremediation injections; contractor submittals, including health and safety and quality assurance/quality control plans; project management; monitoring; and institutional controls. O&M costs include soil and

groundwater sampling, mass flux measurements, annual data review and reporting, 5-year reviews, and project management. Costs are summarized in **Table 12-1**.[16]

The estimated costs are based on the best available information regarding the anticipated scope of the interim remedy. There are many factors that could impact the estimated costs of implementing the interim remedy. For example, issues with obtaining enough power from the local power grid to implement in-situ thermal treatment of contaminated sediment and soil could negatively impact the above cost estimate. In addition, while the cost estimate for the selected remedy assumes a small volume of sediment and soil would need to be excavated and disposed of after thermal treatment, additional costs could be realized if a larger volume of sediment and soil require excavation if thermal treatment does not achieve the 10 mg/kg PCE CUL or if there is not a licensed disposal facility relatively close to the Site. Costs could also increase if more injections of biological amendments are needed to meet the high concentration groundwater performance measure or if additional injections or injection points are needed to polish the thermal treatment zone and achieve the 10 mg/kg PCE CUL in subsurface soil.

Changes in the cost elements are likely to occur as a result of new information and data collected during the remedial design phase. Major changes may be documented either in an amendment to this ROD or in an Explanation of Significant Differences document, depending on the extent of changes. Non-significant or minor post-ROD changes would be documented in a memo to the Site file and in a Remedial Design Fact Sheet. The projected cost is based on an order-of-magnitude engineering cost estimate that is expected to be within +50 or -30% of the actual project cost.

12.4 Expected Outcomes of the Selected Remedy

Implementation of the OU1 Selected Interim Remedy is expected to achieve RAOs 1 through 4, the sediment and soil CUL, and the performance measures identified in Section 8 and **Table 12-2** of this ROD. The interim remedy will significantly reduce risks to humans and the environment in and near OU1 while allowing for the continued use of land for commercial, industrial, and recreational purposes. There are no anticipated adverse socio-economic impacts from the interim remedy, and every effort will be made during implementation of the remedy to not hinder transportation and commerce.

Thermal remediation of PCE-contaminated sediment and soil will reduce risks for commercial/industrial workers, construction/utility (trench) workers, and the occasional Berwick Creek recreator to less than 1×10^{-6} and will provide a safer habitat for the short-tailed shrew, raccoon, and white-tailed deer. The relocated or reconstructed Berwick Creek channel designed to be less than 0.468 mg/kg PCE will be protective of benthic and freshwater organisms living in creek bed sediments.

[16] The specific O&M activities to be conducted and the costs borne by the State of Washington's Department of Ecology during the Superfund Program-defined O&M phase will be determined during design of the OU1 interim remedial action. This determination will be codified in a Superfund State Contract to be signed by both parties prior to initiation of the OU1 interim remedy.

In combination with in-situ thermal treatment, enhanced bioremediation via injecting organic material into contaminated groundwater will significantly reduce contaminant mass in OU1 and is expected to reduce mass discharge (Md) of PCE from OU1 to downgradient areas of the Site by 90%. Meeting this performance measure and measuring the Md is also expected to result in a greater understanding of the relationship between the OU1 DNAPL source and the downgradient dissolved-phase plume response that can help future remediation decision-making for OU1 and the rest of the Site.

Returning groundwater throughout OU1 to its most beneficial use as a potential drinking water source and attainment of groundwater cleanup levels protective of human consumption is outside the scope of this interim remedy. Therefore, achievement of RAO 1 and overall protectiveness in OU1 will be ensured through the use of institutional controls prohibiting installation of groundwater wells in OU1 until such time as restoration can be achieved throughout the Site as part of the eventual final remedy. In the interim, the risk from drinking contaminated groundwater is unlikely as properties within OU1 will remain on the City of Chehalis municipal-water supply system. Even so, ICs to prevent using the groundwater will be implemented during and after the remedy is implemented as long as necessary.

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13.0 STATUTORY DETERMINATIONS

Under CERCLA Section 121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with ARARs (unless a statutory waiver is justified), are cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable commensurate with the scope of the Selected Remedy. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a principal element, and the offsite transport and disposal of hazardous substances or contaminated material without such treatment should be the least favored alternative remedial action where practicable treatment technologies are available. The following sections discuss how the OU1 Selected Interim Remedy meets these statutory requirements.

Protection of Human Health and the Environment

The OU1 Selected Interim Remedy will protect human health and the environment within the scope of the interim action by remediating all sediment and soil in excess of 10 mg/kg PCE within OU1; substantially removing or reducing the amount of contaminant mass, including DNAPL, from sediment, soil, and groundwater in OU1 within 5 years; and implementing, monitoring, and enforcing institutional controls until such time as OU1 sediment, soil, and groundwater are restored to levels that allow for unrestricted use.

Thermal remediation of PCE-contaminated sediment and soil to 10 mg/kg of PCE or less will reduce risks for commercial/industrial workers, construction/utility (trench) workers, and the occasional Berwick Creek recreator to less than 1×10^{-6} and will provide a safer habitat for the short-tailed shrew, raccoon, and white-tailed deer. Re-routing of Berwick Creek within OU1 will take place within the State of Washington's in-stream work window to lessen the impacts to fish species at critical life stages. The relocated or reconstructed Berwick Creek channel designed to be less than 0.468 mg/kg PCE will be protective of benthic and freshwater organisms living in creek bed sediments.

If necessary, sediment and surface soils that exceed the 10 mg/kg PCE cleanup level after thermal treatment will be excavated and placed within OU1 on an impermeable liner and the stockpile covered to minimize the risk of contaminants leaking into the underlying soil. If treatment is required prior to disposal, sampling and testing will be conducted to determine the best chemical oxidant and dosage needed to effectively reduce contaminants in the excavated material. The excavated sediment and surface soil, whether treated on or off site, will then be loaded into dump trucks, covered, and transported to a licensed disposal facility.

Bioremediation by injecting organic material, such as emulsified vegetable oil, into groundwater contaminated with PCE greater than 4,000 µg/L, and remaining subsurface soil that exceeds 10 mg/kg PCE after thermal treatment, will help reduce contaminant mass in OU1 and is expected to reduce mass discharge from OU1 to downgradient areas of the Site by 90%. The use of organic injection materials, versus chemical agents, lessens the concern of further contaminating groundwater.

Returning groundwater within the Site (including OU1) to its most beneficial use as a drinking water source is outside the scope of this interim remedy; however, the risks from drinking contaminated groundwater is unlikely as properties within OU1 will remain on the City of Chehalis municipal-water supply system. Even so, ICs to prevent the use of OU1 groundwater will be implemented. Other risks to community members and onsite workers will be minimized during remedy implementation by controlling access, such as fencing off the construction and treatment areas and posting warning signs to prevent swimming in Berwick Creek; enforcing conventional traffic controls to minimize car/truck accidents; and implementing best management practices, such as dust suppression with water or foam, requiring trucks to cover their loads when leaving the project area, requiring workers to wear personal protection equipment to include air monitoring devices, and effectively capturing vapors created during treatment.

Compliance with Applicable or Relevant and Appropriate Requirements

As indicated in **Table 13-1,** the OU1 Selected Interim Remedy will comply with ARARs with the following exceptions:

- Safe Drinking Water Act, National Primary Drinking Water Regulations, and the Ground Water Cleanup Standards in Section 720 of MTCA (WAC 173-340-720). These requirements, which include federal and state MCLs for PCE, typically would be relevant and appropriate requirements for cleanup actions where groundwater is or may be used for drinking water.
- MTCA Section 747(WAC 173-340-747). This section, subtitled "Deriving soil concentrations for groundwater protection" requires that soil cleanups achieve levels that will not cause an exceedance of the groundwater cleanup level established under WAC 173-340-720 and will not result in the accumulation of non-aqueous phase liquid on or in groundwater.

Because this ROD selects an interim remedy, EPA has determined that a waiver of the above groundwater protection ARARs is necessary as provided for in CERCLA Section 121(d)(4)(A). This statutory provision allows such a waiver when the remedial action selected is only part of a total remedial action that will attain such level or standard of control when completed. To assure protectiveness in the interim, contaminated groundwater above such standards will be addressed using institutional controls to prevent human exposure. This ROD will be followed by a Final ROD that will identify ARARs that pertain to the final remedy and fully address compliance with these ARARs or provide the basis for one of the other waivers provided for in CERCLA Section 121(d)(4), if necessary.

Cost Effectiveness

In EPA's judgment, the OU1 Selected Interim Remedy is cost effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." (40 CFR §300.430(f)(1)(ii)(D)). EPA evaluated the overall effectiveness of the alternatives that satisfied the threshold criteria (protection of human health and the environment and compliance with ARARs) by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost effectiveness. The relationship of the overall effectiveness of this remedial alternative was determined to be proportional to its costs.

Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable

EPA has determined that the Selected Interim Remedy represents the maximum extent to which permanent solutions and alternative treatment technologies can be utilized in a practicable manner at OU1 and provides the best balance of tradeoffs among the evaluated alternatives.

One of the tradeoffs that tipped the balance towards the OU1 Selected Interim Remedy is long-term effectiveness and permanence. Low permeability silt zones and clay seams in the shallow aquifer would not reduce the effectiveness of enhanced in-situ bioremediation as much as it would for chemical oxidation since dechlorination conditions and bacteria would stay in the subsurface longer than chemical oxidizers. It has also been observed that rebound effects (initial reductions in contamination followed by increases) are far less prevalent at sites implementing enhanced bioremediation compared to chemical oxidation.

The combination of technologies assembled for the OU1 Selected Interim Remedy allows for a multi-component approach that couples aggressive mass removal in the creek bed sediment/bank surface soil and subsurface soil remediation target zones with more green and sustainable treatment in the high concentration groundwater remediation target zone. In addition, synergies between the technologies can be maximized such that the beneficial impacts of aggressive treatment (e.g., thermal treatment) in the smaller contaminated sediment and soil footprint can be taken advantage of to augment or enhance treatment effectiveness of the less aggressive technologies (e.g., bioremediation) employed in the larger contaminated groundwater footprint.

Preference for Treatment as a Principal Element

The OU1 Selected Interim Remedy satisfies the statutory preference for treatment as a principal element. The PCE DNAPL present in contaminated sediment and soil in OU1 is considered a principal threat waste. This waste will be treated primarily by a thermal technology to be chosen during remedial design. Any remaining sediment and surface soil that exceed 10 mg/kg PCE after thermal treatment will be excavated and possibly treated with a chemical oxidant prior to disposal at a licensed disposal facility.

The DNAPL in groundwater is also considered a principal threat waste as it is considered to be highly toxic, cannot be contained in a reliable manner, and presents a significant risk to human health and the environment should exposure occur. This waste will be treated thermally, in conjunction with soil and sediment, within the subsurface soil remediation zone. Elevated volatile organic compound concentrations in groundwater also will be biologically treated to reduce mass discharge from OU1 to downgradient areas of the Site by 90%. Any subsurface soil that exceeds 10 mg/kg of PCE after in-situ thermal treatment also will be biologically treated along with contaminated groundwater.

Five-Year Review Requirements

Because the OU1 Selected Interim Remedy will result in hazardous substances remaining on site above levels that allow for unrestricted use and unlimited exposure after remedial actions are completed (as expected), 5-year site reviews will be performed as required by statute to evaluate whether the remedy is or will be protective of human health and the environment. A review will be conducted 5 years from the start of the interim remedy.

14.0 DOCUMENTATION OF SIGNIFICANT CHANGES

To fulfill CERCLA Section 117(b) and NCP Sections 300.430(f)(5)(iii)(B) and 300.430(f)(3)(ii)(A), the ROD must document and discuss the reasons for any significant changes made to the Selected Remedy from the time the Proposed Plan was released for public comment to the final selection of the remedy.

There are five changes to the OU1 Selected Interim Remedy since publication of the Proposed Plan. These are:

- Changes in toxicity data and human health risk results.

  The human health risk evaluation was revised to include current toxicity data for the four OU1 COCs to ensure that the remedy is protective of human health and the environment. The revised results are included in ROD Section 7.1.4. The revised results did not change the OU1 COCs or the risks to human receptor categories.

- Methylene chloride as an OU1 COPC and COC.

  Methylene chloride was inadvertently excluded as an OU1 COPC in the Proposed Plan text; however, it was evaluated in the 2011 Draft Site-wide Baseline Risk Assessment Report (BLRA) and in the revised human health risk evaluation presented in this ROD and is considered an OU1 COC.

- Clarification of the selected Cleanup Level and Performance Measures as described in Section 8.

- Remaining subsurface soil that exceeds 10 mg/kg after in-situ thermal treatment.

  Under CTS-2, the Proposed Plan erroneously stated that any remaining subsurface soil that exceeded 10 mg/kg PCE after thermal treatment would be treated with a chemical oxidant. This was an editorial error. Remaining contaminated subsurface soil will be biologically treated along with contaminated groundwater.

- Estimated costs for CTS 2 (OU1 Selected Interim Remedy) and CTS-3.

  The total net present worth costs for CTS-2 and CTS-3 presented in the Proposed Plan did not include all costs that were included in the 2012 Draft FS Report, e.g., IC implementation, monitoring, annual data review and reporting, and 5-year reviews. These costs are now included in this ROD. The total estimated net present worth costs for CTS-2 and CTS-3 have increased by approximately $1 million each from what was listed in the Proposed Plan. These revised costs, however, did not change the overall comparative analysis of the alternatives.

None of the above changes were significant enough to alter the alternatives, including the Preferred Alternative, selected as the OU1 interim remedy in this ROD**.**

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III. RESPONSIVENESS SUMMARY

OPERABLE UNIT 1

INTERIM REMEDIAL ACTION

HAMILTON/LABREE ROADS GROUNDWATER CONTAMINATION SUPERFUND SITE

CHEHALIS, LEWIS COUNTY, WASHINGTON

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1.0 INTRODUCTION

This part of the Record of Decision (ROD) for the Operable Unit 1 (OU1) interim remedy at the Hamilton/Labree Roads Groundwater Contamination Superfund Site (Site) provides an overview of community involvement and public participation at the Site and provides responses to categories of comments received during the public comment period on the OU1 Proposed Plan.

2.0 OVERVIEW OF COMMUNITY INVOLVEMENT

The U.S. Environmental Protection Agency (EPA) is committed to meaningful community participation throughout the Superfund process at the Hamilton/Labree Superfund Site. EPA has worked with the community since 2000 to ensure that interested parties are kept informed and given an opportunity to provide input on activities to be performed at the Site. This has been accomplished via website postings, direct mailings, door-to-door visits, community interviews, newspaper notices, and public meetings.

In July 2012, EPA released a fact sheet notifying the community of the pending cleanup proposal for OU1. A second fact sheet summarizing the cleanup proposal was released in early October 2012. The Proposed Plan for the OU1 interim remedy was released on September 28, 2012, which marked the start of a 42-day public comment period ending on November 9, 2012. The Proposed Plan as well as the 2011 Draft Site-wide Remedial Investigation (RI) report, 2011 Draft Site-wide Baseline Risk Assessment (BLRA) report, and the 2012 Draft Feasibility Study (FS) Report for OU1 were made available to the public as part of the Administrative Record (AR). The AR is located at the EPA Region 10 Superfund Records Center in Seattle, Washington, and at the Vernetta Smith Chehalis Timberland Public Library in Chehalis, Washington. These documents were also made available through the EPA Hamilton/Labree Roads Superfund Site website:

http://yosemite.epa.gov/R10/cleanup.nsf/sites/HLabree.

The public was given until November 9, 2012 to submit questions and comments on the Proposed Plan and supporting documents. To facilitate public participation, EPA held a public open house and meeting in Chehalis on October 23, 2012. At this meeting, representatives from EPA answered questions about the Site and the interim remedy (called the Preferred Alternative in the Proposed Plan) under consideration for OU1. A transcript of the more formal "oral testimony" portion of the public meeting was prepared by a court reporter.

In addition to comments and questions received at the public meeting, EPA received several questions and comments by mail and e-mail during the public comment period. These documents, in addition to the public meeting transcript, are available for review at the Chehalis Timberland Library and the Seattle Records Center as part of the AR.

3.0 RESPONSE TO QUESTIONS AND COMMENTS

This section provides responses to categories of questions and comments received on the Proposed Plan during the public comment period. None of the questions or comments were

significant enough, or brought new information to consider, for EPA to alter any of the cleanup alternatives that were considered for OU1, including the Preferred Alternative. Therefore, EPA chooses the Preferred Alternative as the Selected Interim Remedy for OU1 in this ROD.

3.1 General Site Information

3.1.1 Site Boundaries and Surface Water Bodies

Questions: What are the boundaries of the Site? What rivers and creeks does it include?

EPA Response: The Hamilton/Labree Roads Groundwater Contamination Superfund Site is located about two miles south of the City of Chehalis, Washington, near the intersection of North Hamilton Road and Labree Road, west of Interstate 5 (I-5). The Site lies within the Newaukum River Valley. The valley generally slopes down to the northwest toward the Chehalis River. The Site is bordered to the north by farmland and to the south and west by the Newaukum River, which flows northwesterly where it joins with the Chehalis River about five miles northwest of the Site. I-5 marks the eastern boundary of the Site. I-5 marks the eastern boundary of the Site.

Two creeks run through the Site: Berwick Creek and Dillenbaugh Creek. In addition, two ditches intermittently discharge into Berwick Creek within OU1. Both ditches pass under I-5 and flow from east to west. Berwick Creek flows through OU1 from southeast to northwest, turns west at the Breen Property, and follows a mostly channelized reach for approximately 1,500 feet where it then turns towards the north-northwest, meeting Dillenbaugh Creek about 2,100 feet further to the north. Dillenbaugh Creek flows roughly southeast to northwest through the downgradient area of the Site and discharges into the Chehalis River. See **Figure 1-2** in the ROD for an aerial view of the Site and its surface water bodies.

3.1.2 Operable Units

Question: What are the two Operable Units?

EPA Response: In 2007, the Site was administratively divided into two areas, called Operable Units or OUs, to facilitate the identification and cleanup of hazardous substances. Hazardous substances, primarily tetrachloroethylene (PCE) and its degradation products, have come to be located in both OUs contaminating sediment, soil, and groundwater.

OU1 is also known as the Hamilton Road Impacted Area (HRIA). OU1 is located at the most upgradient, or upstream, portion of the Site. It is about 10 acres in size. It is crossed from northwest to southeast by North Hamilton Road and Berwick Creek. It is this OU that is the focus of this ROD. Operable Unit 2 (OU2) includes all other areas outside of OU1 where hazardous substances have come to be located, including what is referred to as the Breen Property and the Thurman Berwick Creek Area and the areas west and northwest of Labree Road. **Figure 1-2** in the ROD provides an overview of the Site.

The Breen Property (part of OU2) is located northwest of OU1 and covers about 11 acres. The Breen Property includes part of the property owned by the Breens, and part of the property

currently owned by the Chehalis Livestock Auction. Just south of the Breen Property is what EPA refers to as the "Thurman Berwick Creek Area." The Thurman Berwick Creek Area is divided by Berwick Creek into two portions: the northwest portion, which currently contains a residential structure built in 1930, and the southeast portion, which is undeveloped land. The Thurman Berwick Creek Area is also within OU2. OU2 also includes those areas west and northwest of Labree Road. Most of the current land use in this area is farmland, but residential and light commercial uses also occur.

Figure 1-2 in the ROD provides an aerial view of the Site, the OUs, and the Breen Property and Thurman Berwick Creek Area.

3.1.3 Groundwater Flow Speed

Questions: How fast is the groundwater moving to properties that are downgradient from OU1, especially those properties that are not on the Chehalis municipal water-supply line? How long does it take to cover 2 miles?

EPA Response: More data need to be collected to definitively answer how fast groundwater is moving across the Site. There is little data available about hydraulic conductivity. Hydraulic conductivity describes the ease with which groundwater can move through pore spaces or fractures in the groundwater aquifer and is one of the main controls on how fast groundwater flows.

The gradient (steepness of the groundwater table) is another important control on how fast groundwater flows. We do know that the gradient is steepest in OU1. The gradient gets flatter as you head west and northwest from OU1 along the Newaukum River Valley. This tells us that groundwater flow is probably faster in OU1 than areas downgradient of OU1. But there are many other factors that impact how fast groundwater flows. EPA's best estimate at this time is that groundwater moves slower than 50 feet a year across the entire Site, and contamination in groundwater tends to move more slowly than the actual water flow.

3.1.4 Depth of Contamination

Questions: How deep is the contamination? Should we drill to the deep aquifer to get our drinking water?

EPA Response: Contamination mainly occurs in the shallow groundwater aquifer located approximately 5 to 50 feet below the ground surface (bgs) across the Site. An approximately 100-foot thick silt/clay layer (called an aquitard) lies at the bottom of the shallow groundwater aquifer. Below this is another aquifer, which is referred to at this Site as the deep aquifer. The thickness of the deep aquifer is unknown.

Sampling from deep private wells beneath areas of lower zone contamination on and downgradient of the Breen property have shown no significant impact on the deep aquifer; however, very few samples have been taken and the data are more than 10 years old. Note, that if pursued, the installation of a water well into the deep aquifer would involve higher costs than

well installation in the shallow aquifer because of the need to drill through the 100-foot thick aquitard to reach the deeper water bearing zone.

3.1.5 Surface Water Impacts on Direction of Contaminated Groundwater Plume(s)

Questions: Does having the Newaukum River so close to the western boundary of the PCE-contaminated groundwater plume(s) impact its direction? Would the river tend to push the plume(s) closer towards the freeway?

EPA Response: Typically groundwater tends to discharge (empty) into nearby surface waters, but at this Site, there are competing smaller surface water bodies apparently controlling the groundwater gradients in the area of the contaminated groundwater plume(s). The plume(s) generally flows down and along Berwick Creek and then towards Dillenbaugh Creek and I-5 rather than heading west to the Newaukum River. In addition, it is not so much that the Newaukum River is pushing the plume(s) any particular way. The plume(s) is most likely being drawn by the creeks rather than by the Newaukum River because the creeks (especially Berwick Creek) are so much closer to the sources.

3.1.6 Risks from Drinking Groundwater

Questions: What are the risks if you were to drink the PCE-contaminated groundwater? What was the PCE level found at the old school house on Rice Road? Where does the dairy on Labree Road get its water?

EPA Response: PCE and its degradation products (trichloroethylene [TCE], cis-1,2-dichloroethylene [DCE] and vinyl chloride) are neurocarcinogens. If you drink water that has PCE above the safe drinking water level (called the Maximum Contaminant Level or MCL) for long enough, there is a chance that you can get cancer in your lifetime. However, there are other mitigating factors that can predispose humans to cancer that must be considered when determining risks, such as genetics.

The MCL for PCE in groundwater is 5 micrograms per liter (µg/L) or parts per billion (ppb). The levels of PCE found at the old school house along Rice Road (2377 Rice Road) have ranged from 4.8 µg/L in August 2002 to 5.3 µg/L in July 2007. This property currently houses the Newaukum Valley Community Club and a private business. It was connected to the Chehalis municipal water-supply system in 2002/2003, as was the dairy along Labree Road.

3.1.7 Site Studies Conducted After Summer 2007

Questions: What studies happened after groundwater wells were last tested in the summer of 2007? Why haven't wells been tested since 2007, especially those properties west of Labree Road that were not hooked up to the Chehalis municipal water-supply system in 2002?

EPA Response: In July 2007, EPA sampled 17 wells across the Site (eight private water supply wells and nine monitoring wells). The purpose of this sampling was to evaluate whether significant changes in concentrations had occurred since the previous Site-wide sampling events in 2003/2004. No significant changes were found. In November 2007, EPA took 34 air

samples in and around private residences and commercial buildings across the Site to assess possible risks to humans from vapor intrusion. No current risks were indicated by the data. EPA then studied the entire body of data collected to date and conducted 3-dimensional (3-D) groundwater modeling to better understand contamination patterns across the Site. In May 2010, EPA measured water levels and assessed the condition of most of the monitoring wells across the Site. In 2011, after review of the additional data collected in 2007 and 2010 and reviewing previous data that had been collected across the Site, EPA determined that an interim remedial action was warranted for OU1. Additional studies are needed to further define the nature and extent of contamination and determine options for cleaning up the rest of the Site.

Private water-supply and groundwater monitoring wells had not been tested since 2007 for a number of reasons which include: (1) PCE had not been detected in any of the Rice Road private drinking water-supply wells, (2) no significant changes in PCE contamination in those groundwater monitoring wells tested in 2007 were found, (3) the slow rate of groundwater flow, especially in the flatter areas west of Labree Road, and (4) having stable plume margins (boundaries) over a 10- or 15-year period.

On April 23 and 24, 2013, EPA and START Contractor E&E sampled 19 domestic wells along Rice and Hamilton Roads. The purpose of this sampling was to determine if contaminated groundwater from the Hamilton/Labree source areas had migrated to cross- and downgradient properties not connected to the Chehalis municipal water-supply system. No Site chemicals were found at detectable levels in any of the wells sampled.

3.2 Prior Cleanup Actions at the Site

3.2.1 Breen Property Cleanup

Question: What were the contents of the drums discovered on the Breen Property in 1999?

EPA Response: All of the drums appeared to contain water, as a result of groundwater having seeped through rust holes, as well as a black sludge-like material. The contents of two of the excavated drums were sampled and analyzed. Based on laboratory results, the two drums contained a mixture of lubrication oil, grease, paint residue, and solvents typically associated with painting and equipment degreasing activities. PCE was detected in both drums above the federal Safe Drinking Water Act MCL of 5 µg/L. The other drums were assumed to have similar compounds. A total of sixty-six 55-gallon drums, four 30-gallon drums, and several 1- to 5-gallon containers, and approximately 600 tons of PCE and petroleum-contaminated soil were removed from under what is referred to as Building B on the Breen Property and taken to nearby treatment and disposal facilities.

3.2.2 2002/2003 Municipal Water-Supply Line Extension

Question: What criteria were used to determine which properties were to be connected to the Chehalis municipal water-supply system in 2002/2003?

EPA Response: EPA and the City of Chehalis extended the Chehalis municipal water-supply system to 18 homes and businesses in 2002 and 2003 as a result of earlier groundwater investigations conducted across the Site. Properties to be connected to the water-supply system were based on the following criteria:

- The private well that provided potable water to the residents/workers on the Site contained detectable concentrations of PCE; or
- The property had a future potential to be impacted by PCE-contaminated groundwater based on the projected five-year migration of the PCE plume(s) (2002 to 2007).

Wells sampled by EPA in July 2007 included those along Rice Road that were not connected to the municipal water-supply system, and no PCE was detected. These wells were also tested in April of 2013 with the same results.

3.3 Operable Unit 1 aka Hamilton Road Impacted Area

3.3.1 Contaminant Release/Spill Date

Comment Summary: When was the PCE released into Berwick Creek in OU1?

EPA Response: The source of contamination within OU1 appears to be the result of a spill or direct release of liquid PCE into Berwick Creek. The person or persons who caused this release is unknown. The exact date of the release is also unknown. Estimates range from the 1970s to no later than 1990 based on the results of various plume migration and groundwater modeling studies that have been conducted and on other factors, such as construction of North Hamilton Road.

Regarding the latter, it seems unlikely that the release occurred before North Hamilton Road, which runs parallel and west of Berwick Creek in OU1, was constructed in 1974. The 2004 engineering evaluation/cost analysis (EE/CA) report completed by URS estimated the volume of release to be between 100 and 700 gallons (URS 2004). Such large volumes would require easy access to the release area such as from a road. In addition, contamination patterns observed in OU1 indicate the release occurred on the west side of Berwick Creek. Soil gas surveys conducted east of Berwick Creek along I-5, and a review of I-5 accident reports in this area, do not support a release along I-5. These factors all seem to suggest that the release did not occur before construction of North Hamilton Road in 1974.

The “no later than 1990” date is based on PCE contamination levels observed in private well (PW) -3, located approximately 400 feet from OU1’s Southeastern Hotspot in 1993 and on the groundwater seepage velocity provided in URS’s 2004 EE/CA report of 0.36 feet/day.

Additional data need to be collected to better understand when the OU1 release occurred and the fate and transport of the OU1 plume and other contaminated groundwater plumes across the Site. This includes data on vertical and horizontal hydraulic conductivity (Parametrix/CDM Smith 2013)

3.3.2 Estimating Contaminant Mass

Comment: EPA's use of 3-D geostatistical modeling using Mining Visualization Systems (MVS) Version 9.13 software to re-calculate contaminant mass in soil within OU1 may provide a more accurate estimate than the previous mass estimates completed in the 2004 EE/CA report. However, the use of MVS to calculate contaminant mass in groundwater is not considered to be representative of actual conditions due to the limitations in using MVS for this purpose. Specifically, the MVS does not have the capability to account for groundwater migration; thus, the estimated extent of PCE concentrations exceeding 4,000 µg/L is probably not accurate. The empirical groundwater analytical results and groundwater isoconcentration contours based on the groundwater flow should be used in conjunction with the MVS data to estimate overall contaminant mass in affected media in OU1.

EPA Response: Implementation of the OU1 interim remedy will include additional characterization of OU1 sediment, soil, and groundwater to determine the current extent of contamination. This characterization will also include obtaining hydraulic parameters so that more accurate estimates of groundwater flow can be modeled. The new data will be used to refine both the PCE contaminant mass and extent and also evaluate fate and transport more accurately (likely using both MVS and a numerical flow model). If the outcome of the characterization effort indicates a more cost-effective approach, it is possible that a change to the primary treatment approach is required, e.g., a significant increase or decrease in volume and target remediation zone footprint. In this case, EPA would release a new Proposed Plan and either an amendment to this ROD or an Explanation of Significant Differences Document, depending on the extent of changes. Non-significant or minor post-ROD changes would be documented in a memo to the Site file and in a Remedial Design Fact Sheet.

3.3.3 Major Components of the Selected Interim Remedy

Question: What technologies will be used to treat the contaminants in OU1?

EPA Response: The major components of the Selected Interim Remedy for OU1 include two treatment technologies: (1) in-situ thermal treatment of sediment and soil with PCE concentrations greater than 10 milligrams/kilogram (mg/kg) and (2) enhanced in-situ bioremediation of groundwater with PCE concentrations greater than 4,000 µg/L.

In regards to thermal treatment, a full suite of in-situ thermal technologies (e.g., steam injection, steam extraction, electrical heating) will be considered as part of the remedial design. Thermal treatment methods work by heating contaminated sediment, soil, and groundwater. The heat volatilizes chemicals, which are then extracted using multi-phase (liquid and vapor) and/or vapor collection wells. Collection wells capture the harmful chemicals in liquids and/or gases and pipe them to the ground surface for treatment. Construction of the in-situ thermal treatment system will be accomplished using conventional construction equipment and services with contractors that specialize in this innovative technology. During operation, temperature, groundwater quality, vapor emissions, and condensate/discharge will be monitored.

Bioremediation has been described as a technology that uses natural processes to reduce the concentration or toxicity of a hazardous substance. Microbes that live in soil and groundwater, such as bacteria or fungi, will eat certain harmful chemicals. When microbes completely digest these chemicals, they change them into water and harmless gases, such as carbon dioxide. In order for microbes to clean up harmful chemicals, the right temperature, nutrients, and amount of oxygen must be present in the soil and groundwater. In order to boost or enhance this natural process, certain organic materials can be injected into the soil and groundwater. Examples of these amendments include whey, lactate, emulsified vegetable oil, and suspensions of zero-valent iron. Testing will be done during remedial design to determine the best amendment or combination of amendments to use and to determine where injection wells are to be placed. This testing area will be located in the area of highest PCE concentrations along the most downgradient boundary of the 4,000 µg/L PCE high concentration groundwater remediation target zone.

3.3.4 Establishing Cleanup Levels That Comply With ARARs

Comment: The September 2011 Draft FS Report was released to the public the same time as the Proposed Plan for the OU1 interim remedy. Table 3-2 of the FS provides a summary of the preliminary remediation goals (PRGs) developed for OU1, including a list of the chemical-specific applicable or relevant and appropriate requirements (ARARs) and their status. It is understandable that ARARs for soil and groundwater will be waived for this interim cleanup action pursuant to a Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) provision allowed for interim measures and that these ARARs would be addressed under the final ROD for the Site. It is not clear, however, why the Washington State Model Toxics Control Act (MTCA) Method A cleanup levels were not listed in this table. In addition, there is no reference to MTCA Method B soil cleanup levels protective of potable water.

EPA Response: The key factors for setting the OU1 cleanup levels include ARARs, risk-based calculations, and the decision to proceed with an interim remedy at this time. In regards to ARARs, CERCLA and the National Contingency Plan (NCP) require cleanup actions to comply with the substantive provisions of ARARs during and at the completion of cleanup actions unless legal waivers are documented in a ROD or other remedy decision document in accordance with waiver provisions of CERCLA Section 121 and NCP Section 300.435f)(1)(ii)(c).

The key ARARs for establishment of groundwater cleanup levels and points of compliance for this interim remedy and the Site include the Safe Drinking Water Act MCLs and the substantive provisions of Ground Water Cleanup Standards in Section 720 of MTCA (Washington Administrative Code [WAC] 73-340-720). Another section of MTCA that is considered an ARAR is WAC 173-340-747 (Deriving soil concentrations for groundwater protection), which requires soil cleanups to achieve levels that will not cause exceedance of the groundwater cleanup levels and will not result in the accumulation of non-aqueous phase liquid on or in groundwater. The interim remedy presented in this ROD will address the significant sources of groundwater contamination located within OU1 to the maximum extent practicable, but as noted in the comment, full compliance with groundwater protection ARARs is beyond its scope.

Groundwater protection ARARs, therefore, are being waived pending selection of the final remedy for the Site.

The key ARARs considered in the establishment of a sediment and soil cleanup level for this interim remedy include MTCA Section 705 (WAC 173-340-705 Use of Method B) and MTCA Section 740 (WAC 173-340-740 Unrestricted land use soil cleanup standards). Use of MTCA Method B was determined to be more appropriate than MTCA Method A (WAC 173-340-704) for this interim remedy after a consideration of the intended application of each Method. MTCA Method A is to be used for sites undergoing routine cleanup actions or sites with relatively few hazardous substances or exposure pathways. Under MTCA, the definition of a routine cleanup includes one that qualifies for an exclusion from conducting a site-specific ecological (terrestrial) risk assessment (WAC 173-340-7491). That is not the case for this interim remedy; the short-tailed shrew is one of the terrestrial receptors at risk from current soil contamination levels. While it may be argued that this interim remedy deals with relatively few hazardous substances, it considers multiple exposure pathways and receptors in establishing protective cleanup levels and performance measures, and MTCA Method B was therefore identified as a key ARAR rather than MTCA Method A.

3.3.5 Excavation of Contaminated Sediment and Soil

Question: What and how much will be excavated?

EPA Response: If creek bed sediment and surface soil have PCE concentrations greater than 10 mg/kg after being thermally treated, most if not all, will be excavated with conventional construction equipment, and consolidated within OU1 prior to disposal. For cost estimating purposes, EPA estimated in this ROD that 140 loose cubic yards (LCY) of contaminated sediment and soil would require excavation. Excavated sediment and soil will be placed on an impermeable liner and covered to minimize the risk of contaminants leaking into the underlying soil and groundwater until waste characterization testing can be completed and the material is transported off site to an approved disposal facility.

Limited excavation may also be required prior to thermal treatment. For example, excavation would be considered if results of additional site characterization conducted during remedial design indicate isolated hotspots of elevated PCE levels in surface soil outside of the creek bed sediment/bank surface soil zone that would be inefficient to address by extending the thermal treatment grid. In this case, excavated sediment and/or soil may be placed within the thermal treatment zone or disposed offsite.

3.3.6 Disposal of Excavated Contaminated Sediment and Soil

Comment: The Washington State Department of Ecology recently revised its MTCA Method B soil cleanup levels for PCE. The revision includes substantive changes to the MTCA Method B direct contact cleanup level for soil for unrestricted land use, which would allow for direct disposal of much higher concentrations of PCE-contaminated soil to a Subtitle D Landfill under a Contained-Out Determination. Based on these changes, EPA should re-evaluate the remedial

action objectives developed for soil and groundwater for the Interim Cleanup Action as it may provide for a more cost-effective approach for the HRIA cleanup.

Also, the referenced concentration in the 2011 Draft Feasibility Study report (p. 6-15) of 6.0 mg/kg as the Land Disposal Restriction (LDR) for direct disposal to a landfill is incorrect. The LDR is 60 mg/kg.

EPA Response: EPA acknowledges that the MTCA Method B direct contact soil cleanup level for PCE has been revised; however, the remedial action objectives and cleanup levels developed for sediment and soil are still applicable and cost effective as presented in the OU1 Interim ROD. The Contained-Out Determination refers to the evaluation by Ecology to determine whether soil or concrete contaminated by listed wastes must be managed as a dangerous waste or not. Contaminated media may be determined to no longer contain dangerous waste when the dangerous constituents in the media fall below site-specific risk-based levels and the media does not exhibit properties of a characteristic waste. Because some of the PCE concentrations in soil indicate it would fail toxicity characteristic leaching procedures (TCLP)[1] and qualify as a characteristic waste, those concentration restrictions would still apply for disposal in a Subtitle D landfill. Implementation of the OU1 interim remedy will include additional characterization of OU1 soils and groundwater to determine current PCE concentrations in OU1. If the outcome of the characterization effort indicates a more cost-effective approach is possible that requires a change to the primary treatment approach, (e.g., a significant decrease in volume and target remedial zone footprint), EPA will propose a change to the interim remedy.

EPA appreciates the noting of the LDR restriction concentration error in the draft FS report. The final FS report reflects the correct LDR restriction concentration of 60 mg/kg (Universal Treatment Standard x 10).

3.3.7 Types of Bacteria and Amendments to be used During Bioremediation

Question: Are you using pseudomonas or other bacteria in the natural flora? How about using anaerobic bacteria?

EPA Response: The types of bacteria that will be used to carry out bioremediation of PCE in groundwater at OU1 are called the *Dehalococcoides*. This genus is the only known population of bacteria that can degrade PCE all the way to ethylene, a non-hazardous end product. Effective bioremediation of chlorinated ethylenes is often linked to the presence of these bacteria. They are strict anaerobes present in most natural environments at low levels. We can test for the bacteria's presence by pulling a groundwater sample and looking for its DNA. If it is determined that these bacteria are not present, cultures of these bacteria can be added. In order to create anaerobic conditions required by *Dehalococcoides* to grow and metabolize chlorinated ethylenes, a carbon amendment is generally added to the groundwater. Many different types of carbon

[1] TCLP is a soil sample extraction method for chemical analysis employed as an analytical method to simulate leaching through a landfill. The testing methodology is used to determine if a waste is characteristically hazardous (D-List).

amendments have been used successfully, including sugars, starches, chitin, cheese whey, and emulsified vegetable oil. For OU1, it was assumed that vegetable oil will be used to facilitate the biodegradation of PCE. Vegetable oil is a long-lived amendment that can facilitate bioremediation for many years.

3.3.8 Timeline for Cleanup

Question: What is the timeline for conducting the cleanup?

EPA Response: After the ROD for the OU1 interim remedy is signed, EPA will develop planning documents and complete sampling and testing needed to develop the remedial design for the interim remedy. Depending upon available funding, this phase (called the pre-design phase) will be initiated in July 2013 and should be completed in 2014. Work on the remedial design for the remedy would then proceed using the information collected in the sampling and testing phase. The length of the design phase may change depending on availability of resources and funding. Below is the estimated timeline to achieve major remedy milestones:

- Diversion of Berwick Creek: Up to 6 months
- Design, construct and operate in-situ thermal treatment system, and achieve sediment and soil CUL: 18 months
- Design, pilot test, construct and operate enhanced bioremediation treatment, and achieve high concentration groundwater performance measure: 4 years
- Total estimated timeframe to achieve both the sediment and soil CUL and the high concentration groundwater performance measure: 5 years. This assumes there will be an overlap of in-situ thermal and enhanced bioremediation treatment, and that thermal treatment will achieve the 10 mg/kg PCE or less CUL. If the additional remedial components described for the selected remedy (i.e., additional excavation, treatment and offsite disposal of sediment/surface soil and/or bioremediation or chemical oxidation polishing in subsurface soils not meeting the CUL following in-situ thermal treatment) are needed to achieve the 10 mg/kg PCE CUL in sediment and soil, the total estimated timeframe may be different.

3.3.9 Funds for Cleanup

Question: Are there funds available for the cleanup?

EPA Response: EPA will make every effort to secure funds in a timely fashion for pre-design, design, and implementation of the OU1 interim remedy.

3.4 Impacts of OU1 Cleanup on Downgradient Properties

3.4.1 Impacts on Direction of Contaminated Groundwater Plume(s)

Question: Will the cleanup action in OU1, especially if you have to excavate sediment and soil, impact the direction of the contaminated groundwater plume(s), causing movement closer to the

Newaukum River and properties not currently impacted by the plume(s), e.g., those properties not on the Chehalis municipal water-supply system?

EPA Response: EPA does not anticipate that the OU1 cleanup action will cause a major shift in the direction of the groundwater plume(s) even if sediment and soil need to be excavated. Excavations that extend into groundwater do not typically "push" contaminant plumes as a result of the disturbance of fine particles of soil containing adsorbed contaminants that might then be released. The amount of contamination released depends on how much excavation, if any, will be done below the water table and the contaminant concentrations on the soil particles. During cleanup, EPA will monitor groundwater downgradient of OU1 to identify changes to groundwater quality and movement.

3.4.2 Impacts on Municipal Water-Supply System

Question: What will the impacts be to the municipal water-supply system when Berwick Creek is re-routed?

EPA Response: EPA does not anticipate any impacts to the municipal water-supply system if Berwick Creek is re-routed to lie between the current creek channel and I-5 in OU1. If it needs to be re-routed somewhere else, there might be some temporary disruption. EPA will work closely with the City of Chehalis during design to minimize any disruption that may occur.

3.5 Private Water-Supply Wells

3.5.1 Getting Wells Tested

Question: Can we take a sample of our drinking-well water to the Health Department and have it tested?

EPA Response: Well samples can be taken to the Lewis County Health Department to be tested; however, they do not analyze for PCE or the other contaminants identified at the Hamilton/Labree Site. The Health Department tests for such things as fecal coliform and nutrients, e.g. compounds found in fertilizer. As mentioned above, EPA collected groundwater samples at 19 properties along Rice and Hamilton Roads on April 23 and 24, 2013 to see if Site contaminants had migrated to these residential drinking-water wells. Fortunately, no Site contaminants were detected. EPA will likely conduct at least one more round of sampling of these wells, or a subset of these wells, until an adequate groundwater monitoring program is implemented at the Site.

3.5.2 Fluctuations in PCE Concentrations in Wells

Comment: PCE is not very soluble in water, and in OU1 it is present in part as a dense non-aqueous phase liquid (DNAPL) that is even less soluble. The PCE can then be moved by water to other areas of the Site and not necessarily moved in a continuous pattern especially as it is moved further from the original source area. Rather, it could often be moved as spikes or small amounts of PCE at a time depending on the water volume and rate of movement. Therefore, is it

possible that these spikes could appear in water wells, and as people are using the water, it again slowly disappears and when the water is again tested it is negative?

EPA Response: Studies to date have not shown evidence of PCE as DNAPL occurring outside of OU1's 4,000 µg/L plume boundary. PCE beyond this boundary is dissolved in the groundwater.

There is a common misconception that DNAPLs can migrate a long way laterally, but that is not true unless: (1) there is a lot of it and (2) it pools on an extensive low-permeability layer in the aquifer. The only extensive low-permeability layer within OU1 is the aquitard at the base of the shallow aquifer. There is no evidence that DNAPL has pooled there. Because of this, EPA does not think it is possible that PCE DNAPL migration could lead to spikes in the downgradient dissolved-phase plume(s).

It is possible that changes in pumping patterns near the edge of the plume(s), coupled with the natural heterogeneity in the aquifer, could lead to small temporary variations or "spikes" in individual wells near the plume(s) edge. This was seen when production wells at the dairy on Labree Road drew the plume(s) southward prior to being hooked up to the municipal water-supply system. Once those wells were decommissioned, the southern boundary of the plume(s) retracted northward. At this time, it does not appear that any production wells are impacting the direction of the Site's groundwater plume(s).

3.5.3 Point-of-Use Treatment System

Question: Are there any point-of-use treatment systems that can be placed on private water-supply wells as a protective measure?

EPA Response: There are wellhead-treatment systems that can be installed on wells, e.g., granular-activated charcoal. These types of treatment systems can be expensive, however, and you would need to carefully weigh the benefits vs. the costs, especially if your well is not currently contaminated.

3.5.4 Extending the Municipal Water-Supply Line

Question: Are there any plans to extend the City of Chehalis' municipal water-supply line beyond where it currently terminates on Rice and Hamilton Roads?

EPA Response: EPA is not aware of any plans to extend this water-supply system. Since to date no contamination from the Site has been found in these wells, nor does EPA anticipate contamination in the near future due to the known current direction of the groundwater plume(s), EPA does not have the authority or funds to act on such an endeavor. This question is better answered by Lewis County and the City of Chehalis at this time.

3.6 Conceptual Site Model

3.6.1 OU1 Contribution to Groundwater Plumes

Comment: EPA should revise its estimate of the relative contribution of the HRIA (OU1) sources to the Regional Plume west of Labree Road to more accurately reflect that the majority of the Regional PCE Plume is the result of migration from the DNAPL source at the HRIA.

EPA Response: EPA will be collecting additional data in the future to better characterize the Site's contaminated groundwater plume(s).

3.6.2 Breen Property Contribution to Groundwater Plumes

Comment: EPA should re-evaluate the relative contributions of the confirmed sources at the Breen Property to the Regional PCE Plume based on the previous groundwater modeling conducted by Farallon as described in the Allocation Memorandum and additional comments provided below in the modeling category (Section 3.7).

EPA Response: EPA will be collecting additional data in the future to better characterize the Site's contaminated groundwater plume(s).

3.6.3 Downgradient Monitoring Well 28

Comment: Strongly recommend that EPA re-sample monitoring well 28 (MW-28) in the near future.

EPA Response: EPA attempted to sample MW-28 in 2007; however, the well could not be located. EPA will be collecting additional data in the future to better characterize the Site's contaminated groundwater plume(s), including MW-28 if it can be located and is viable.

3.6.4 Sampling North of Boring RS-47

Comment: EPA should revise its conclusion that additional characterization is needed north of boring RS-47 or should provide a sound technical rationale why further characterization is needed.

EPA Response: Comment is noted.

3.6.5 Groundwater Isoconcentration Maps

Comments: EPA should revise groundwater isoconcentration contour maps to include the maximum PCE concentrations used at each boring or well location, reflect the local variations in groundwater flow, and reflect a 5 µg/L contour. These revisions are necessary in order to more accurately depict the nature and extent of groundwater contamination, which is critical to development and implementation of an effective remedial strategy for cleanup.

EPA Response: Comments are noted.

3.6.6 "Bottleneck" Area West of Former United Rentals Property

Comment: EPA should revise its description of this local area (the "bottleneck") to more accurately reflect the hydrogeologic conditions and confirmed migration of the Regional PCE Plume thru this area.

EPA Response: EPA will be collecting additional data in the future to better characterize the Site's contaminated groundwater plume(s), including hydrogeologic and contaminant fate and transport data downgradient of OU1.

3.7 Groundwater Modeling

3.7.1 CDM Smith Model

Comment: EPA should revise the previous groundwater modeling effort using a 1970s release date and adjusted hydraulic conductivity value to re-evaluate the HRIA (OU1) contribution to the Regional PCE Plume.

EPA Response: Comment is noted.

3.7.2 BIOCHLOR Modeling

Comment: Recommend that EPA re-evaluate the BIOCHLOR modeling results using a more technically defensible release date of the 1970s and revise the conceptual site model accordingly. EPA should also gather more data in the area of the "bottleneck" in order to better understand the migration pathway of the Regional PCE Plume in the upper portion of the Shallow Aquifer between the HRIA (OU1) and the Thurman Berwick Creek Area or whether contaminant transport is primarily in the lower portion of the Shallow Aquifer through this area.

EPA Response: Comments are noted.

3.7.3 Geostatistical Modeling

Comment: EPA's use of the Mining Visualization Software (MVS) to depict the nature and extent of the PCE concentrations in groundwater at the Site is not considered representative of the Site groundwater conditions because the MVS software does not account for dynamic groundwater flow. EPA should revise their conceptual site model to acknowledge the significant contribution of the HRIA (OU1) source to the Regional PCE plume, including the area west of Labree Road.

EPA Response: Comment is noted.

3.8 Breen Property Characterization

3.8.1 North of Monitoring Well 33

Comment: EPA should consider additional characterization of the Shallow Aquifer in the area north of MW-33 to ensure that the northeastern margin of the Regional PCE Plume emanating from the HRIA (OU1) is adequately bounded.

EPA Response: Comment is noted.

3.8.2 Soil Sampling Method

Comment: EPA should revise its statement that the incorrect soil sampling method for preserving soil samples was used in Farallon's RI field program in 2002 and 2003. This was the approved sampling method at the time this field program was conducted.

EPA Response: EPA recognizes that Farallon used an approved soil sampling method in 2002 and 2003; however, by 2003, it was determined that the method used leads to results that are biased low, especially for samples collected from coarse soils like the gravelly materials that comprise the Site's shallow aquifer.

3.8.3 Additional Characterization

Comment: EPA should re-evaluate the need for proposed additional characterization on the Breen Property.

EPA Response: Comment is noted.

Tables

Table 2-1 Historical Site Investigations and Key Findings

Date Range	Investigated by	Scope of Investigation	Key Findings	References
1993-1994	Washington State Department of Health (WDOH)	Sampled 18 private water-supply wells in the Hamilton/Labree Roads area.	Tetrachloroethene (PCE) detected in 6 wells screened in the shallow aquifer.	Ecology 1999b
1996	WDOH	Re-sampled 5 of 6 wells previously exhibiting PCE.	Slight increase in PCE concentrations from 1993-1994 sampling event.	Ecology 1999b
1996	Geo-Recon and SAIC (for Washington Department of Ecology [Ecology])	Geophysical reconnaissance investigation on the Breen property for sources, sampled private water-supply wells, and installed monitoring wells in the shallow aquifer. Ecology started supplying bottled water to affected well owners.	Some geophysical anomalies detected, but no obvious cache of buried drums. PCE concentrations ranged from 500 to 1,350 micrograms per liter (µg/L) in MW-3 and 2.4 to 7 µg/L in MW-5.	SAIC 1997 and Geo-Recon 1996
1997-2001	Ecology	Quarterly sampling of monitoring wells and private water-supply wells. Installed 7 wells intended for monitoring and remediation, all within the OU1 study area. Sampling of surface water in Berwick Creek.	Identified two distinct PCE source areas: one centered in the vicinity of the Hamilton/Labree Roads intersection and the other located along Berwick Creek west of I-5 (OU1). Analytical results indicated the presence of DNAPL at OU1 and the potential presence of DNAPL at the Hamilton/Labree Roads intersection.	Ecology 2000; Ecology 1999b
1998	Transglobal Environmental Geosciences Northwest, Inc. [TEG] (for Ecology)	Sampled soil and groundwater from 28 temporary borings in the Hamilton/Labree Roads area.	PCE detected in groundwater at a maximum concentration of 60,000 µg/L at location B2. This indicated the presence of DNAPL in the area between Hamilton Road and Berwick Creek.	Ecology 1999a
1999	Northwest Geophysical Associates and GeoEngineers for Breen	Located and removed 70 drums and several small containers, and contaminated soil from beneath a building on the Breen property.	Buried drums were a source of PCE in groundwater.	GeoEngineers 2001
2000 – 2002	Ecology and Environment, Inc. for EPA	Site added to the NPL. EPA took over supplying alternative sources of water to affected well owners. Four phase removal assessment. Installed and sampled temporary borings, monitoring wells, and combined monitoring and recovery wells. All temporary and permanent sampling locations assessed the shallow aquifer, with various sampling and screen depths. Evaluated removal action alternatives.	Removal assessments resulted in Time Critical Removal Action to expand the City of Chehalis municipal water supply system to 18 properties across the Site (15 residential and 3 commercial).	E&E 2000, 2001, 2002
2002	Farallon Consulting for Breen	Phase I field investigation sampling program to meet objectives of the AOC and identify data gaps to guide development of a Site-wide RI/FS work plan. Within OU1, collected surface water from Berwick Creek and groundwater from existing monitoring and private water supply wells. Outside of OU1, installed and sampled temporary borings and permanent monitoring wells, collected stream-bed soil samples from Berwick Creek, collected soil gas samples on Breen property. Results of Phase I activities discussed in the RI/FS Work Plan.	Eliminated some potential source areas on the Breen property from consideration. Added to understanding of distribution of PCE in soil and groundwater. Found downgradient PCE plume extended further than indicated by previous investigations.	Farallon 2003

Table 2-1 Historical Site Investigations and Key Findings (continued)

Date Range	Investigated by	Scope of Investigation	Key Findings	References
2003-2004	URS Group for EPA	Engineering evaluation/cost analysis (EE/CA) investigation for the OU1 study area. Performed geophysical survey to look for targets and characterize subsurface. Collected soil gas samples, stream bed and bank soil samples from Berwick Creek, sampled soil and groundwater from temporary Geoprobe borings to 30 feet below ground surface (bgs), sampled soil and groundwater from auger borings to 50 feet bgs, installed and sampled permanent monitoring wells, performed two constant-discharge aquifer performance tests.	Identified source as dumping to Berwick Creek. Delimited dense nonaqueous-phase liquid (DNAPL) zone and zone of highest PCE concentrations. Obtained soil, groundwater, and aquifer characteristics for screening and design of removal and remedial technologies. Installed wells for use in future remediation and monitoring.	URS Group 2004
2003-2004	Farallon Consulting	Phase I Remedial Investigation/Feasibility Study (RI/FS) on the Breen property. Installed and sampled permanent monitoring wells, performed constant-discharge aquifer performance tests. Collected soil, groundwater, creek bed, and surface water samples.	At existing wells, PCE concentrations in groundwater were comparable to those identified during prior investigations by others. The highest PCE concentration in groundwater on the Breen property was downgradient of the wash-down pad (2,400 µg/L). A high of 40 µg/L PCE was detected in surface water.	Farallon 2004
2007	Parametrix for EPA	Collected groundwater and surface water data to support and update the Draft Final RI/FS for the site.	PCE concentrations in monitoring wells were consistent with the 2003 data. PCE concentrations in private wells sampled beyond the end of the public water supply line were all non-detect.	Parametrix 2009
2007	EPA Emergency Response Team (ERT)	Collected indoor and ambient air samples in and around private residences and commercial buildings at OU1, the Breen Property, and other locations at the Site.	Low levels of PCE were detected in the majority of residential, commercial, and ambient samples. Based on limited data, indoor and ambient air quality sampling results did not indicate elevated risk from vapor intrusion of PCE.	EPA 2008
2010	EPA Region 10 Office of Environmental Assessment	Measured water levels and assessed the condition and accessibility of most of the monitoring wells at the Hamilton/Labree Roads Superfund Site.	The assessment found that many wells are no longer accessible.	CDM Smith 2011b

Acronyms:
WDOH - Washington State Department of Health
PCE - tetrachloroethene
SAIC - Science Applications International Corporation
µg/L- micrograms per liter
TEG - Transglobal Environmental Geosciences Northwest, Inc
DNAPL - dense non-aqueous phase liquid
EPA - U.S. Environmental Protection Agency
NPL - National Priorities List
AOC - Administrative Order on Consent
RI/FS - Remedial Investigation/Feasibility Study
EE/CA – engineering evaluation/cost analysis
ERT – EPA Emergency Response Team (ERT)

Table 5-1 Surface Water Monitoring Station Data

Surface Water Monitoring Station	Date Monitored	Creek Gauge Elevation (feet)[1]	Creek Height (feet)[2]	Surface Water Elevation (feet)	Estimated Groundwater Elevation[3]	Elevation Head Difference (feet)[4]	Flow Rate (cfm)	Flow Rate (gpm)	Channel Depth (feet)[5]
SW-5	9/5/02	209.08	4.32	204.76	201.00	-3.76	0.0	0	2.46
	11/21/02	209.08	4.50	204.58	202.20	-2.38	1.2	<50	2.22
SW-6	9/5/02	209.88	5.13	204.75	201.11	-3.64	0.0	0	2.40
	11/21/02	209.88	5.19	204.69	202.30	-2.39	0.6-4.2	<50	2.60
SW-7	9/5/02	208.77	3.98	204.79	200.90	-3.89	6.0	<50	4.11
	11/21/02	208.77	4.18	204.59	202.18	-2.41	0.0	0	3.91
SW-8	9/5/02	205.00	6.18	198.82	196.42	-2.40	65.0	500	0.37
	11/22/02	205.00	5.88	199.12	198.00	-1.12	190.0	1,400	0.91
SW-9	9/5/02	204.49	7.46	197.03	195.00	-2.03	116.0	870	0.43
	11/22/02	204.49	7.16	197.33	196.00	-1.33	170.0	1,250	0.70
SW-10	9/5/02	196.14	4.13	192.01	192.00	-0.01	0.0	0	2.09
	11/21/02	196.14	4.04	192.10	193.00	0.90	6.0	<50	2.20

Source: Farallon (2003)

Notes:

1. Surveyed elevation of top of stream gauge to vertical datum NGVD 29, in feet above mean sea level
2. Height measured in feet from top of stream gauge to water surface
3. Groundwater elevation estimated from corresponding well or groundwater contour
4. A head difference is calculated by subtracting the groundwater elevation from the surface water elevation
5. Channel depth in feet, measured in center of channel from water surface to bottom of channel

cfm - cubic feet per minute

gpm - gallons per minute

Table 5-2 OU1 Contaminant Mass, Volume, and Surface Area

Concentration Area	Mass Groundwater (kg)	Mass (kg) Soil	Total (Mass kg)	Total Plume Volume (cubic yards)	Surface Area (square feet)
Berwick Creek Sediment, >0.468 mg/kg		163	163	1360	7348
Subsurface Soil >1 mg/kg	221	245	421	21981	38,805
Subsurface Soil >10 mg/kg	92	171	250	3599	8,741
Subsurface Soil >38 mg/kg	35	102	137	1035	3769
>20,000 µg/L	238	268	506	42,235	33,342
>10,000 µg/L	275	291	566	62,876	45,575
>4,000 µg/L	289	308	597	87,840	64,162
>3,000 µg/L	307	311	618	105,000	83,619
>2,000 µg/L	315	318	633	136,000	91,942
>1,500 µg/L	320	320	640	150,000	100,695
>1,000 µg/L	325	325	650	177,000	120,253
>500 µg/L	337	329	661	336,000	209,119
>100 µg/L	343	336	679	485,000	305,979
> 5 µg/L (MCL)	349	337	686	639,000	339,260

Notes:
Average Bulk Soil Density: 1.7 gm/cc
Total Porosity: 0.36
> - greater than
kg -kilograms
MCL - maximum contaminant level
mg/kg - milligrams per kilogram
µg/L - micrograms per liter

Table 7-1 Human Health Risk Assessment Summary

Table 7-1a: Soil Risk (Indoor commercial/industrial worker scenario)-HRIA

			Noncancer							Cancer						
			Dose (mg/kg-day)			HQ				Dose (mg/kg-day)			Cancer Risks			Total
Area	Timeframe	Chemical	Ingestion	Inhalation	Dermal	Ingestion	Inhalation	Dermal	HI	Ingestion	Inhalation	Dermal	Ingestion	Inhalation	Dermal	Cancer
HRIA	Current/	Tetrachloroethylene	1.8E-04	3.3E-02	-	0.030	0.829	-	0.86	6.4E-05	1.2E+01	-	1.4E-07	3.1E-06	-	3.2E-06
Soil	Future	Trichloroethylene	2.5E-08	4.8E-06	-	0.000	0.002	-	0.00	8.7E-09	1.7E-03	-	4.0E-10	7.0E-09	-	7.4E-09
					Total HI	0.030	0.831	-				Total	1.4E-07	3.1E-06	-	
								Total HI	**0.86**						**Total Cancer**	**3.2E-06**

Table 7-1b: Groundwater Risk (Indoor commercial/industrial worker scenario)

			Dose (mg/kg-day)			HQ				Dose (mg/kg-day)			Cancer Risks			Total
Area	Timeframe	Chemical	Ingestion	Inhalation*	Dermal	Ingestion	Inhalation	Dermal	HI	Ingestion	Inhalation	Dermal	Ingestion	Inhalation	Dermal	Cancer
HRIA	Current/	cis-1,2-DCE	2.6E-03	3.0E-02	6.6E-04	1.300	-	0.3	1.63	9.3E-04	1.1E+01	2.4E-04	-	-	-	-
Groundwater	Future	Methylene Chloride	9.6E-03	1.1E-01	7.2E-04	1.590	0.186	0.1	1.90	3.4E-03	4.0E+01	2.6E-04	6.8E-06	4.0E-07	5.1E-07	7.8E-06
		Tetrachloroethylene	5.5E-01	6.4E+00	6.5E-01	91.200	160.000	109.0	360.20	2.0E-01	2.3E+03	2.3E-01	4.1E-04	5.9E-04	4.9E-04	1.5E-03
		Trichloroethylene	2.6E-03	3.1E-02	8.8E-04	5.260	15.400	1.8	22.41	9.4E-04	1.1E+01	3.1E-04	4.3E-05	4.5E-05	1.4E-05	1.0E-04
					Total HI	99.350	175.586	111.2				Total	4.6E-04	6.4E-04	5.0E-04	
								Total HI	**386.14**						**Total Cancer**	**1.6E-03**

*Includes Showering

Table 7-1c: Soil Risk [Composite (Indoor/outdoor commercial and industrial) Worker Scenario]-HRIA

			Noncancer							Cancer						
			Dose (mg/kg-day)			HQ				Dose (mg/kg-day)			Cancer Risks			Total
Area	Timeframe	Chemical	Ingestion	Inhalation	Dermal	Ingestion	Inhalation	Dermal	HI	Ingestion	Inhalation	Dermal	Ingestion	Inhalation	Dermal	Cancer
HRIA	Current/	Tetrachloroethylene	3.6E-04	3.3E-02	-	0.060	0.829	-	0.89	1.3E-04	1.2E+01	-	2.7E-07	3.1E-06	-	3.3E-06
Soil	Future	Trichloroethylene	4.9E-08	4.8E-06	-	0.000	0.002	-	0.00	1.8E-08	1.7E-03	-	8.0E-10	7.0E-09	-	7.8E-09
					Total HI	0.060	0.831	-				Total	2.7E-07	3.1E-06	-	
								Total HI	**0.89**						**Total Cancer**	**3.4E-06**

Table 7-1d: Soil Risk (Outdoor construction worker scenario)-HRIA

			Noncancer							Cancer						
			Dose (mg/kg-day)			HQ				Dose (mg/kg-day)			Cancer Risks			Total
Area	Timeframe	Chemical	Ingestion	Inhalation	Dermal	Ingestion	Inhalation	Dermal	HI	Ingestion	Inhalation	Dermal	Ingestion	Inhalation	Dermal	Cancer
HRIA	Current/	Tetrachloroethylene	6.5E-04	3.0E-02	-	0.108	0.746	-	0.85	2.3E-04	1.1E+01	-	4.9E-07	2.8E-06	-	3.3E-06
Soil	Future	Trichloroethylene	8.8E-08	4.3E-06	-	0.000	0.002	-	0.00	3.2E-08	1.5E-03	-	1.5E-10	6.3E-09	-	6.5E-09
					Total HI	0.108	0.748	-				Total	4.9E-07	2.8E-06	-	
								Total HI	**0.86**						**Total Cancer**	**3.3E-06**

Table 7-1e: Groundwater Risk (Outdoor Construction worker scenario)

			Noncancer Dose (mg/kg-day)			Cancer Dose (mg/kg-day)			Noncancer Risk				Cancer Risk			
Chemical	Timeframe	Concentration (ug/L)	Ingestion	Inhalation	Dermal	Ingestion	Inhalation	Dermal	Ingestion HQ	Inhalation HQ	Dermal HQ	Total HI	Ingestion Risk	Inhalation Risk	Dermal Risk	Total Cancer Risk
cis-1,2-DCE		266	2.1E-04	2.4E-03	9.6E-06	3.0E-06	3.5E-02	1.4E-07	0.1	-	0.0	0.11	-	-	-	-
Methylene Chloride	Future	978	7.7E-04	8.9E-03	1.1E-05	1.1E-05	1.3E-01	1.5E-07	0.1	0.0	0.0	0.14	2.2E-08	1.3E-09	3.0E-10	2.4E-08
Tetrachloroethylene		55894	4.4E-02	5.1E-01	9.6E-03	6.3E-04	7.3E+00	1.4E-04	7.3	12.8	1.6	21.70	1.3E-06	1.9E-06	2.9E-07	3.5E-06
Trichloroethylene		269	2.1E-04	2.5E-03	1.3E-05	3.0E-06	3.5E-02	1.8E-07	0.4	1.2	0.0	1.68	1.4E-07	1.4E-07	8.4E-09	2.9E-07
								TOTAL	7.9	14.0	1.6	23.60	1.5E-06	2.0E-06	3.0E-07	3.8E-06

Table 7-1 Human Health Risk Assessment Summary (continued)

Table 7-1f: Soil and Sediment Risk (Recreational Scenarios)-Berwick Creek

Area	Timeframe	Chemical	Noncancer Dose (mg/kg-day)						Noncancer HQ						Total HI	Cancer Dose (mg/kg-day)						Cancer Risks						Total Cancer Risk
			Ingestion		Inhalation		Dermal		Ingestion		Inhalation		Dermal			Ingestion		Inhalation		Dermal		Ingestion		Inhalation		Dermal		
			Adult	Child	Adult	Child	Adult	Child	Adult	Child	Adult	Child	Adult	Child		Adult	Child	Adult	Child	Adult	Child	Adult	Child	Adult	Child	Adult	Child	
Berwick Cr Soil/Sediment (Near source Area)	Current/ Future	Tetrachloroethylene	3.0E-03	1.0E-02	1.3E-02	1.3E-02	-	-	1.9E-01	1.7E+00	3.2E-01	3.2E-01	-	-	**8.2E-01**	1.3E-03	-	5.5E+00	-	2.3E-01	-	2.7E-06	-	1.4E-06	-	-	-	**4.1E-06**
Berwick Cr Soil/Sediment (Downgradient Area)	Current/ Future	Tetrachloroethylene	1.1E-08	1.0E-07	1.3E-07	1.3E-07	-	-	1.9E-06	1.7E-05	3.2E-06	3.2E-06	-	-	**8.2E-06**	1.9E-06	-	5.5E-05	-	-	-	2.7E-11	-	1.4E-11	-	-	-	**4.1E-11**

Table 7-1g: Surface water Risk (Recreational Scenario)-Berwick Creek

Area	Timeframe	Chemical	Noncancer Dose (mg/kg-day)						Noncancer HQ				Adjusted HQs		Total HI		Total Adjusted HI	Cancer Dose (mg/kg-day)		Cancer Risks		Total Cancer Risk
			Ingestion		Dermal		Adjusted Dose		Ingestion		Dermal											
Berwick Cr Surface Water	Current/ Future		Adult	Child	Adult	Child	Ingestion	Dermal	Adult	Child	Adult	Child	Ingestion	Dermal	Adult	Child		Ingestion	Dermal	Ingestion	Dermal	
		cis-1,2-DCE	2.5E-08	1.2E-07	1.7E-07	2.9E-07	4.3E-08	1.9E-07	1.2E-05	5.8E-05	8.4E-05	1.4E-04	2.1E-05	9.6E-05	9.7E-05	2.0E-04	0.00	1.8E-08	8.2E-08	-	-	-
		Tetrachloroethylene	1.8E-06	8.3E-06	5.6E-05	9.6E-05	3.1E-06	6.4E-05	3.0E-04	1.4E-03	9.4E-03	1.6E-02	5.2E-04	1.1E-02	9.6E-03	1.7E-02	0.01	1.3E-06	2.8E-05	2.8E-09	5.8E-08	6.0E-08
		Trichloroethylene	3.2E-08	1.5E-07	2.8E-07	4.7E-07	5.5E-08	3.2E-07	6.3E-05	3.0E-04	5.5E-04	9.5E-04	1.1E-04	6.3E-04	6.2E-04	1.2E-03	0.00	8.8E-08	3.9E-07	4.0E-09	1.8E-08	2.2E-08
														Total HI =	1.0E-02	1.9E-02	0.01	Total Cancer Risk =		6.8E-09	7.6E-08	8.3E-08

Table 7-1 Human Health Risk Assessment Summary (continued)

Table 7-1h: Trench Worker Scenario-HRIA

Area	Timeframe	Chemical	GW Conc (µg/L)	Noncancer Dose (mg/kg-day)	Noncancer HQ	Cancer Dose (mg/kg-day)	Cancer Cancer
United Rentals:	Current/	cis-1,2-DCE	163	1.2E-01	-	1.8E-03	-
North Area	Future	Methylene Chloride	613	4.9E-01	0.81	7.0E-03	7.0E-11
		Tetrachloroethylene	24447	1.4E+01	355.00	2.0E-01	5.0E-08
		Trichloroethylene	311	2.0E-01	101.25	2.9E-03	1.0E-08
				Total	**457.06**		**6.0E-08**
United Rentals:	Current/	cis-1,2-DCE	240	1.8E-01	-	2.6E-03	-
Core Area	Future	Tetrachloroethylene	13115	7.6E+00	190.00	1.1E-01	3.0E-08
		Trichloroethylene	816.5	5.3E-01	265.83	7.6E-03	3.0E-08
				Total	**455.83**		**6.0E-08**
United Rentals:	Current/	cis-1,2-DCE	-	-	-	-	
Fringe Area	Future	Tetrachloroethylene	387	2.3E-01	6.00	3.2E-03	8.0E-10
		Trichloroethylene	4.5	2.9E-03	1.47	4.2E-05	2.0E-10
				Total	**7.47**		**1.0E-09**

Table 7-1i: Indoor Air Scenarios at HRIA (United Rentals)

Area	Timeframe	Exposure Assumption	Chemical	Indoor Air Conc ($\mu g/m^3$)	Noncancer Dose (mg/kg-day)	Noncancer HQ	Cancer Dose (mg/kg-day)	Cancer Cancer
United Rentals:	Current/	EPA	cis-1,2-DCE	-	-	-	-	-
Main Bldg	Future		Methylene Chloride	0.38	8.7E-05	0.00	3.1E-02	3.1E-10
			Tetrachloroethylene	0.21	4.8E-05	0.00	1.7E-02	4.5E-09
			Trichloroethylene	0.29	6.6E-05	0.01	2.4E-02	9.7E-08
					Total	**0.01**		**1.0E-07**
United Rentals:	Current/	EPA	cis-1,2-DCE	-	-	-	-	-
Paint Shop	Future		Methylene Chloride	0.23	5.3E-05	0.00	1.9E-02	1.9E-10
			Tetrachloroethylene	0.14	3.2E-05	0.00	1.1E-02	3.0E-09
			Trichloroethylene	0.077	1.8E-05	0.01	6.3E-03	2.6E-08
					Total	**0.01**		**2.9E-08**

Table 7-1j: Outdoor Air Risk HRIA (Composite [Indoor/outdoor] Worker Scenario)

Area	Timeframe	Chemical	Outdoor Air Conc ($\mu g/m^3$)	Noncancer Dose (mg/kg-day)	Noncancer HQ	Cancer Dose (mg/kg-day)	Cancer Cancer
HRIA	Current/	cis-1,2-DCE	-	-	-	-	-
	Future	Methylene Chloride	0.2	4.8E-05	0.00	1.6E-02	1.6E-10
		Tetrachloroethylene	0.14	2.6E-07	0.00	1.1E-02	3.0E-09
		Trichloroethylene	0.099	4.1E-06	0.01	8.1E-03	3.3E-08
				Total	**0.01**		**3.6E-08**

Notes:
µg/L - micrograms per liter
$\mu g/m^3$ - micrograms per cubic meter
mg/kg-day - milligrams per kilogram per day
HQ - hazard quotient
HI - hazard index

Table 7-2a Summary of OU1 Chemicals of Potential Concern and Medium-Specific Exposure Point Concentrations

This table presents the exposure point concentrations for each of the chemicals of potential concern (COPC) detected in OU1 (i.e., the concentration that will be used to estimate the exposure and risk from each COPC) in groundwater, soil, surface water, sediment, and air. The table includes the range of concentrations detected for each COPC, as well as the frequency of detection (i.e., the number of times the chemical was detected in the samples collected within OU1), the EPC, and how the EPC was derived.

Scenario Timeframe	Exposure Medium	Exposure Points	Chemical of Potential Concern (COPC)	Concentration Detected Min	Concentration Detected Max	Units	FOD	EPC*	EPC Units	Statistical Measure
Groundwater										
Future	Groundwater	Tap Water (Drinking, Showering, Direct Contact)	cis-1,2-DCE	0.026 J	1,570 J (MW-604)	µg/L	36 / 257	266	µg/L	95% UCL
Future	Groundwater	Tap Water (Drinking, Showering, Direct Contact)	Methylene Chloride	12 B	5,000 (MW-R1)	µg/L	10 / 238	978	µg/L	95% UCL
Future	Groundwater	Tap Water (Drinking, Showering, Direct Contact)	PCE	1	2,720,000 (MW-602)	µg/L	362 / 407	55894	µg/L	95% UCL
Future	Groundwater	Tap Water (Drinking, Showering, Direct Contact)	TCE	0.87 J	1,200 (AB-8)	µg/L	74 / 257	269	µg/L	95% UCL
Future	Groundwater	Tap Water (Drinking, Showering, Direct Contact)	Gasoline#	4,200	4,200 (GP-1)	µg/L	1 / 2	N/A	µg/L	N/A

Table 7-2a Summary of OU1 Chemicals of Potential Concern and Medium-Specific Exposure Point Concentrations (continued)

Scenario Timeframe	Exposure Medium	Exposure Points	Chemical of Potential Concern (COPC)	Concentration Detected Min	Concentration Detected Max	Units	FOD	EPC*	EPC Units	Statistical Measure
Soil										
Current/Future	Soil	Ingestion, Inhalation	PCE	0.003 J	5,220 (SB-409)	mg/kg	369 / 641	366.98	mg/kg	95% UCL
Current/Future	Soil	Ingestion, Inhalation	TCE	0.19	0.19 (AB-4)	mg/kg	1/92	0.05	mg/kg	95% UCL
Surface Water										
Current/Future	Surface Water	Direct Contact, Ingestion	cis-1,2-DCE	0.3	4 (SW-3)	µg/L	11 / 30	0.28	µg/L	95% UCL
Current/Future	Surface Water	Direct Contact, Ingestion	PCE	0.21	40 (SW-5)	µg/L	21 / 30	20.29	µg/L	95% UCL
Sediment										
Current/Future	Sediment	Direct Contact, Ingestion, Inhalation	PCE	0.0142	5,220 (SB-409)	mg/kg	13 / 19	3798.49	mg/kg	95% UCL
Air										
Current/Future	Indoor Air	Inhalation (UR Main Bldg)	Methylene Chloride	-	0.38	$\mu g/m^3$	1/1	0.38	$\mu g/m^3$	Max. Conc.
Current/Future	Indoor Air	Inhalation (UR Main Bldg)	PCE	-	0.21	$\mu g/m^3$	1/1	0.21	$\mu g/m^3$	Max. Conc.
Current/Future	Indoor Air	Inhalation (UR Main Bldg)	TCE	-	0.29	$\mu g/m^3$	1/1	0.29	$\mu g/m^3$	Max. Conc.
Current/Future	Indoor Air	Inhalation (UR Paint Shop)	Methylene Chloride	-	0.23	$\mu g/m^3$	1/1	0.23	$\mu g/m^3$	Max. Conc.
Current/Future	Indoor Air	Inhalation (UR Paint Shop)	PCE	-	0.14	$\mu g/m^3$	1/1	0.14	$\mu g/m^3$	Max. Conc.
Current/Future	Indoor Air	Inhalation (UR Paint Shop)	TCE	-	0.077	$\mu g/m^3$	1/1	0.077	$\mu g/m^3$	Max. Conc.

Table 7-2a Summary of OU1 Chemicals of Potential Concern and Medium-Specific Exposure Point Concentrations (continued)

Scenario Timeframe	Exposure Medium	Exposure Points	Chemical of Potential Concern (COPC)	Concentration Detected Min	Concentration Detected Max	Units	FOD	EPC*	EPC Units	Statistical Measure
Current/Future	Outdoor Air	Inhalation	Methylene Chloride	-	0.2	$\mu g/m^3$	1/1	0.2	$\mu g/m^3$	Max. Conc.
Current/Future	Outdoor Air	Inhalation	PCE	-	0.14	$\mu g/m^3$	1/1	0.14	$\mu g/m^3$	Max. Conc.
Current/Future	Outdoor Air	Inhalation	TCE	-	0.099	$\mu g/m^3$	1/1	0.099	$\mu g/m^3$	Max. Conc.

Notes:

* EPCs for Groundwater were calculated per the following: If the COPC in a well had 10 or more data points, an average concentration was calculated for that COPC in that well using data reported as detected , thus providing a single value by COPC and by well for use in EPC calculations. If a COPC in a well had less than 10 data points, the maximum detected value was used for that COPC in that well. If no detections were reported for a COPC in a specific well, the highest detection limit for that COPC was used. To determine the EPC for each COPC to be used, the 95% UCL of the concentrations for the group of wells in OU1 was calculated.

* EPCs for Soil: Available data for soils were also grouped for OU1, and used to estimate 95% UCLs for exposure to soil via dermal contact and ingestion.

* EPCs for Surface Water: The EPCs for surface water in Berwick Creek were modeled based on groups of surface water data. EPCs were calculated using a 95% UCL on available data.

* EPC for Sediment: No surficial sediment data were collected from Berwick Creek. However, URS in 2004 collected sediment/soil cores (0 – 1; 1-3; 2-3 feet) from the Berwick Creek bed as part of its characterization of a possible source area in OU1. These sediment/soil data were used as a conservative surrogate for surface sediments. Exposure concentrations were calculated using a 95% UCL on available data.

* EPCs for Air: For indoor air exposure pathways, the maximum measured indoor air data were used for EPCs for each building. Outdoor air EPCs were based on single or maximum ambient air concentrations.

Gasoline was detected in one of two samples which exceeded the risk screening benchmark. Because gasoline and other petroleum hydrocarbons have not been widely examined in OU1, including no analyses in OU1 soils, they were not evaluated further in the risk assessment. However, they will be evaluated further in the future.

Table 7-2a Summary of OU1 Chemicals of Potential Concern and Medium-Specific Exposure Point Concentrations (continued)

Key:

µg/L - micrograms per liter
µg/m^3 - micrograms per cubic meter
95% UCL - 95% Upper Confidence Limit
B - denotes the analyte indicated was also found in the method blank samples
cis-1,2-DCE - cis-1,2-dichloroethene
COPC - Chemical of Potential Concern
EPC - exposure point concentration
FOD - frequency of Detection
J - denotes analyte was positively identified and the value is an estimated concentration
Max - maximum concentration
mg/kg - milligrams per kilogram
Min - minimum concentration
PCE - tetrachloroethene
TCE - trichloroethene

Table 7-2b Groundwater to Trench Air in Three OU1 Subareas

Table 7-2b presents the chemicals of potential concern and exposure point concentrations in trench air within three OU1 subareas.

Scenario Timeframe	Exposure Medium	Exposure Points	Chemical of Potential Concern (COPC)	GW Concentration (µg/L)	Trench Air EPC*	EPC Units	Statistical Measure
Current/Future	Groundwater to Trench Air	Vapor Inhalation (Subarea 1)	cis-1,2-DCE	163	2.1	mg/m^3	Box Model
Current/Future	Groundwater to Trench Air	Vapor Inhalation (Subarea 1)	Methylene Chloride	613	8.3	mg/m^3	Box Model
Current/Future	Groundwater to Trench Air	Vapor Inhalation (Subarea 1)	PCE	24447	242	mg/m^3	Box Model
Current/Future	Groundwater to Trench Air	Vapor Inhalation (Subarea 1)	TCE	311	3.5	mg/m^3	Box Model
Current/Future	Groundwater to Trench Air	Vapor Inhalation (Subarea 2)	cis-1,2-DCE	240	3.1	mg/m^3	Box Model
Current/Future	Groundwater to Trench Air	Vapor Inhalation (Subarea 2)	PCE	13115	130	mg/m^3	Box Model
Current/Future	Groundwater to Trench Air	Vapor Inhalation (Subarea 2)	TCE	817	9.1	mg/m^3	Box Model
Current/Future	Groundwater to Trench Air	Vapor Inhalation (Subarea 3)	PCE	387	3.8	mg/m^3	Box Model
Current/Future	Groundwater to Trench Air	Vapor Inhalation (Subarea 3)	TCE	4.5	0.05	mg/m^3	Box Model

Table 7-2b Groundwater to Trench Air in Three OU1 Subareas (continued)

Notes

* EPCs for Trench Air: The Air EPCs are based on groundwater concentrations as stipulated in the "Box Model" approach (Dawson, 1999 and Andelman, 1985). The concentration of chemical in trench air ($\mu g/m^3$) is calculated by multiplying the groundwater concentration ($\mu g/L$) by the VF (L/m^3).

Key:

µg/L - micrograms per liter
cis-1,2-DCE - cis-1,2-dichloroethene
COPC - Chemical of Potential Concern
EPC - exposure point concentration
Max - maximum concentration
mg/m^3 - milligrams per cubic meter
Min -minimum concentration
PCE - tetrachloroethene
TCE - trichloroethene

Table 7-3: Human Health Potentially Complete Exposure Pathways

Scenario Timeframe	Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route
OU1 Groundwater, Soil and Air						
Current/Future	Groundwater	Indoor Air	Vapor Inhalation	Commercial/Industrial Worker	Adult	Inhalation
Current/Future	Groundwater	Outdoor Air	Incidental Inhalation of Vapor	Commercial/ Industrial Worker/ Recreational/ Trespasser	Adult	Inhalation
Current/Future	Groundwater	Outdoor Air	Inhalation of Vapor	Outdoor Construction Worker	Adult	Inhalation
Current/Future	Groundwater	Outdoor Air	Incidental Inhalation of Vapor	Trespasser	Adult	Inhalation
Future	Groundwater	Groundwater	Tap water-drinking	Commercial/Industrial Worker	Adult	Ingestion
Future	Groundwater	Groundwater	Tap water-showering	Commercial/Industrial Worker	Adult	Ingestion
Future	Groundwater	Groundwater	Tap water-drinking	Outdoor Construction worker	Adult	Ingestion
Current/Future	Soil	Soil	Incidental Ingestion	Commercial/Industrial Worker	Adult	Ingestion
Current/Future	Soil	Soil	Incidental Inhalation of Vapor	Commercial/Industrial Worker	Adult	Inhalation
Current/Future	Soil	Soil	Incidental Ingestion	Outdoor Construction Worker	Adult	Ingestion
Current/Future	Soil	Soil	Incidental Inhalation of Vapor	Outdoor Construction Worker	Adult	Inhalation
Current/Future	Soil	Soil	Incidental Ingestion	Trespasser	Adult	Ingestion
Current/Future	Soil	Soil	Incidental Inhalation of Vapor	Trespasser	Adult	Inhalation
Current/Future	Soil	Outdoor Air	Incidental Inhalation of Vapor	Commercial/Industrial Worker	Adult	Inhalation
Current/Future	Soil	Outdoor Air	Inhalation of Vapor	Outdoor Construction Worker/Utility Trench Worker	Adult	Inhalation
Current/Future	Soil	Outdoor Air	Incidental Inhalation of Vapor	Trespasser	Adult	Inhalation
OU1 Berwick Creek Bed Sediment/Bank Surface Soil and Surface Water						
Current/Future	Creek Bed Sediment/Bank Surface Soil	Creek Bed Sediment/Bank Surface soil	Incidental Ingestion	Recreator	Child/Adult	Ingestion
Current/Future	Creek Bed Sediment/Bank Surface Soil	Creek Bed Sediment/Bank Surface soil	Incidental Inhalation	Recreator	Child/Adult	Inhalation
Current/Future	Creek Bed Sediment/Bank Surface Soil	Creek Bed Sediment/Bank Surface soil	Incidental Contact	Recreator	Child/Adult	Dermal
Current/Future	Surface Water	Surface Water	Incidental Contact	Recreator	Child/Adult	Ingestion
Current/Future	Surface Water	Surface Water	Incidental Ingestion	Recreator	Child/Adult	Dermal

Table 7-4 OU1 Cancer Toxicity Data Summary

This table provides carcinogenic risk information which is relevant to the human health contaminants of potential concern (COPCs) in sediment, soil and groundwater. At this time, slope factors are not available for the dermal route of exposure. Thus, the dermal slope factors used in the assessment have been extrapolated from oral values.

Pathway:	**Ingestion, Dermal**					
COPC	**Oral Cancer Slope Factor (CSF)**	**Absorbed Dermal CSF**	**Slope Factor Units**	**Weight of Evidence/ Cancer Guideline Description**	**Source**	**Date**
cis-1,2-DCE	-	-	-	-	-	-
Methylene Chloride	0.002	0.002	1/(mg/kg-d)	c	EPA RSL	2012
PCE	0.0021	0.0021	1/(mg/kg-d)	c	EPA RSL	2012
TCE	0.046	0.046	1/(mg/kg-d)	c	EPA RSL	2012

Pathway:	**Inhalation**				
COPC	**Inhalation Unit Risk (IUR)**	**IUR Units**	**Weight of Evidence/ Cancer Guideline Description**	**Source**	**Date**
cis-1,2-DCE	-	-	-	-	-
Methylene Chloride	0.00000001	$1/\mu g/m^3$	c	EPA RSL	2012
PCE	0.00000026	$1/\mu g/m^3$	c	EPA RSL	2012
TCE	0.0000041	$1/\mu g/m^3$	c	EPA RSL	2012

Key:

- No information available
$\mu s/m^3$ – micrograms per cubic meter
c - cancer value
cis-1,2-DCE - cis-1,2-dichloroethene
IUR - Inhalation Unit Risk. A plausible upper bound on the estimate of risk per unit of concentration per $\mu g/m^3$ air breathed
mg/kg-d - milligrams per kilogram per day
PCE - tetrachloroethene
RSL - EPA Regional Screening Levels
TCE - trichloroethene

Table 7-5 OU1 Non-Cancer Toxicity Data Summary

This table provides non-carcinogenic risk information which is relevant to the human health contaminants of potential concern (COPCs) in sediment, soil and groundwater.

Pathway:	**Ingestion, Dermal**								
COPC	**Chronic/ Subchronic**	**Oral RfD Value**	**Oral RfD Units**	**Absorbed Dermal RfD**	**Dermal RfD Units**	**Primary Target Organ**	**Combined Uncertainty/ Modifying Factors**	**Source**	**Date**
cis-1,2-DCE	Chronic	0.002	mg/kg-d	0.002	mg/kg-d	Kidney	3000	EPA RSL	2012
Methylene Chloride	Chronic	0.006	mg/kg-d	0.006	mg/kg-d	Liver	30	EPA RSL	2012
PCE	Chronic	0.006	mg/kg-d	0.006	mg/kg-d	Neurotoxicity	1000	EPA RSL	2012
TCE	Chronic	0.0005	mg/kg-d	0.0005	mg/kg-d	Fetal cardiac malformations	10	EPA RSL	2012
Construction Worker and Child Recreation Scenarios (1)									
cis-1,2-DCE	Chronic	0.002	mg/kg-d	0.002	mg/kg-d	Kidney	3000	EPA RSL	2012
Methylene Chloride	Chronic	0.006	mg/kg-d	0.006	mg/kg-d	Liver	30	EPA RSL	2012
PCE	Chronic	0.006	mg/kg-d	0.006	mg/kg-d	Neurotoxicity	1000	EPA RSL	2012
TCE	Chronic	0.0005	mg/kg-d	0.0005	mg/kg-d	Fetal cardiac malformations	10	EPA RSL	2012

Table 7-5 OU1 Non-Cancer Toxicity Data Summary (continued)

Pathway: Inhalation									
COC	**Chronic/ Subchronic**	**Inhalation RfC Value**	**Inhalation RfC Units**	**Extrapolated RfD**	**Units**	**Primary Target Organ**	**Combined Uncertainty/ Modifying Factors**	**Source**	**Date**
cis-1,2-DCE	-	-	-	-	-	-	-	-	-
Methylene Chloride	Chronic	0.6	mg/m^3	-	mg/kg-d	Liver	30	EPA RSL	2012
PCE	Chronic	0.04	mg/m^3	-	mg/kg-d	Neurotoxicity	1000	EPA RSL	2012
TCE	Chronic	0.002	mg/m^3	-	mg/kg-d	Fetal cardiac malformations	100	EPA RSL	2012
Construction Worker and Child Recreation Scenarios (1)									
cis-1,2-DCE	-	-	-	-	-	-	-	-	-
Methylene Chloride	Chronic	0.6	mg/m^3	-	mg/kg-d	Liver	30	EPA RSL	2012
PCE	Chronic	0.04	mg/m^3	-	mg/kg-d	Neurotoxicity	1000	EPA RSL	2012
TCE	Chronic	0.002	mg/m^3	-	mg/kg-d	Fetal cardiac malformations	100	EPA RSL	2012

Notes:

1. Subchronic values were used for the construction worker and child recreation scenarios where available, otherwise chronic values were used

Key:

cis-1,2-DCE - cis-1,2-dichloroethene
mg/kg-d - milligrams per kilogram per day
mg/m^3 - milligrams per cubic meter
PCE - tetrachloroethene
RfC - reference concentration
RfD - reference dose
RSL - EPA Regional Screening Levels
TCE - trichloroethene

Table 7-6 Hazard Quotients for Wildlife Receptors

			Oral		Inhalation		Exposure Concentration						Oral Dose (mg/kg-d)				Hazard Quotient			
																	Oral		Inhalation	
Receptor	Location	Chemical	NOAEL (mg/kg-d)	LOAEL (mg/kg-d)	NOAEL (mg/m^3)	LOAEL (mg/m^3)	Soil (mg/kg dry wt.)	Sediment (mg/kg dry wt.)	Surface Water (mg/L)	Air, burrow (mg/m^3)	Air, surface (mg/m^3)	Air, total (mg/m^3)	Soil	Sediment	Surface Water	Total Oral Dose	NOAEL	LOAEL	NOAEL	LOAEL
Bald eagle	HRIA	cis-1,2-Dichloroethene	45.2	-	-	-	ND	NA	0.00028	-	-	-	-	-	1.0E-05	1.0E-05	2.2E-07	-	-	-
		Tetrachloroethene	1.4	7	-	-	367	3798	0.0203	-	-	-	2.2E-01	2.3E+00	7.3E-04	1.3E+00	0.9	0.2	-	-
		Trichloroethene	0.7	7	-	-	0.046	NA	0.00036	-	-	-	2.8E-05	-	1.3E-05	2.7E-05	3.8E-05	3.8E-06	-	-
	Breen Property	cis-1,2-Dichloroethene	45.2	-	-	-	8.28	NA	0.00028	-	-	-	5.0E-03	-	1.0E-05	2.5E-03	5.5E-05	-	-	-
		Tetrachloroethene	1.4	7	-	-	49.6	3798	0.0203	-	-	-	3.0E-02	2.3E+00	7.3E-04	1.2E+00	0.8	0.2	-	-
		Trichloroethene	0.7	7	-	-	11.5	NA	0.00036	-	-	-	6.9E-03	-	1.3E-05	3.5E-03	5.0E-03	5.0E-04	-	-
	Downgradient: Berwick Cr[1]	cis-1,2-Dichloroethene	45.2	-	-	-	ND	NA	0.00028	-	-	-	-	-	1.0E-05	1.0E-05	2.2E-07	-	-	-
		Tetrachloroethene	1.4	7	-	-	1.3	0.0381	0.0203	-	-	-	7.8E-04	2.3E-05	7.3E-04	1.1E-03	0.001	0.0002	-	-
		Trichloroethene	0.7	7	-	-	ND	NA	0.00036	-	-	-	-	-	1.3E-05	1.3E-05	1.9E-05	1.9E-06	-	-
	Downgradient: Dillenbaugh Cr[1]	cis-1,2-Dichloroethene	45.2	-	-	-	ND	NA	ND	-	-	-	-	-	-	-	-	-	-	-
		Tetrachloroethene	1.4	7	-	-	1.3	0.0381	0.0036	-	-	-	7.8E-04	2.3E-05	1.3E-04	5.3E-04	3.8E-04	0.0001	-	-
		Trichloroethene	0.7	7	-	-	ND	NA	ND	-	-	-	-	-	-	-	-	-	-	-
American robin	HRIA	cis-1,2-Dichloroethene	45.2	-	-	-	ND	NA	0.00028	-	-	-	-	-	3.9E-05	3.9E-05	8.7E-07	-	-	-
		Tetrachloroethene	1.4	7	-	-	367	3798	0.0203	-	-	-	7.9E+00	8.1E+01	2.8E-03	1.5E+01	11	2	-	-
		Trichloroethene	0.7	7	-	-	0.046	NA	0.00036	-	-	-	9.8E-04	-	5.0E-05	9.4E-04	1.3E-03	1.3E-04	-	-
	Breen Property	cis-1,2-Dichloroethene	45.2	-	-	-	8.28	NA	0.00028	-	-	-	1.8E-01	-	3.9E-05	1.6E-01	3.5E-03	-	-	-
		Tetrachloroethene	1.4	7	-	-	49.6	3798	0.0203	-	-	-	1.1E+00	8.1E+01	2.8E-03	9.1E+00	6	1.3	-	-
		Trichloroethene	0.7	7	-	-	11.5	NA	0.00036	-	-	-	2.5E-01	-	5.0E-05	2.2E-01	0.3	3.2E-02	-	-
	Downgradient: Berwick Cr[1]	cis-1,2-Dichloroethene	45.2	-	-	-	ND	NA	0.00028	-	-	-	-	-	3.9E-05	3.9E-05	8.7E-07	-	-	-
		Tetrachloroethene	1.4	7	-	-	1.3	0.0381	0.0203	-	-	-	2.8E-02	8.2E-04	2.8E-03	2.8E-02	0.02	0.004	-	-
		Trichloroethene	0.7	7	-	-	ND	NA	0.00036	-	-	-	-	-	5.0E-05	5.0E-05	7.2E-05	7.2E-06	-	-
	Downgradient: Dillenbaugh Cr[1]	cis-1,2-Dichloroethene	45.2	-	-	-	ND	NA	ND	-	-	-	-	-	-	-	-	-	-	-
		Tetrachloroethene	1.4	7	-	-	1.3	0.0381	0.0036	-	-	-	2.8E-02	8.2E-04	5.0E-04	2.6E-02	0.02	0.004	-	-
		Trichloroethene	0.7	7	-	-	ND	NA	ND	-	-	-	-	-	-	-	-	-	-	-
Mallard duck	HRIA	cis-1,2-Dichloroethene	45.2	-	-	-	ND	NA	0.00028	-	-	-	-	-	1.6E-05	1.6E-05	3.5E-07	-	-	-
		Tetrachloroethene	1.4	7	-	-	367	3798	0.0203	-	-	-	4.1E-01	4.3E+00	1.2E-03	3.9E+00	3	0.6	-	-
		Trichloroethene	0.7	7	-	-	0.046	NA	0.00036	-	-	-	5.2E-05	-	2.0E-05	2.6E-05	3.7E-05	3.7E-06	-	-
	Breen Property	cis-1,2-Dichloroethene	45.2	-	-	-	8.28	NA	0.00028	-	-	-	9.3E-03	-	1.6E-05	9.4E-04	0.0000	-	-	-
		Tetrachloroethene	1.4	7	-	-	49.6	3798	0.0203	-	-	-	5.6E-02	4.3E+00	1.2E-03	3.8E+00	3	0.5	-	-
		Trichloroethene	0.7	7	-	-	11.5	NA	0.00036	-	-	-	1.3E-02	-	2.0E-05	1.3E-03	0.002	0.0002	-	-
	Downgradient: Berwick Cr[1]	cis-1,2-Dichloroethene	45.2	-	-	-	ND	NA	0.00028	-	-	-	-	-	1.6E-05	1.6E-05	3.5E-07	-	-	-
		Tetrachloroethene	1.4	7	-	-	1.3	0.0381	0.0203	-	-	-	1.5E-03	4.3E-05	1.2E-03	1.3E-03	0.001	0.0002	-	-
		Trichloroethene	0.7	7	-	-	ND	NA	0.00036	-	-	-	-	-	2.0E-05	2.0E-05	2.9E-05	2.9E-06	-	-
	Downgradient: Dillenbaugh Cr[1]	cis-1,2-Dichloroethene	45.2	-	-	-	ND	NA	ND	-	-	-	-	-	-	-	-	-	-	-
		Tetrachloroethene	1.4	7	-	-	1.3	0.0381	0.0036	-	-	-	1.5E-03	4.3E-05	2.0E-04	3.9E-04	2.8E-04	0.0001	-	-
		Trichloroethene	0.7	7	-	-	ND	NA	ND	-	-	-	-	-	-	-	-	-	-	-

Table 7-6 Hazard Quotients for Wildlife Receptors

			Oral		Inhalation		Exposure Concentration						Oral Dose (mg/kg-d)				Hazard Quotient			
																	Oral		Inhalation	
Receptor	Location	Chemical	NOAEL (mg/kg-d)	LOAEL (mg/kg-d)	NOAEL (mg/m^3)	LOAEL (mg/m^3)	Soil (mg/kg dry wt.)	Sediment (mg/kg dry wt.)	Surface Water (mg/L)	Air, burrow (mg/m^3)	Air, surface (mg/m^3)	Air, total (mg/m^3)	Soil	Sediment	Surface Water	Total Oral Dose	NOAEL	LOAEL	NOAEL	LOAEL
Short-tailed shrew	HRIA	cis-1,2-Dichloroethene	52.1	-	793	-	ND	NA	0.00028	-	-	-	-	-	6.2E-05	6.2E-05	1.2E-06	-	-	-
		Tetrachloroethene	1.6	8.1	-	678	367	3798	0.0203	42742	0.15	34193	1.0E+00	1.1E+01	4.5E-03	2.0E+00	1.2	0.2	-	50
		Trichloroethene	0.8	8.1	403	806	0.046	NA	0.00036	5.2	0.000014	4.1	1.3E-04	-	8.0E-05	2.0E-04	2.4E-04	2.4E-05	1.0E-02	5.1E-03
	Breen Property	cis-1,2-Dichloroethene	52.1	-	793	-	8.28	NA	0.00028	1412	0.0045	1130	2.3E-02	-	6.2E-05	2.1E-02	4.1E-04	-	1.4	-
		Tetrachloroethene	1.6	8.1	-	678	49.6	3798	0.0203	5775	0.02	4620	1.4E-01	1.1E+01	4.5E-03	1.2E+00	0.7	0.1	-	6.8
		Trichloroethene	0.8	8.1	403	806	11.5	NA	0.00036	1302	0.0036	1041	3.3E-02	-	8.0E-05	3.3E-02	4.0E-02	4.0E-03	3	1.3
	Downgradient: Berwick Cr[1]	cis-1,2-Dichloroethene	52.1	-	793	-	ND	NA	0.00028	-	-	-	-	-	6.2E-05	6.2E-05	1.2E-06	-	-	-
		Tetrachloroethene	1.6	8.1	-	678	1.3	0.0381	0.0203	151	0.00052	121	3.7E-03	1.1E-04	4.5E-03	7.8E-03	0.005	0.001	-	0.2
		Trichloroethene	0.8	8.1	403	806	ND	NA	0.00036	-	-	-	-	-	8.0E-05	8.0E-05	1.0E-04	1.0E-05	-	-
	Downgradient: Dillenbaugh Cr[1]	cis-1,2-Dichloroethene	52.1	-	793	-	ND	NA	ND	-	-	-	-	-	-	-	-	-	-	-
		Tetrachloroethene	1.6	8.1	-	678	1.3	0.0381	0.0036	151	0.00052	121	3.7E-03	1.1E-04	8.0E-04	4.1E-03	0.003	0.001	-	0.2
		Trichloroethene	0.8	8.1	403	806	ND	NA	ND	-	-	-	-	-	-	-	-	-	-	-
Raccoon	HRIA	cis-1,2-Dichloroethene	12.1	-	793	-	ND	NA	0.00028	-	-	-	-	-	2.3E-05	2.3E-05	1.9E-06	-	-	-
		Tetrachloroethene	0.4	1.9	-	678	367	3798	0.0203	-	-	-	1.7E+00	1.8E+01	1.7E-03	1.6E+01	43	8.6	-	-
		Trichloroethene	0.2	1.9	403	806	0.046	NA	0.00036	-	-	-	2.1E-04	-	3.0E-05	5.1E-05	2.7E-04	2.7E-05	-	-
	Breen Property	cis-1,2-Dichloroethene	12.1	-	793	-	8.28	NA	0.00028	-	-	-	3.9E-02	-	2.3E-05	3.9E-03	3.2E-04	-	-	-
		Tetrachloroethene	0.4	1.9	-	678	49.6	3798	0.0203	-	-	-	2.3E-01	1.8E+01	1.7E-03	1.6E+01	43	8.5	-	-
		Trichloroethene	0.2	1.9	403	806	11.5	NA	0.00036	-	-	-	5.4E-02	-	3.0E-05	5.4E-03	2.9E-02	2.9E-03	-	-
	Downgradient: Berwick Cr[1]	cis-1,2-Dichloroethene	12.1	-	793	-	ND	NA	0.00028	-	-	-	-	-	2.3E-05	2.3E-05	1.9E-06	-	-	-
		Tetrachloroethene	0.4	1.9	-	678	1.3	0.0381	0.0203	-	-	-	6.1E-03	1.8E-04	1.7E-03	2.5E-03	0.007	0.0013	-	-
		Trichloroethene	0.2	1.9	403	806	ND	NA	0.00036	-	-	-	-	-	3.0E-05	3.0E-05	1.6E-04	1.6E-05	-	-
	Downgradient: Dillenbaugh Cr[1]	cis-1,2-Dichloroethene	12.1	-	793	-	ND	NA	ND	-	-	-	-	-	-	-	-	-	-	-
		Tetrachloroethene	0.4	1.9	-	678	1.3	0.0381	0.0036	-	-	-	6.1E-03	1.8E-04	3.0E-04	1.1E-03	0.003	0.0006	-	-
		Trichloroethene	0.2	1.9	403	806	ND	NA	ND	-	-	-	-	-	-	-	-	-	-	-
White-tailed deer	HRIA	cis-1,2-Dichloroethene	6.9	-	793	-	ND	NA	0.00028	-	-	-	-	-	1.8E-05	1.8E-05	2.7E-06	-	-	-
		Tetrachloroethene	0.2	1.1	-	678	367	3798	0.0203	-	-	-	2.5E-01	2.6E+00	1.3E-03	1.4E+00	6.6	1.3	-	-
		Trichloroethene	0.1	1.1	403	806	0.046	NA	0.00036	-	-	-	3.1E-05	-	2.4E-05	3.9E-05	3.7E-04	3.7E-05	-	-
	Breen Property	cis-1,2-Dichloroethene	6.9	-	793	-	8.28	NA	0.00028	-	-	-	5.6E-03	-	1.8E-05	2.8E-03	4.1E-04	-	-	-
		Tetrachloroethene	0.2	1.1	-	678	49.6	3798	0.0203	-	-	-	3.3E-02	2.6E+00	1.3E-03	1.3E+00	6.1	1.2	-	-
		Trichloroethene	0.1	1.1	403	806	11.5	NA	0.00036	-	-	-	7.8E-03	-	2.4E-05	3.9E-03	3.7E-02	3.7E-03	-	-
	Downgradient: Berwick Cr[1]	cis-1,2-Dichloroethene	6.9	-	793	-	ND	NA	0.00028	-	-	-	-	-	1.8E-05	1.8E-05	2.7E-06	-	-	-
		Tetrachloroethene	0.2	1.1	-	678	1.3	0.0381	0.0203	-	-	-	8.7E-04	2.6E-05	1.3E-03	1.8E-03	0.008	0.0017	-	-
		Trichloroethene	0.1	1.1	403	806	ND	NA	0.00036	-	-	-	-	-	2.4E-05	2.4E-05	2.2E-04	2.2E-05	-	-
	Downgradient: Dillenbaugh Cr[1]	cis-1,2-Dichloroethene	6.9	-	793	-	ND	NA	ND	-	-	-	-	-	-	-	-	-	-	-
		Tetrachloroethene	0.2	1.1	-	678	1.3	0.0381	0.0036	-	-	-	8.7E-04	2.6E-05	2.4E-04	6.9E-04	0.003	0.0006	-	-
		Trichloroethene	0.1	1.1	403	806	ND	NA	ND	-	-	-	-	-	-	-	-	-	-	-

Notes:
1) Downgradient wildlife HQs were calculated based on both Berwick and Dillenbaugh Creek surface water data (the same soil and sediment exposure concentrations were assumed for each)
Wildlife HQs greater than 1.0 are shaded
LOAEL - Lowest Observed Adverse Effect Level
NOAEL - No Observed Adverse Effect Level
mg/kg-d - milligrams per kiligram per day
mg/L - milligrams per liter
mg/m3 - milligrams per cubic meter
ND - not detected
NA - not analyzed

Table 7-7 Hazard Quotients for Terrestrial Plants

Location	Chemical	Oral		Concentration		HQs	
		ED_{50} (mg/kg)	ED_{50} (mg/L)	Soil (mg/kg dry wt.)	Groundwater (mg/L) [2]	Soil	Groundwater
HRIA	cis-1,2-Dichloroethene	1000 [1]	64	ND	0.27	-	0.004
	Tetrachloroethene	1000	12	367	55.89	0.4	4.7
	Trichloroethene	1000	31.7	0.046	0.27	0.00005	0.01
Breen Property	cis-1,2-Dichloroethene	1000 [1]	64	8.28	0.004	0.008	0.000
	Tetrachloroethene	1000	12	49.6	1.50	0.05	0.1
	Trichloroethene	1000	31.7	11.5	0.010	0.01	0.0003
Downgradient	cis-1,2-Dichloroethene	1000 [1]	64	ND	0.09	-	0.001
	Tetrachloroethene	1000	12	1.3	2.70	0.001	0.2
	Trichloroethene	1000	31.7	ND	0.17	-	0.005

1) PCE and TCE data were used as a surrogate for 1,2-DCE
2) Groundwater data are the 95% UCLs from Table 2-7a in the Baseline Risk Assessment Report (BLRA) (CDM Smith 2011a) and the maximum 95% UCL from all wells for Table 2-7b in the BLRA (CDM Smith 2011a)

Terrestrial plant HQs greater than 1.0 are shaded
mg/L - milligrams per liter
mg/kg -milligrams per kilogram
ND - not detected

Table 10-1 Criteria Priorities

Group	Criteria	Definition
Threshold Criteria	Overall Protection of Human Health and the Environment Compliance with ARARs	Standards that an alternative must meet to be eligible for selection as a cleanup action unless an ARAR waiver is used.
Balancing Criteria	Long-Term Effectiveness and Permanence Reduction of Toxicity, Mobility, or Volume through Treatment Short-Term Effectiveness Implementability Cost	Technical criteria that weigh the tradeoffs between alternatives.
Modifying Criteria	State Acceptance and Community Acceptance	Fully evaluated after comments are received on the Proposed Plan.

Acronym:
ARARs - Applicable or Relevant and Appropriate Requirement

Table 10-2 Summary of Comparative Analysis of Comprehensive Technology Scenarios

CTS	Components	Threshold Criteria		Balancing Criteria					
		Overall Protection of Human Health and the Environment	Compliance with ARARs	Long-Term Effectiveness and Permanence	Reduction of Toxicity, Mobility, or Volume through Treatment	Short-Term Effectiveness	Implementability		Present Worth Cost (Dollars)
							Engineering/ Technical Considerations	Estimated Time for Implementation (years)	
CTS-1	No Action	No	No	⓪	⓪	❸	❺	<1	$0
CTS-2	In-situ thermal treatment of creek sediment, surface soil and subsurface soils; enhanced in-situ bioremediation of groundwater	Yes	Sediment/Soil – Yes with waivers Groundwater – Yes, with waivers	❺	❺	❹	❹	5	$9.8M
CTS-3	In-situ thermal treatment of creek sediment, surface soil and subsurface soils; in-situ chemical oxidation of groundwater	Yes	Sediment/Soil – Yes with waivers Groundwater – Yes, with waivers	❺	❺	❸	❹	5	$11.7M

Table 10-2 Summary of Comparative Analysis of Comprehensive Technology Scenarios (continued)

Notes:

Threshold and Balancing Criteria (Excluding Cost)

⓪	None	❹	Moderate to High
❶	Low	❺	High
❷	Low to Moderate		
❸	Moderate		

Table 12-1 Estimated Costs for OU1 Selected Interim Remedy

Item	Quantity	Units	Unit Cost	Capital Cost	Long-Term O&M Cost	
					Annual	Present Worth
Mobilization	1	LS	$100,000	$100,000		
Supplemental Investigation	1	LS	$98,000	$98,000		
Creek Diversion						
Creek Bed Diversion/Restoration	1	LS	$236,400	$236,400		
ISTR						
ISTR Sediment/Soils to 10/mg/kg PCE	1	LS	$1,082,800	$1,082,800		
Excavation and Disposal Sediment/Surface Soil >10 mg/kg PCE						
Excavation	140	LCY	$50	$7,000		
Disposal (including transportation)	188	TON	$462	$86,856		
EAB Groundwater > 4,000 µg/L PCE						
Treatability Study	1	LS	$50,000	$50,000		
Install Injection Wells	55	EA	$10,300	$566,500		
EAB Injections	2	RD	$484,000	$968,000		
Bioaugmentation Injections	2	LS/RD	$31,000	$62,000		
Monitoring and Institutional Controls						
Long Term Monitoring Well Installation	1	LS	$70,000	$70,700		
Institutional Controls	1	LS	$148,000	$148,000		
Sampling Work Plan	1	LS	$15,000	$15,000		
Sampling	Multiple	EVENT			$90,500	$581,154
Short-Term O&M of Remedy Implementation	1	EVENT	$19,000	$19,000		
Reporting						
Review data and prepare annual reports	1	LS	$20,000		$20,000	$248,181
5-Year Review (every 5 years for 30 years)	1	LS	$50,000		$50,000	$107,900
Construction Subtotal				$3,510,256	$160,500	$937,235

Table 12-1 Estimated Costs for OU1 Selected Interim Remedy (continued)

Item	Quantity	Units	Unit Cost	Capital Cost	Long-Term O&M Cost	
					Annual	Present Worth
Contingencies and Other Costs						
Contractor Submittals, H&S, and Construction QA/QC (10% Construction Subtotal)				$351,026		
Contractor Overhead (15% Construction Subtotal)				$526,538		
Contractor Profit (10% Construction Subtotal)				$351,026		
Contingency (40% Construction Subtotal)				$1,404,102		
Construction Total				$6,142,948		
Project Management (10% Construction total)				$614,295		
Engineering (15% Construction total)				$921,442		
Services During Construction (15% Construction total)				$921,442		
O&M Project Management (5% of O&M Subtotal)					$8,025	$46,862
O&M Contingency (25% of O&M Subtotal)					$40,125	$234,309
Total Estimated Costs				$8,600,000	$209,000	$1,218,000
Net Present Worth				$9,818,000		

Notes

Cost estimates were developed according to *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* (EPA 2000). Unit costs for the remedy components were derived from vendor quotes and engineering estimates developed from costs for similar work. The level of detail employed in making the estimate is conceptual but is considered appropriate for making choices between Combined Technology Scenarios (CTSs). The information provided in the cost estimate is based on the best available information regarding the anticipated scope of the OU1 remedy. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the selected remedy. Major changes may be documented in the form of a memorandum in the Administrative Record File, an ESD or a ROD amendment. Per the guidance, the present worth analysis (a.k.a. present value) was performed on remedial alternatives under CTS-2 (the selected remedy) and CTS-3 using a 7 percent discount (interest) rate over the period of evaluation for the selected remedy and other considered alternatives. Inflation and depreciation were not considered in preparing the present worth costs. This is an order-of-magnitude engineering cost estimate that is expected to be within a range of +50 to -30 percent of the actual project cost.

Sources of uncertainty and potential cost drivers for the selected remedy include:

- Dimensions of Remediation Target Zones - The estimated extent of the remediation zones were established with data available to date and used to develop remedial alternatives. However, data gaps remain in the current understanding of extent of contamination associated with OU1 and OU2, which means there is some uncertainty associated with the defined dimensions of the remediation zones. A substantial change in the size of the remediation zones and amount of material to be addressed will lead to a change in project costs.
- Energy Costs – A rapid, sustained increase in energy costs will increase overall project costs. Energy-intensive components of the selected remedy (ISTR) would be most affected and may require reconsideration if energy cost increases are substantial.

Table 12-1 Estimated Costs for OU1 Selected Interim Remedy (continued)

- Site Setting - The valley in which the Site is located is prone to flooding every few years and the flooding could impact the effectiveness of equipment employed for treatment. The potential for flooding could be further increased as a result of climate change. Limitations due to site setting may limit the types of thermal treatment for consideration or require the re-design of in-situ treatment or monitoring components of the interim remedy.
- Implementation of Remedy Components Involving Excavation and Disposal of Sediment and Surface Soil and Enhanced In-Situ Bioremediation of Subsurface Soil - Although it is anticipated that ISTR will be effective at reducing the high levels of PCE found in OU1 sediment and soil, the interim remedy includes components to address any remaining sediment and soil with PCE concentrations greater than 10 mg/kg. While the cost estimate does includes excavation and offsite disposal for a small volume of sediment and surface soil, project costs would increase if a larger volume required excavation and disposal or if subsurface soil remains with PCE concentrations greater than 10 mg/kg and requires enhanced in-situ bioremediation treatment.

Abbreviations
EA - each
EAB - enhanced anaerobic bioremediation
H&S - health and safety
ISTR - in-situ thermal remediation
LCY - loose cubic yard
LS - lump sum
O&M - operations and maintenance
PCE - tetrachloroethylene
QA/QC - quality assurance/quality control
RD - round

Table 12-2 Cleanup Levels for OU1 Selected Interim Remedy

Media and Chemicals of Concern	Cleanup Level	Basis for Cleanup Level	Risk at Cleanup Level
Sediment and Soil			
PCE	10 mg/kg	**Primary Basis:** Ecological Risk Based Level-EPA RSL - 9.92 mg/kg PCE in soil for terrestrial ecological receptor **Also Satisfies:** Compliance with State ARARs - WAC 173-340-705 (Use of Method B to establish soil cleanup levels) - WAC 173-340-740 (Unrestricted land use soil cleanup standards) *The MTCA Method B soil cleanup level protective (1 x 10^{-6}) of human direct contact with PCE in soil is 480 mg/kg.* - WAC 173-204-560 (Sediment cleanup standards – general requirements)) Human Health Risk Based Level –EPA RSL @ $1x10^{-6}$ - 22 mg/kg PCE – (residential soil) - 110 mg/kg PCE (industrial/ commercial soil) - 924 mg/kg PCE (recreational soil)	Eco Receptor (shrew) Hazard Index $\leq$ 1 Carcinogenic risk to Humans $\leq$ $1x10^{-6}$
TCE	10 mg/kg [a]	Ecological Risk Based Level-EPA RSL - 12.4 mg/kg TCE in soil for terrestrial ecological receptor	Eco Receptor (shrew) Hazard Index $\leq$ 1
Groundwater			
PCE TCE cis-1,2-DCE Methylene chloride	5 µg/L [b] 5 µg/L [b] 70 µg/L [b] 5 µg/L [b]	Waiver of Federal and State Groundwater ARARs for example: - Safe Drinking Water Act MCLs - WAC 173-340-720 (MTCA Groundwater Cleanup Standards)	N/A

Table 12-2 Cleanup Levels for OU1 Selected Interim Remedy (continued)

Notes:

a. The current maximum soil TCE level detected in OU1 is 0.19 mg/kg which is already below this cleanup level. FYI: Although not a COC in soil for humans, the TCE RSL is 0.91 mg/kg for protection of human health under a residential use scenario.

b. The OU1 ROD selects an interim remedy; therefore, EPA has determined that a waiver of groundwater ARARs, and soil concentrations protective of groundwater (WAC 173-340-747), is necessary as provided for in CERCLA Section 121(d)(4)(A) . This statutory provision allows such a waiver when the remedial action selected is only part of a total remedial action that will attain such level or standard of control when completed. To assure protectiveness in the interim, contaminated groundwater above such standards will be addressed using institutional controls to prevent human exposure. The OU1 interim remedy will be followed by a Final ROD that will identify ARARs which pertain to the final remedy and fully address compliance with these ARARs or provide the basis for a waiver pursuant to CERCLA 121(d)(4)appropriate to a final remedy, if necessary.

Key:
µg/L - micrograms per liter
ARARs - Applicable or Relevant and Appropriate Requirement
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
COCs - contaminants of concern
cis-1,2-DCE – cis-1,2-dichloroethylene
MCL - maximum contaminant level
mg/kg - milligrams per kilogram
MTCA - Model Toxics Control Act
PCE - tetrachloroethylene
RSL - EPA Regional Screening Levels
TCE - trichloroethylene
WAC - Washington Administrative Code

Table 13-1 ARARs for the OU1 Selected Interim Remedy

Standard/Authority	Requirement Citation Or Reference	Description	Status	Comments
BERWICK CREEK DIVERSION AND SEDIMENT/SOIL EXCAVATION				
Clean Water Act (Dredge and Fill Requirements) 33 USC 1251-1376	40 CFR 230, 231	Provides protection to waters in and around the site.	Relevant and Appropriate	Relevant and appropriate to actions involving capping, berm construction and/or onsite disposal of contaminated soil that may impact local water bodies, such as will be done when diverting Berwick Creek.
Magnuson-Stevens Fishery Conservation and Management Act Regulations 16 USC1801-1884	50 CFR Part 600	Consideration of the effects of federal actions on Essential Fish Habitat (EFH) for certain species is required. Federal agencies whose actions might adversely affect an EFH-managed species must formally consult with the applicable fisheries agency regarding the action. If the fisheries agency were to determine that an action would adversely affect EFH, the agency would provide EFH conservation recommendations.	Applicable	Applicable to actions within Berwick Creek, which has been designated an EFH for both Coho and Chinook salmon.
Clean Air Act 42 USC 7201 et.seq. National Ambient Air Quality Standards	40 CFR 50.6, 50.12	Provides acceptable ambient air quality levels for particulate matter and lead.	Applicable	Applicable to earth-moving activities as well as to treatment processes that may include mixing or other processes that result in potential releases of particulates or lead.
Clean Water Act 33 USC 1251 et. seq. Storm Water Permit Program	40 CFR 122.26	Best management practices must be used and appropriate monitoring performed to ensure that storm water runoff does not cause an exceedance of water quality standards in a receiving surface water body.	Applicable	Substantive requirements of the general storm water permit program for storm water discharges associated with construction activities disturbing over 1 acre are applicable to remedial actions at the site if construction activities are required on and disturb an area greater than 1 acre.

Table 13-1 ARARs for the OU1 Selected Interim Remedy (continued)

Standard/Authority	Requirement Citation Or Reference	Description	Status	Comments
Surface Mining Control and Reclamation Act of 1977 30 USC. Chapter 25 1201 et. seq.	30 CFR Parts 816.11, .95, .97, .100, .102, .111, 113, .114, .116	Provides requirements for removing contaminated soils.	Relevant and Appropriate	Relevant and appropriate to earthwork components of the selected remedy. Includes requirements for postings (.11), stabilization (erosion control)(.95), minimizing disturbances(.97), reclamation (.100), sloping (.102) and revegetation (.100, .102, .111, .113, .114, .116).
Native American Graves Protection and Repatriation Act 25 USC. 3001et seq., 104 Stat. 3048,	43 CFR Part 10	Protects Native American burials from desecration through the removal and trafficking of human remains and "cultural items," including funerary and sacred objects.	Applicable	Potentially applicable to remedial actions at the Site because it is possible that the disturbance of Native American materials could occur as a result of work in the stream bed or subsurface excavations elsewhere at the Site. Such materials are not known to be present at the Site, but could be inadvertently uncovered during soil or sediment removal.
Endangered Species Act of 1973 16 USC 1531-1543	50 CFR Parts 17, 401; 40 CFR 6.302 (h)	Provides protection of critical habitat upon which endangered or threatened species depend.	Applicable	Applicable to actions that impact critical habitat of endangered or threatened species. Certain reaches of Berwick Creek have been identified as having Coho salmon spawning and rearing habitat. Coho salmon is a candidate for the ESA list as a threatened species. Bull trout is listed as a threatened species on the ESA list. Chinook salmon and Bull trout are listed as threatened species but have not been observed in Berwick Creek although they have the potential to access it.
Washington Hydraulic Code Rules RCW 75.20	WAC 220-110 WAC 220-110-040 through -224	Requires WDFW approval for projects that will use, divert, obstruct, or change the natural flow or bed of waters of the state. Substantive technical provisions include considerations for: bank protection, channel change/realignment, temporary bypass culvert, flume, or channel, dredging in freshwater areas, gravel removal, outfall structures and/or water diversions.	Applicable	Applicable to remedial actions taken at Berwick Creek. Will require adherence to in-stream work windows, which are typically issued under the authority of this program.

Table 13-1 ARARs for the OU1 Selected Interim Remedy (continued)

Standard/Authority	Requirement Citation Or Reference	Description	Status	Comments
Washington Surface Water Quality Standards—Short-Term Modifications RCW 90.48.035	WAC 173-201A-410	Provides for short-term modifications of standards for specific water bodies on a short-term basis when necessary to accommodate essential activities, respond to emergencies, or to otherwise protect the public interest.	Applicable	The substantive requirements of this regulation are applicable for the selected remedy if implementation of creek diversion and/or sediment/soil excavation require in-water work at Berwick Creek.
Washington Clean Air Act and Implementing Regulations SWCAA Regulation	WAC 173-400 WAC 173-460 SWCAA 400	Air emissions at the site boundary must fall below the acceptable source impact limit of 1.1 $\mu g/m^3$ PCE (WAC 173-460-150). Compliance could be demonstrated through modeling of PCE sources from treatment technologies with air emissions. WAC 173-400 also requires control of fugitive dust emissions during construction.	Applicable	Applicable to earth-moving activities as well as to treatment processes employed as part of the selected remedy that may include mixing or other processes that result in potential releases of emissions to air.
Washington State Water Quality Standards for Surface Waters	WAC 173-201A	Provides limitations on parameters, such as turbidity, temperature, dissolved oxygen, and pH for protection of organisms. Protects freshwater aquatic life by specifying protection criteria by stretch of surface waters. Tributaries of waters whose uses are designated salmon and trout spawning, core rearing and migration, or extraordinary primary contact recreation are protected at the same level as the waters themselves.	Applicable	Limitations would not serve as cleanup standards but are applicable to remedial activities that could adversely impact surface water at the Site.
Washington National Pollutant Discharge Elimination System Permit Program RCW 90.48	WAC 173-220	Best management practices must be used and appropriate monitoring performed to ensure that storm water runoff does not cause an exceedance of water quality standards in a receiving surface water body.	Applicable	Substantive requirements applicable to construction, grading, and excavation activities conducted as part of site remediation.

Table 13-1 ARARs for the OU1 Selected Interim Remedy (continued)

Standard/Authority	Requirement Citation Or Reference	Description	Status	Comments
IN SITU THERMAL TREATMENT OF SEDIMENT AND SOIL				
Washington Hazardous Waste Cleanup - Model Toxics Control Act of 1989, RCW 70.105D	WAC 173-340 Specific subsections: WAC 173-340-700 WAC 173-340-702 WAC 173-340-703 WAC 173-340-705 WAC 173-340-740	Establishes the process and methods used to evaluate risk and develop standards for soil and other environmental media.	Applicable or Relevant and Appropriate	The substantive requirements of the specified subsections are applicable or relevant and appropriate to developing cleanup standards for the selected remedy. The cleanup level established for PCE meets the MTCA Method B requirement for cleanups to attain the 1 x 10^{-6} risk level for protection of human direct contact exposure with soil.
	WAC 173-340-747	This subsection (deriving soil concentrations for groundwater protection) requires soil cleanups to achieve levels that will not cause exceedances of groundwater cleanup levels and will not result in the accumulation of non-aqueous phase liquid on or in groundwater.	Waived	This specific subsection of MTCA is being waived for this interim remedy as cleanup of soil to levels that protect groundwater for its most beneficial use (drinking water) is beyond the scope of this interim remedy.
Sediment Cleanup Standards Washington Hazardous Waste Cleanup - Model Toxics Control Act of 1989, RCW 70.105D RCW 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70	WAC 173-204-560	Provide standards to eliminate adverse effects on biological resources and significant health threats to humans from sediment contamination.	Applicable	Applicable to establishment of sediment cleanup level. Sediment cleanup objectives are the freshwater sediment standards provided in 173-204-340. Ecology determines on a case by case basis the criteria, methods, and procedures necessary to meet the intent of the chapter.
Washington Hazardous Waste Cleanup - Model Toxics Control Act of 1989, RCW 70.105D	WAC 173-340-760	Sediment cleanup actions conducted under this chapter must comply with the requirements of chapter 173-204 WAC.	Applicable	Applicable to establishment of sediment cleanup level.

Table 13-1 ARARs for the OU1 Selected Interim Remedy (continued)

Standard/Authority	Requirement Citation Or Reference	Description	Status	Comments
ENHANCED ANAEROBIC BIOREMEDIATION OF GROUNDWATER				
Safe Drinking Water Act of 1974. 42 USC 300 et. Seq.	National Primary Drinking Water Standards Subpart G 40 CFR 141.11-.16	Establishes maximum contaminant levels for drinking water.	Waived	Reaching these Maximum Contaminant Limits (MCLs) is beyond the scope of this interim remedy; therefore, EPA has determined that a waiver of these groundwater ARARs is necessary as provided for in CERCLA Section 121(d)(4)(A).
Washington Hazardous Waste Cleanup - Model Toxics Control Act of 1989, RCW 70.105D	WAC 173-340-720	Establishes the process and methods used to evaluate risk and develop standards for groundwater.	Waived	Reaching MTCA groundwater cleanup levels is beyond the scope of this interim remedy; therefore, EPA has determined that a waiver of groundwater ARARs is necessary as provided for in CERCLA Section 121(d)(4)(A).
Washington Water Well Construction RCW 18.104	Minimum Standards for Construction and Maintenance of Water Wells WAC 173-160 Rules and Regulations Governing the Licensing of Well Contractors and Operators WAC 173-162	Provides requirements for water well construction. Establishes qualifications for well contractors and operators.	Applicable	Applicable to the installation of wells that will be required for implementation of the selected remedy.

Table 13-1 ARARs for the OU1 Selected Interim Remedy (continued)

Standard/Authority	Requirement Citation Or Reference	Description	Status	Comments
MONITORING				
Washington Hazardous Waste Cleanup - Model Toxics Control Act of 1989, RCW 70.105D	WAC 173-340-410	Describes minimum compliance monitoring requirements. Three types of compliance monitoring: protection (confirm that human health and the environment are adequately protected during construction and the operation and maintenance period of an interim action as described in the safety and health plan); performance (confirm that the interim action has attained cleanup standards and, if appropriate, remediation levels or other performance standards, such as construction quality control measurements or monitoring, necessary to demonstrate compliance with a permit or where a permit exemption applies, the substantive requirements of other laws); and, conformational monitoring (confirm that human health and the environment are adequately protected during construction and the operation and maintenance period of an interim action or cleanup action as described in the safety and health plan). In all cases, compliance monitoring plans are required.	Applicable	Applicable to monitoring component of the selected remedy.

Table 13-1 ARARs for the OU1 Selected Interim Remedy (continued)

Standard/Authority	Requirement Citation Or Reference	Description	Status	Comments
INSTITUTIONAL CONTROLS				
Washington Hazardous Waste Cleanup - Model Toxics Control Act of 1989, RCW 70.105D	WAC 173-340-440	Institutional controls (ICs) are measures undertaken to limit or prohibit activities that may interfere with the integrity of an interim action or cleanup action or that may result in exposure to hazardous substances at a site. ICs may include use restrictions, such as limitations on the use of property or resources, or requirements that cleanup action occur if existing structures or pavement are disturbed or removed; maintenance requirements for engineered controls, such as the inspection and repair of monitoring wells, treatment systems, caps or groundwater barrier systems; and educational programs, such as signs, postings, public notices, health advisories, mailings, and similar measures that educate the public and/or employees about site contamination and ways to limit exposure.	Applicable	Applicable to institutional controls to be established as part of the selected remedy.
WASTE MANAGEMENT AND DISPOSAL				
Clean Water Act 33 USC 1251-1376 National Pollutant Discharge Elimination System (NPDES) Regulations	40 CFR Part 122-125	The NPDES program requires that permits be obtained for point-source discharges of pollutants to surface water. Under this regulation, a point-source discharge to a surface water body cannot cause an exceedance of water quality standards in the receiving water body outside the mixing zone.	Applicable	Although permits would not be required for on-site actions under CERCLA, the substantive regulatory requirements of the NPDES permit program are applicable to the direct discharge of treated groundwater to a surface water body, such as Berwick Creek as well as the unnamed or small ditches connected to Berwick Creek, if treatment and discharge of groundwater is needed to complete the remedy.
Clean Water Act 33 USC 1251-1376 Section 304 -Federal Ambient Water Quality	National Recommended Water Quality Criteria, November 2002, and 67 Federal Register 79091-79095, December 27, 2002	Provides chemical concentrations for acceptable ambient water quality.	Relevant and Appropriate	Relevant and appropriate to point-source discharges to BerwickCreek if they occur as part of the remedy. The PCE value for human exposure to both water and organisms is 0.69 µg/L and to organisms only is 3.3 µg/L.

Table 13-1 ARARs for the OU1 Selected Interim Remedy (continued)

Standard/Authority	Requirement Citation Or Reference	Description	Status	Comments
Resource Conservation and Recovery Act (RCRA) 42 USC 1601 et. seq. Identification and Listing of Hazardous Waste	40 CFR Part 261-265, 270, and 271	Defines those solid wastes that are subject to regulations as hazardous wastes, and lists specific chemical and industry-source wastes.	Applicable	Applicable to determining whether wastes are considered hazardous under RCRA.
RCRA 42 USC 1601 et. seq. Manifesting, Transport and Recordkeeping Requirements	40 CFR 262	Develops guidelines for record-keeping of the management actions for hazardous wastes.	Applicable	Applicable if remedial activities include the off-site transport of hazardous waste. The selected remedy includes the potential excavation and offsite disposal of sediment/soil that is characterized as hazardous waste.
RCRA 42 USC 1601 et. seq. Storage Requirements	40 CFR 264; 40 CFR 265, Subparts I and J	Develops standards for the storage of hazardous wastes.	Applicable	Applicable if remedial activities include the storage of hazardous waste greater than 90 days. The selected remedy includes the potential excavation and offsite disposal of sediment/soil that is characterized as hazardous waste.
RCRA 42 USC 1601 et. seq. Land Disposal Restrictions	40 CFR 268	Establishes standards for land disposal of RCRA hazardous waste. Requires treatment to diminish a waste's toxicity and/or minimize contaminant migration.	Applicable	Applicable if sediment/soil is excavated for offsite disposal and characterized as hazardous.
RCRA 42 USC 1601 et. seq. Subtitle D Nonhazardous Waste Management Standards	40 CFR 257	Develops standards for the management of non-hazardous wastes.	Applicable	Applicable if sediment/soil is excavated for offsite disposal and characterized as non-hazardous waste.
RCRA 42 USC 1601 et. seq. Standards for Generators Standards for Transporters	40 CFR Parts 262 and 263	Applicable to generators and transporters of hazardous waste.	Applicable	Applicable to off-site disposal or treatment of hazardous waste.

Table 13-1 ARARs for the OU1 Selected Interim Remedy (continued)

Standard/Authority	Requirement Citation Or Reference	Description	Status	Comments
Washington Dangerous Waste Regulations 70.105 RCW, the Hazardous Waste Management Act of 1976 as amended, and implements, in part, chapters 70.105A, 70.105D, and 15.54 RCW	WAC 173-303	Requirements and restrictions on hazardous waste disposal.	Applicable	This regulation is applicable to remedy components that involve disposal of contaminated media in an off-site location. The area of contamination policy allows contaminated media to be consolidated within the same area of a site without triggering RCRA or Washington dangerous waste regulations. Several waste streams from the site could be hazardous wastes as they could contain PCE at concentrations high enough to fail the TCLP; the PCE TCLP threshold is 0.7 mg/L.
Washington Solid Waste Handling Standards RCW 70.95	WAC 173-350	Provides waste management requirements for non-hazardous wastes.	Applicable or Relevant and Appropriate	Applicable to off-site disposal of solid nonhazardous wastes resulting from implementation of the selected remedy and relevant and appropriate to on-site remedial actions governing contaminated media management. Requirements for contaminated media disposal will be found in the permit of the landfill that agrees to accept the waste.
OTHER				
State Environmental Policy (SEPA) RCW 43.21C	WAC 197-11	Requires a review of potential damage that occurs to the environment as a result of human activities.	Applicable	SEPA checklist may be required prior to construction of a remediation system at the site.
Federal Protection of Wetlands and Management of Floodplains	Executive Order Nos. 11990 and 11988	Establishes requirements for the preservation of wetlands and floodplain areas.	Applicable	Applicable to remedial actions that affect wetland and floodplain areas if any affected properties are located within wetlands or floodplain areas. Portions of Berwick Creek are in such areas.

Table 13-1 ARARs for the OU1 Selected Interim Remedy (continued)

Standard/Authority	Requirement Citation Or Reference	Description	Status	Comments
National Historic Preservation Act 16 USC 470; et. Seq.; 40 CFR 6.301 (b) Archeological Resources Protection Act 16 USC 469	36 CFR Part 800 40 CFR 6.301 (c)	Minimizes impact of actions on historic properties and landmarks. Provides protection from actions that may cause irreparable harm, loss, or destruction of artifacts.	Applicable	Applicable to actions at historic properties or landmarks, or properties at the site that contain historical and archeological data.
Washington Hazardous Waste Cleanup - Model Toxics Control Act of 1989, RCW 70.105D	WAC 173-340-430	Distinguishes an interim action from a cleanup action and provides requirements for completion of an interim action. Allows for a partial cleanup as an interim action, i.e., cleanup of hazardous substances from all or part of the site, but not achieve cleanup standards. Interim actions shall be followed by additional remedial actions unless compliance with cleanup standards has been confirmed at the site.	Applicable	Applicable to the selected remedy since it will be carried out as an interim remedy and will be followed by a final Site-wide remedy and /or additional OU1 remedies.

Acronyms:
ARAR - Applicable or Relevant and Appropriate Requirement
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act
CFR - Code of Federal Regulations
EFH - essential fish habitat
EPA - U. S. Environmental Protection Agency
mg/kg - milligram per kilogram
mg/L - milligram per liter
MTCA - Model Toxics Control Act
PCE - Tetrachloroethylene
RCRA - Resource Conservation and Recovery Act
SEPA - State Environmental Policy Act
SWCAA - Southwest Clean Air Agency
TCLP - Toxicity Characteristic Leaching Procedure
µg/L - microgram per liter
$\mu g/m^3$ - microgram per cubic meter
WAC - Washington Administrative Code
WDFW - Washington Department of Fish and Wildlife

Figures

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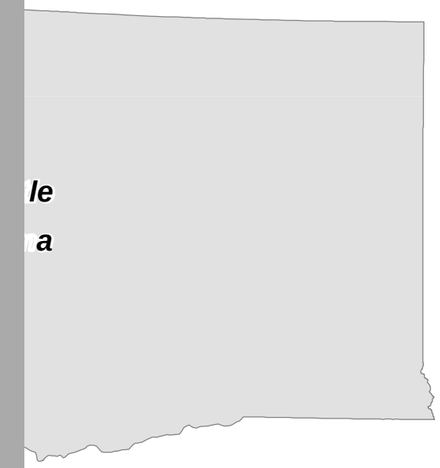

Legend

Project Site Boundary

N

1,250 0 1,250
Feet

Sources:
1. Parametrix (March, 2010)
2. Image from ©2011 Google™

Figure 1-1
Site Location Map

EPA REGION 10

Hamilton / Labree Roads Superfund Site

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Legend

Project Site Boundary

Estimated PCE Concentration Boundary (Dashed Where Inferred - Contour Values in ug/L)

Creek Flow Direction

Groundwater Flow Direction

OU1 – HRIA
OU2 - Includes the Breen Property, the Thurman Berwick Creek Area, and the area west and northwest of Labree Road

N

750 0 750
Feet

Sources:
1. Parametrix (March, 2010)
[Ecology and Environment, Inc. 2002]
2. Image from ©2011 Google™

Figure 1-2
Overview of Hamilton/Labree Superfund Site

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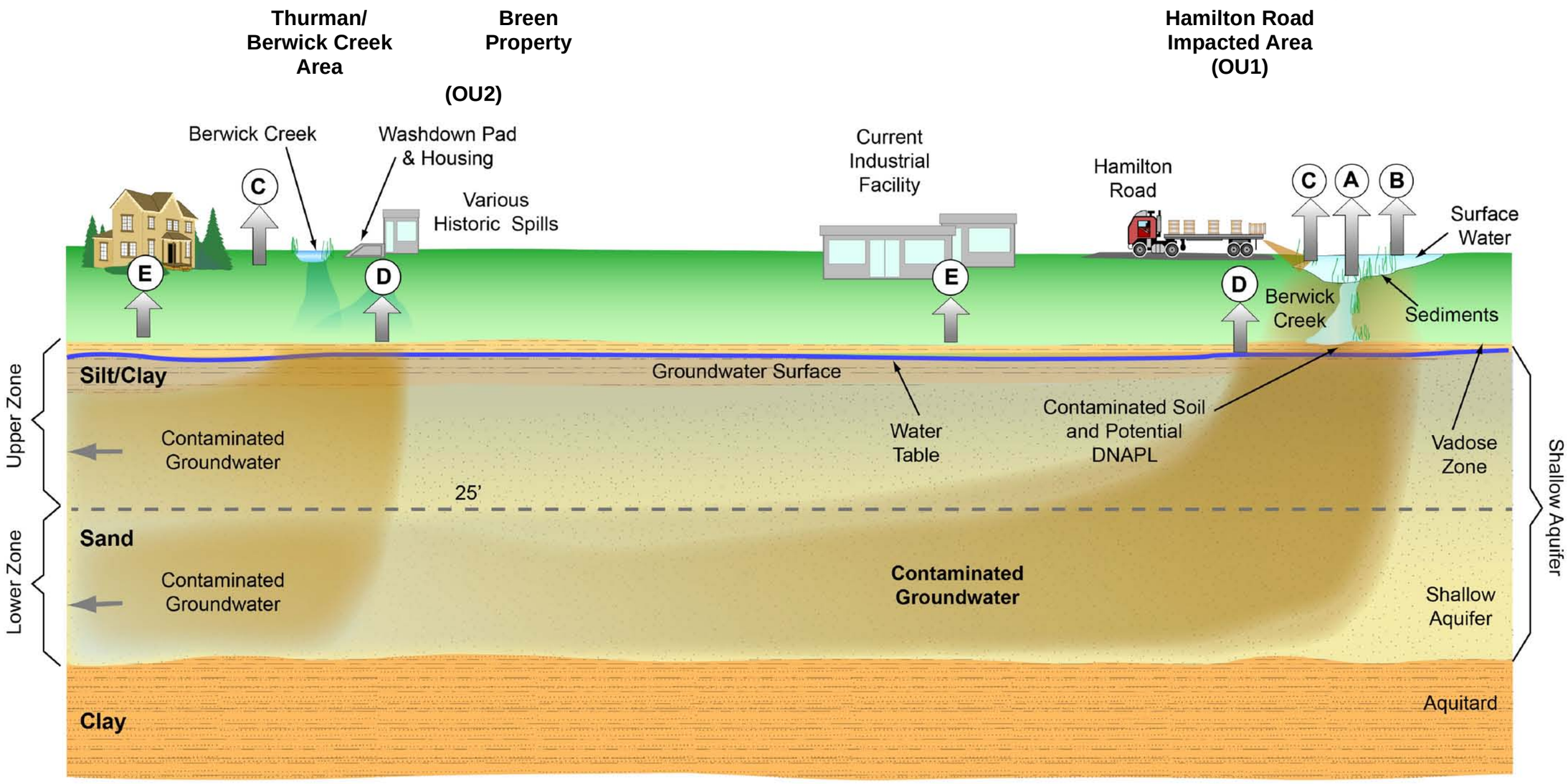
Hamilton / Labree Roads Superfund Site

Date: April 25, 2013, File: \\irvsvr01\GIS\50898_USEPA_Region10_Federal\56094\2013\ROD\Figure1-2_OverviewofHamiltonLaBreeSuperfundSite.mxd



Legend

A - Sediment – Ingestion/Direct Contact (Residential, Aquatic, Terrestrial)
B - Surface Water – Ingestion/Direct Contact (Residential, Aquatic, Terrestrial)
C - Outdoor Air – Inhalation (Residential, Terrestrial)
D - Groundwater – Ingestion (Occupational, Residential)
E - Indoor Air – Inhalation (Occupational, Residential)

Groundwater flows from right to left, and slightly into the figure (west-northwest).
The two groundwater plumes commingle down gradient of the sources.

North is into page

Not to scale

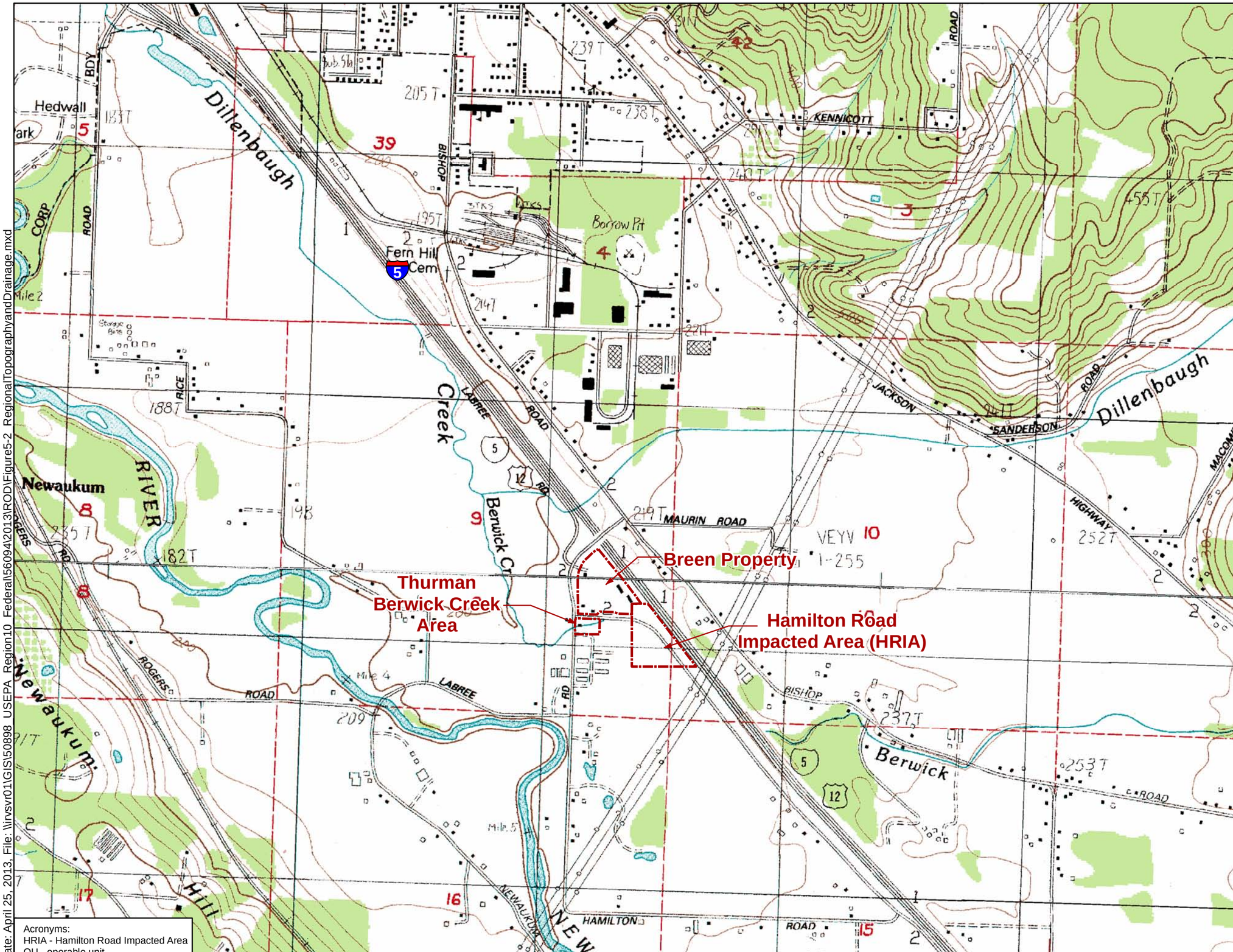
Acronyms:
OU - operable unit

Figure 5-1
Conceptual Model

EPA REGION 10

Hamilton / Labree Roads Superfund Site

Date: April 25, 2013, File: \\irvsvr01\GIS\50898_USEPA_Region10_Federal\56094\2013\ROD\Figure5-1_ConceptualGroundwater.mxd



Legend

Project Site Boundary

N

1,250 0 1,250

Feet

Sources:
1. Parametrix (March, 2010)
2. 7.5' USGS Quadrangle - Centralia, Washington. Dated 1985 and 7.5' USGS Quadrangle - Napavine, Washington. Dated 1985

Figure 5-2
Regional Topography and Drainage

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Hamilton / Labree Roads Superfund Site

Acronyms:
HRIA - Hamilton Road Impacted Area
OU - operable unit

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Legend

AB1	◆	Auger Boring (E&E 2000-2001)
AB-650	◆	Auger Boring (URS 2003)
B1	◉	Soil Boring
GP1	▣	Geoprobe Boring (E&E 2000-2001; soil and water samples)
GP-104	▣	Geoprobe Boring (E&E 2000-2001; soil samples only)
GP-520	▣	Geoprobe Boring (URS 2003)
RS-18	●	Reconnaissance Boring
	⬭	Hot Spot

N

100 0 100
Feet

Sources:
1. Parametrix (March, 2010)
   [Ecology and Environment, Inc. 2002]
2. Image from ©2011 Google™

Figure 5-3A
OU1 Historical Sampling Locations - Borings

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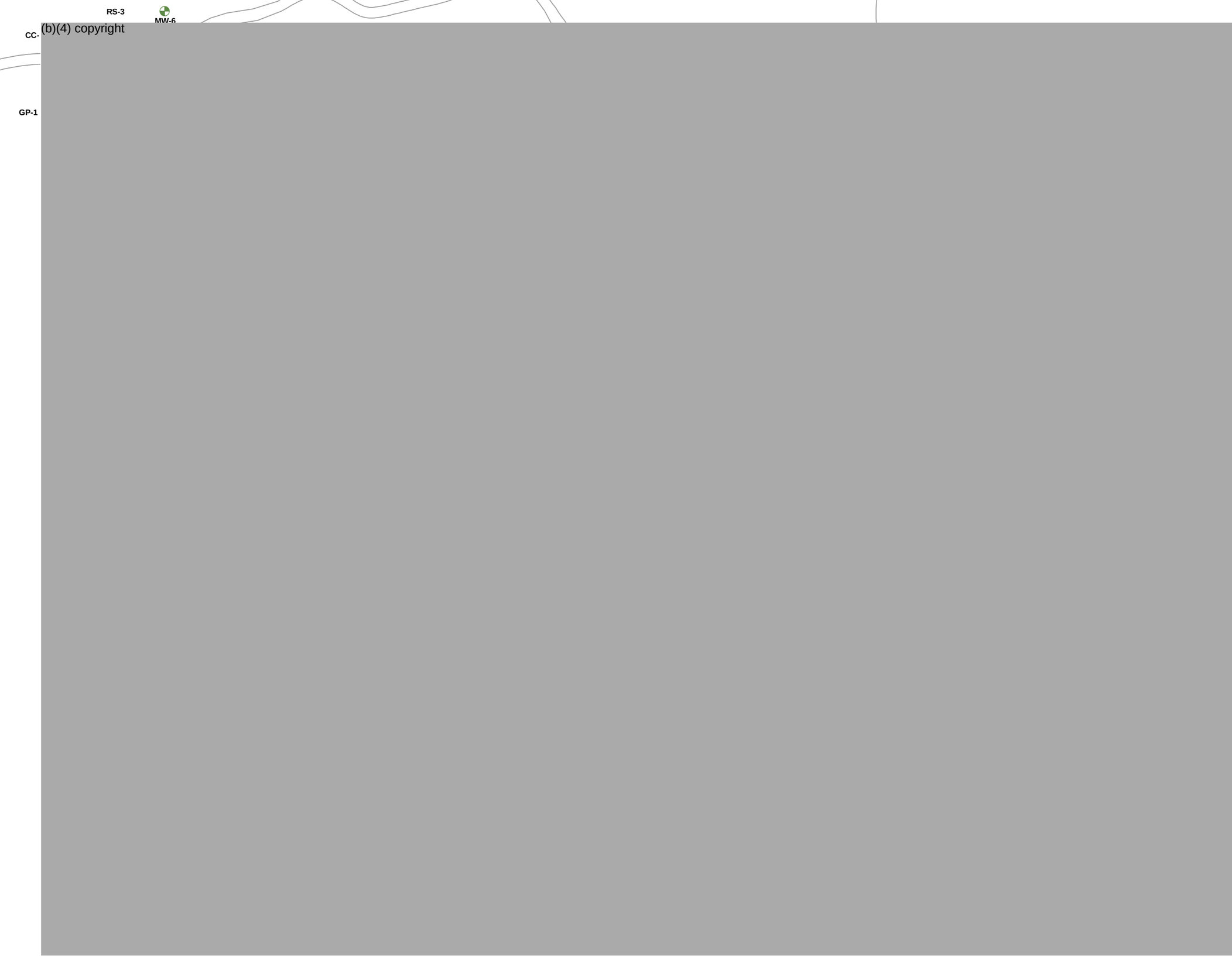
Hamilton / Labree Roads Superfund Site

Date: April 25, 2013. File: \\irvsvr01\GIS\50898_USEPA_Region10_Federal\56094\2013\ROD\Figure5-3A_HistoricSamplingLocations-Borings.mxd



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Legend

- MW-10 Monitoring Well
- MW-R5 Monitoring Well/Recovery Well
- PW-3 Private Well
- Hot Spot

N

100 0 100
Feet

Sources:
1. Parametrix (March, 2010)
   [Ecology and Environment, Inc. 2002]
2. Image from ©2011 Google™

Figure 5-3B
OU1 Historical Sampling Locations - Wells

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Hamilton / Labree Roads Superfund Site

Legend

BS-451	■	Stream Bed
CC-1	▲	Creek Channel
SB-400	✖	Stream Bank
SG1-20	●	Soil Gas
SG-225	●	Soil Gas
SW-5	◬	Surface Water
BK10	•	Bank Sample
	⬭	Hot Spot

N

100 0 100
Feet

Sources:
1. Parametrix (March, 2010)
   [Ecology and Environment, Inc. 2002]
2. Image from ©2011 Google™

Figure 5-3C
OU1 Historical Sampling Locations - Other

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Hamilton / Labree Roads Superfund Site

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Date: July 24, 2013, File: \\irvsvr01\GIS\50898_USEPA_Region10_Federal\56094\2013\ROD\Figure5-3D_HistoricSamplingLocationsBreen.mxd

Legend

AB6	Auger Boring
AB-652	Auger Boring
B1	Soil Boring
CC-9	Creek Channel
GP-118	Geoprobe Boring
GP-524	Geoprobe Boring
MW-33	Monitoring Well
MWR-4	Monitoring Well/Recovery Well
PW-1	Private Well
RS-1	Reconnaissance Boring
SB-403	Stream Bank
SG1-10	Soil Gas
SG2-9	Soil Gas
SG-230	Soil Gas
SP-1	Strataprobe Boring
SW-2	Surface Water
TP-1	Test Pit
BK10	Bank Sample
DB-1	Shallow Soil
CB-1	Boring
GA-6	Geophysical Survey Area

N

100 0 100
Feet

Sources:
1. Paramatrix (March, 2010)
[Ecology and Environment, Inc. 2002]
2. Image from ©2011 Google™

Figure 5-3D
Historical Sampling Locations
Breen Property and Adjacent

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Hamilton / Labree Roads Superfund Site

SG-230
G-235
105
SB-406
GP-517
GP-116

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Legend

- Project Site Boundary
- Hot Spot
- Creek Channel
- Monitoring Well
- Monitoring Well/Recovery Well
- Private Well
- Reconnaissance Boring
- Surface Water

Notes:
Groundwater sampling results indicated two distinct areas or hot spots of groundwater contamination within OU1, the Hamilton Road impacted Area.

The Northwestern Hot Spot is centered on well MW-R4, where tetrachloroethylene (PCE) was detected at concentrations of 5,300 micrograms/Liter (µg/L) and 8,800 µg/L in 2003.

The Southeastern Hot Spot includes wells MW-600 through MW-604 and wells MW-R1 and MW-R5. Detected PCE concentrations in MW-600 through MW-604 ranged from 417 µg/L to 2,720,000 µg/L in 2003; and from 562 to 67,700 µg/L in 2004. Detected concentrations in MW-R1 and MW-R5 ranged from 65,000 µg/L to 89,000 µg/L in 2003.

N

100 0 100
Feet

Sources:
1. Parametrix (March, 2010)
2. Image from ©2011 Google™

Figure 5-4
OU1 Hot Spots
Site Map

EPA REGION 10

Hamilton / Labree Roads Superfund Site

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Legend

BS-451 Stream Bed

CC-1 Creek Channel

SB-416 Stream Bank

SW-7 Surface Water

N

150 0 150

Feet

Sources:
1. Parametrix (March, 2010)
   [Ecology and Environment, Inc. 2002]
2. Image from ©2011 Google™

Figure 5-5
Berwick Creek Bed, Bank and Surface Water Sampling Locations

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Hamilton / Labree Roads Superfund Site

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Date: April 25, 2013, File: \\rvsvr01\GIS\50898_USEPA_Region10_Federal\56094\2013\ROD\Figure5-6HistoricalShallowPCEGroundwaterIsoconcentration.mxd

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Legend

Project Site Boundary

—200— Historical Groundwater Shallow (<= 25 feet depth) for PCE Isoconcentration in ug/L

Auger Boring (E&E 2000-2001)

Auger Boring (URS 2003)

Soil Boring

Monitoring Well

Monitoring Well/Recovery Well

Private Well

Reconnaissance Boring

Shallow Soil Boring

Geoprobe Boring (E&E 2000-2001; soil and water samples)

Geoprobe Boring (URS 2003)

N

100 0 100

Feet

Notes:
1. Contours are based on maximum groundwater concentrations and do not represent a single time-specific sampling event
2. Image from ©2011 Google™

Figure 5-6
Hamilton / Labree
Upper Zone of Shallow Aquifer
PCE Isoconcentration Plot - Historical

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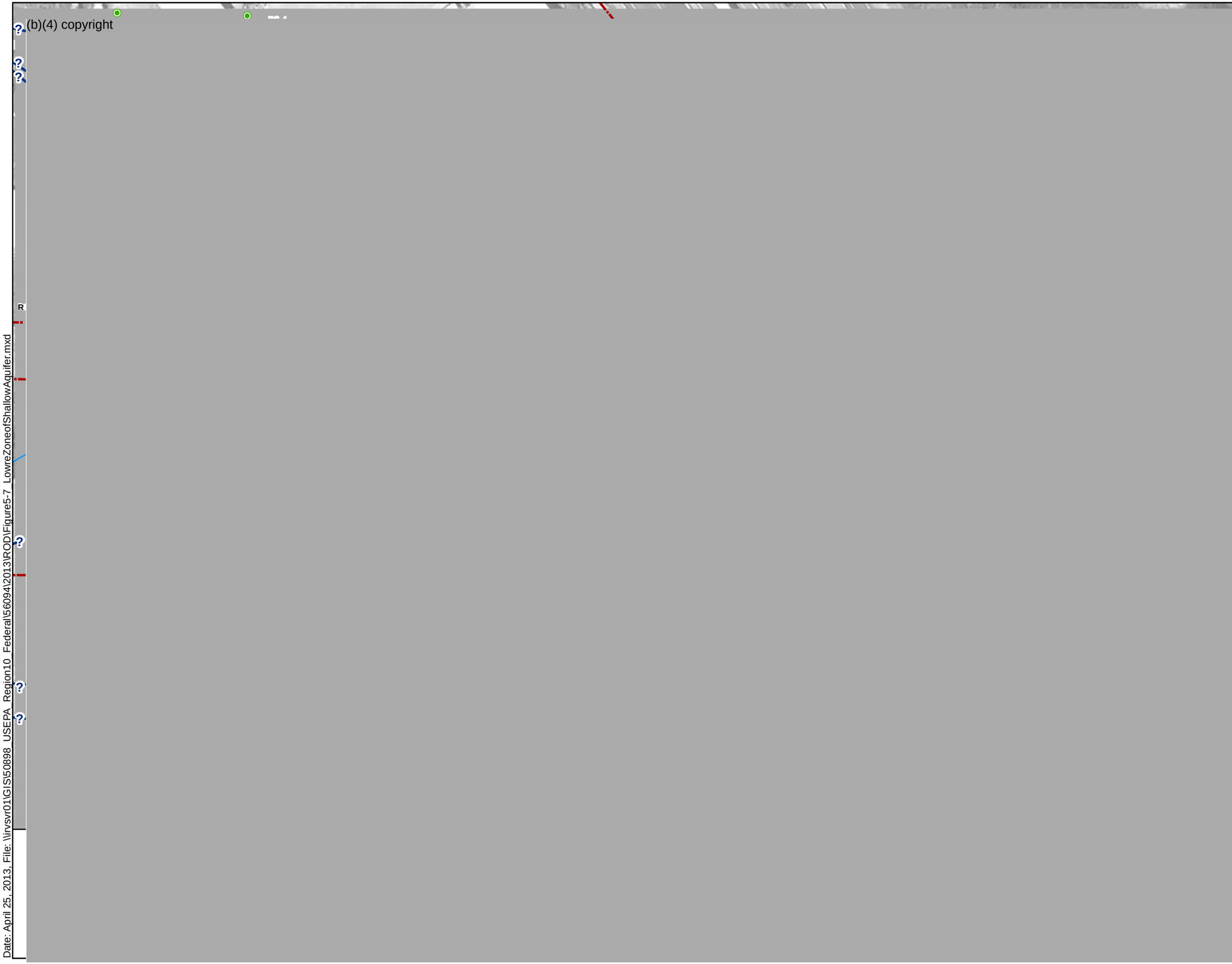
Hamilton / Labree Roads Superfund Site



Legend

- Project Site Boundary
- 200 — Historical Groundwater Deep (> 25 feet depth) for PCE Isoconcentration in ug/L
- Auger Boring (E&E 2000-2001)
- Auger Boring (URS 2003)
- Soil Boring
- Monitoring Well
- Monitoring Well/Recovery Well
- Private Well
- Reconnaissance Boring
- Geoprobe Boring (E&E 2000-2001; soil and water samples)
- Geoprobe Boring (URS 2003)

N

100 0 100
Feet

Notes:
1. PCE concentrations for some wells were ignored due to the sample being located in a transition zone between the shallow and deep zones of the shallow aquifer. It is presumed that these locations underestimate true maximum concentrations in the deep zone, especially downgradient of the United Rentals Building.
2. Contours are based on maximum groundwater concentrations and do not represent a single time-specific sampling event.
3. Image from ©2011 Google™

Figure 5-7
Hamilton / Labree Lower Zone of Shallow Aquifer
PCE Isoconcentration Plot - Historical

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Hamilton / Labree Roads Superfund Site

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Date: April 25, 2013, File: \\irvsvr01\GIS\50898_USEPA_Region10_Federal\56094\2013\ROD\Figure5-8_AirSamplingLocations.mxd

Legend

- Project Site Boundary
- Sub-Slab Sample
- Indoor Air Sample
- Ambient Air Sample

N

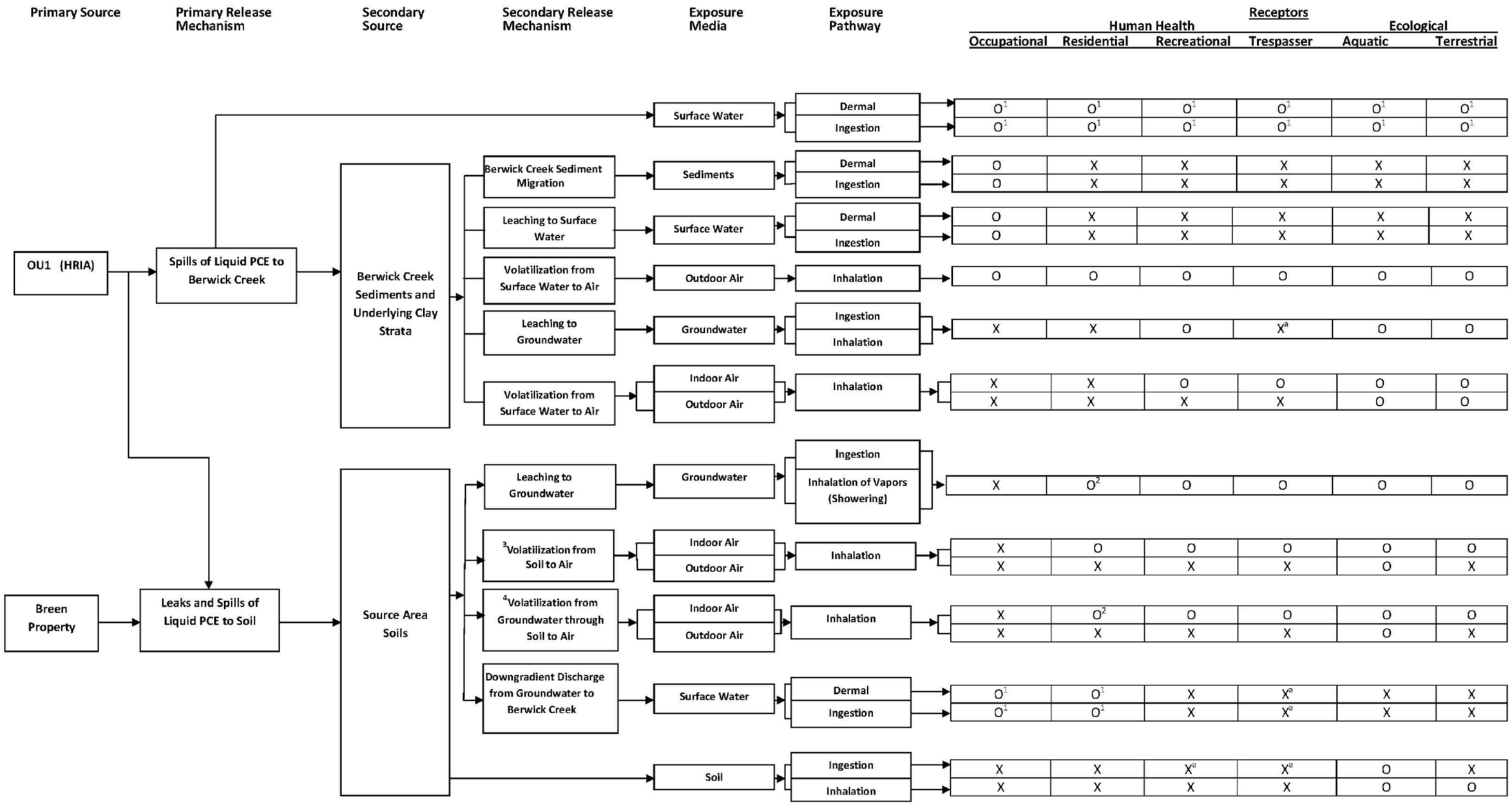
400 0 400
Feet

Sources:
1. U.S. EPA Environmental Response Team [EP_C-04-032]
2. Image from ©2011 Google™

Figure 5-8
Ambient Air and Soil Vapor Sample Locations

EPA REGION 10

Hamilton / Labree Roads Superfund Site



Developed by Julius Nwosu, Risk Assessor/Toxicologist-EPA Region 10, Seattle, Washington (206) 553-7121 from the Exposure Pathway and Receptor CSM presented in September 2011 Baseline Risk Assessment Report (CDM Smith 2011a)

Notes:
X = Potentially Complete Exposure Pathway
X^a = Incidental ingestion / dermal exposure
O = Incomplete Exposure Pathway
1 - Initial mass of dissolved PCE in surface water moved downstream and is no longer present..
2 - Groundwater ingestion and inhalation of vapors through showering is currently an incomplete exposure pathway because drinking water is obtained from the municipal water-supply system within OU1 and certain areas of OU2. There are, however, certain areas in OU2 where the drinking water source is from private-wells. PCE has not been detected in these wells to date; however, in the future there is the potential for the contaminated groundwater plume to reach these wells if the primary source areas are not remediated.
3 - Will occur if there is PCE in unsaturated zone.
4 - Will occur if there is PCE in the dissolved phase in groundwater producing vapors that travel through unsaturated soil to air.

Figure 7-1
Conceptual Site Model - Exposure Pathways and Receptors

EPA REGION 10

Hamilton / Labree Roads Superfund Site

Date: April 25, File: \\rvsvr01\GIS\50898_USEPA_Region10_Federal\56094\2013\ROD\Figure 7-1_Conceptual Site Model.mxd

(b)(4) copyright

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MW - monitoring well
PCE - tetrachloroethene
SB - soil boring

Sources:
1. Image from ©2011 Google™

Legend

- Subsurface Soil Remediation Zone (PCE greater than 10 mg/kg)
- Creek Bed Sediment/Bank Surface Soil Remediation Zone (PCE greater than 0.468 mg/kg)
- Subsurface Soil Sample Location Containing DNAPL
- Creek Bed Sediment Sample Location Containing DNAPL
- Auger Boring (URS / EPA, 2003)
- Monitoring Well (MW-602: URS / EPA, 2003) and (MW-9: E & E / EPA (Start, 2000 - 2001))

Figure 8-1
Creek Bed Sediment/Bank Soil and Subsurface Soil PCE Target Remediation Zones

EPA REGION 10

Hamilton / Labree Roads Superfund Site

Date: April 25, 2013, File: \\irvs

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Legend

- HRIA OU1 Boundary
- Creek Bed Sediment/ Bank Surface Soil Remediation Zone (PCE greater than 0.468 mg/kg) (Area: 7,348 sq. ft.)
- Subsurface Soil Remediation Zone (PCE greater than 10 mg/kg) (Area: 9,450 sq. ft.)
- High Concentration Groundwater Remediation Zone (PCE greater than 4,000 ug/L) (Area: 69,438 sq. ft.)
- 1,000 ppb — PCE Isoconcentration Contour in Shallow Groundwater (<=25 feet depth) Using Historical Maximum Values[1]
- 1,000 ppb — PCE Isoconcentration Contour in Deep Groundwater (>25 feet depth) Using Historical Maximum Values[2]
- 1,000 ppb — MVS-Modelled 1,000 ppb PCE Isoconcentration Contour[3] (Area: 158,000 sq. ft.)
- 2,000 ppb — MVS-Modelled 2,000 ppb PCE Isoconcentration Contour[3] (Area: 95,731 sq. ft.)
- 10,000 ppb — MVS-Modelled 10,000 ppb PCE Isoconcentration Contour[3] (Area: 47,421 sq. ft.)
- 20,000 ppb — MVS-Modelled 20,000 ppb PCE Isoconcentration Contour[3] (Area: 36,260 sq. ft.)
- Mass Discharge Performance Monitoring Location
- Creek Channel Soil Sample
- Monitoring Well
- Monitoring Well/Recovery Well
- Private Well
- Reconnaissance Boring
- Surface Water

N

100 0 100
Feet

Sources:
1. Image from ©2011 Google™

Figure 8-2
Proposed Remediation Target Zones

Date: April

1. Shallow aquifer contour from Remedial Investigation (CDM Smith, September 2011) showing maximum historic values.
2. Deep aquifer contour from Remedial Investigation (CDM Smith, September 2011) showing maximum historic values.
3. MVS modeled contours using only the most recent available data from a given locations (Appendix A).

Acronyms:
MVS - mining visualization system
HRIA - Hamilton Labree Impact Area
OU1 - Operable Unit 1
mg - milligram
MW - monitoring well
kg - kilogram
sq - square
ft - feet
ug - microgram
L - liter
PCE - tetrachloroethene
PW - private well
SW - surface water
CC - creek channel
RS - reconnaissance boring

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Date: January 14, 2013, File: \\irvsvr01\GIS\50898_USEPA_Region10_Federal\56094\2013\ROD\Figure9-1_ConceptualRemedialConfiguration.mxd

Legend

- HRIA OU1 Boundary
- Area of Creek Bed Sedimentary / Soil Removal Replaced by Stream Habitat Underlain by Geosynthetic Clay Liner (GCL)
- Creek Bed Sediments/Bank Surface Soil Remediation Zone (PCE greater than 0.468 mg/kg)
- High Concentration Groundwater Remediation Zone (PCE greater than 4,000 ug/L)
- Subsurface Soil Remediation Zone (PCE greater than 10 mg/kg)
- Stream Diversion
- AB5 Auger Boring
- AB-651 Auger Boring
- B2 Soil Boring
- BS-462 Stream Bed
- GP3 Geoprobe Boring
- GP-111 Geoprobe Boring
- GP-511 Geoprobe Boring
- MW-13 Monitoring Well
- SB-411 Stream Bank
- Vapor Recovery Well*
- Thermal Heating Electrodes*
- Temperature Monitoring Point*
- Bioremediation Injection Wells*

40 0 40
Feet

N

Notes:
1. MVS modeled contours using only the most recent available data from a given locations (Appendix A).
2. Monitoring wells and recovery wells located within the plume will be abandoned prior to implementation of ERH.
3. Remediation target zones based on MVS-modeled contaminant extents in sediment, soil and groundwater.
4. * = Locations approximate, exact locations to be determined by contractor.
5. Developed from CDM Smith RI Report (2011).
6. Image from ©2011 Google™

Figure 9-1
Comprehensive Treatment Scenario (CTS) 2
Conceptual Remedial Configuration

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Legend

- HRIA OU1 Boundary
- Area of Creek Bed Sedimentary / Soil Removal Replaced by Stream Habitat Underlain by Geosynthetic Clay Liner (GCL)
- Creek Bed Sediments/Bank Surface Soil Remediation Zone (PCE greater than 0.468 mg/kg)
- High Concentration Groundwater Remediation Zone (PCE greater than 4,000 ug/L)
- Subsurface Soil Remediation Zone (PCE greater than 10 mg/kg)
- Stream Diversion
- AB5 Auger Boring
- AB-651 Auger Boring
- B2 Soil Boring
- BS-462 Stream Bed
- GP3 Geoprobe Boring
- GP-111 Geoprobe Boring
- GP-511 Geoprobe Boring
- MW-13 Monitoring Well
- SB-411 Stream Bank
- Oxidant Injection Locations*
- Vapor Recovery Well*
- Thermal Heating Electrodes*
- Temperature Monitoring Point*

40 0 40
Feet

N

Notes:
1. MVS modeled contours using only the most recent available data from a given locations (Appendix A).
2. Monitoring wells and recovery wells located within the plume will be abandoned prior to implementation of ERH.
3. Remediation target zones based on MVS-modeled contaminant extents in sediment, soil and groundwater.
4. * = Locations approximate, exact locations to be determined by contractor.
5. Developed from CDM Smith RI Report (2011).
6. Image from ©2011 Google™

Figure 9-2
Comprehensive Treatment Scenario (CTS) 3
Conceptual Remedial Configuration

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