Analysis of Brownfields Cleanup Alternatives
1021 & 1037 Baseline Street, Cornelius, OR

Prepared for:

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Analysis of Brownfields Cleanup Alternatives Report
1021 & 1037 Baseline Street, Cornelius, OR

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1.0 Introduction

Eastern Research Group, Inc. (ERG) was contracted by the U.S. Environmental Protection Agency (EPA) on behalf of the City of Cornelius (the Applicant) to conduct an Analysis of Brownfields Cleanup Alternatives (ABCA) for the 1021 & 1037 Baseline Street Site located in Cornelius, OR, hereinafter referred to as "the Site" or "the subject property."

In April 2024, the City of Cornelius requested assessment and technical assistance services from the EPA Region 10 Targeted Brownfields Assessment (TBA) Program to conduct a Phase II Environmental Site Assessment (ESA) to acquire information regarding the nature of contamination (if present) and risks posed by that contamination to support future cleanup of the Site.

The Phase II report identified petroleum contaminants of concern (COCs) in soil vapor and metals in soil at concentrations exceeding Oregon Department of Environmental Quality (ODEQ) Risk-Based Concentrations (RBCs) (ODEQ 2023, 2024) for Site users.

Soil vapor sampling results indicate exceedances of ODEQ Residential and Commercial Soil Vapor RBCs for Total Petroleum Hydrocarbons-Gasoline Range Organics (TPH-GRO) near the former underground storage tanks (USTs).

In addition, arsenic and lead were detected in surface and near surface soils within the former rail spur footprint at concentrations exceeding ODEQ Residential Soil and Commercial Soil RBCs, although arsenic and lead concentrations appear to fall within background levels for the Portland Basin.

The presence of asbestos-containing building materials (ACBM), mercury-containing light bulbs, and suspect polychlorinated biphenyls (PCB)-containing ballasts was confirmed in Site structures through a hazardous building materials survey (HBMS).

1.1 Purpose

This ABCA identifies the cleanup goals that must be met to ensure that present or future risk to human health or the environment is reduced to protective levels based upon present and future uses of the Site. This ABCA presents cleanup alternatives and describes the evaluation methods used to select a cleanup alternative that will address known COCs and associated risks at the Site. The cleanup alternatives are evaluated on the basis of protection of human health and the environment, ease of implementation, cost of remediation, sustainability, ability to meet proposed land use, and compliance with applicable standards.

1.2 Report Structure

Section 1.0 Introduction provides an overview and brief description of the purpose and scope of the ABCA.

Section 2.0 Background includes a brief Site history and a summary of prior environmental investigations at the Site.

Section 3.0 Development of Cleanup Goals includes a discussion of the current and future land use, COCs, and cleanup goals for the Site.

Section 4.0 Identification of Brownfields Cleanup Alternatives identifies and describes proposed cleanup alternatives.

Section 5.0 Evaluation of Cleanup Alternatives describes the criteria used to evaluate the proposed cleanup alternatives presented in Section 4.0.

Section 6.0 Comparison of Cleanup Alternatives compares the analysis of the proposed alternatives against the evaluation criteria and ranks them based on low to high success, producing a preferred alternative with the highest score.

Section 7.0 Limitations and Additional Assessment describes the limitations associated with planning-level estimates.

Section 8.0 References and Resources Used provides references for reports cited and used for resource information in this document.

Additionally, this report introduces specific documents and procedures designed to address certain environmental challenges associated with the Site. These include an Exposure Mitigation Plan, a Soil Management and Disposal Plan, and Activity and Use Limitations (AULs). These documents and procedures are similar in purpose to those described in the Scope of Work and the Prospective Purchaser Agreement between ODEQ and the City of Cornelius. If submitted to ODEQ in acceptable condition, these materials may satisfy the applicable requirements of the Prospective Purchaser Agreement.

2.0 Background

2.1 Site Location and Description

The subject property is located within the City of Cornelius in northwest Oregon. Cornelius is located 20 miles west of Portland, Oregon, and 40 miles north of Salem, Oregon. The subject property's general central point is located at 45.51986 degrees North Latitude and -123.0592 degrees West Longitude, within the northeastern quarter of Section 4 of Township 1 South, Range 3 West, Willamette Principal Meridian.

The subject property totals 0.53 acre and consists of two parcels (R407081 & R407090) owned by the City of Cornelius. The Site is accessible from South 11th Street, which defines the eastern border of the property or from East Baseline Street, which defines the property's northern border. South 10th Avenue defines the property's western border. The southern boundary of the property is defined by a railroad easement that separates the property from a residential neighborhood. Based on a 2024 City of Cornelius online zoning map, the area near the subject property is mixed zoning, consisting of commercial, general employment, civic, single-family, and multi-family uses. According to the December 2024 City of Cornelius zoning map, the subject property is designated central mixed use, with preferred developments that incorporate active first-floor commercial uses with upper-story residential or office uses. The Site layout is shown in Figure 1.

Dwight Estby Enterprises and/or Dwight Estby and Ethyl Estby owned the Site from 1982 until the dissolution of their marriage resulted in Dwight Estby becoming the sole owner in 2001. From 2002 to 2007, the Site operated as Tri-County Petroleum and has been inactive since 2007. In May 2009, the property was sold in public auction to M&G Collections LLC (M&G) in lieu of foreclosure for $150,000. The property was purchased by Islam R El Masry in 2015.

2.2 Site Use History

The Site was developed as early as 1888 as part of the Southern Pacific Railroad grounds and was further developed with a rail spur by 1912. By the early 1950s, the rail spur was no longer present, and the Site was developed as a fueling station in 1953. The Site has been used as a fueling station or gas station since the early 1950s, with apparent changes in the structures on-site since that time and construction of the current Site structures in 1997.

Two 3,000-gallon diesel fuel USTs were installed at the Site in 1957 and were subsequently decommissioned in place in 2008. The Site currently has seven USTs, including the two decommissioned tanks and five additional USTs (ranging in size from 3,000 to 10,000 gallons) that were installed between 1981 and 1985. A known gasoline release was identified at the Site in the early 1990s and received regulatory closure in 1996 from DEQ after approximately 24 tons of contaminated soil was removed from the Site. A second petroleum release from on-site USTs and/or associated buried piping was identified in 2006.

The Site is currently vacant with five inactive USTs, two decommissioned-in-place USTs, a service kiosk underneath a fueling canopy, and a building with a small bathroom and office (Figure 1). The current owner has covered all the buildings in plywood due to vandalism concerns. Three out-of-use fuel islands are present and several of the fuel pumps have been vandalized and remain open and damaged.

2.3 Site Reuse Plan

The subject property is designated central mixed use, with preferred developments that incorporate active first-floor commercial uses with upper-story residential or office uses. The proposed future use of the Site includes the City's intent is to sell property for development that meets the City's performance and design expectations and is expected to include mixed commercial/residential use or commercial use only that is compatible with central mixed-use development.

2.4 Summary of Previous Environmental Assessments

Previous environmental assessments conducted at the Site are briefly summarized below.

2.4.1 1996 Letter from Oregon Department of Environmental Quality (ODEQ)

The May 1996 letter from ODEQ, addressed to Dwight Estby Enterprises, states that gasoline contamination was discovered during station upgrades at the Site and 24 tons of soil was subsequently removed and disposed of at the Hillsboro Landfill (ODEQ 1996). No remaining contamination or signs of groundwater were reportedly encountered in the excavated areas. The extent of excavation is unknown, and the letter indicates that the cleanup activities were poorly documented. ODEQ issued a No Further Action (NFA) determination in the letter with regards to the contamination and the associated cleanup.

2.4.2 2006 Site Assessment Report

The August 2006 Site Assessment report documents subsurface investigations completed by K&S Environmental (K&S) in July 2006 (K&S 2006). The report indicates five underground storage tanks ranging from 3,000 to 10,000 gallons are present on-site. K&S was contacted at the request of the owner, Mr. Estby, to investigate subsurface conditions in the vicinity of the 5,000-gallon UST. Four borings (B-1 through B-4) were advanced to depths ranging from 8-12 feet below ground surface (bgs). B-1, B-2, and B-4 were centered around the 5,000-gallon tank, and B-3 was advanced under the pump canopy next to a dispenser. Laboratory hydrocarbon identification testing (HCID) indicated GRO were present in samples collected between 8 to 11 feet depth bgs at borings B-1, B-2, and B-4 (indicated within the report as: Positive, Positive, and Positive, respectively). Soil samples were analyzed for TPH by method NWTPH-Gx and gasoline constituents benzene, toluene, ethylbenzene, total xylenes, and naphthalene (BTEXN) by EPA Method 8021B. TPH-GRO were detected in boring locations B-1, B-2, and B-4 (108 parts per million [ppm], 659 ppm, and 107 ppm, respectively). Benzene was detected in borings B-1, B-2, and B-3 (1.32 ppm, 13.2 ppm, and 0.785 ppm, respectively). K&S recommended additional investigation.

2.4.3 2007 Subsurface Investigation Report

The October 2007 subsurface Investigation report completed by K&S documented the collection of soil and groundwater samples to further characterize the Site and collect information associated with decommissioning in place two USTs (K&S 2007). The 2007 report identifies two 3,000-gallon USTs were decommissioned and filled with pea gravel. During this visit, K&S advanced six supplemental borings to a depth of 15 feet bgs. The borings were completed as temporary groundwater monitoring wells. Three borings (TW1, TW2 and TW3) were centered around the two decommissioned USTs on the western portion of the site. Soil samples from these borings were collected at a depth of 10 feet bgs. Groundwater samples were collected from borings B-5, B-6 and B-7 installed along the northern, southern, and eastern boundaries of the USTs installed at the site. TPH-GRO was detected in groundwater and soil samples at elevated concentrations. BTEXN and other gasoline constituents were also detected in soil and groundwater. K&S concluded that groundwater impacts were greatest in the vicinity of the USTs and likely extended off-site. K&S recommended the installation of permanent groundwater monitoring wells and additional investigation.

2.4.4 2008 – 2009 Subsurface Investigations and Routine Monitoring Reports

In March 2008, K&S conducted a supplemental groundwater investigation including the advancement of borings completed as temporary monitoring wells (K&S 2008a). In July 2008, K&S installed and sampled four groundwater monitoring wells (MW-1 through MW-4), located near the northern, southern, and eastern boundaries of the UST area on the western portion of the property (K&S 2008b). An additional well was installed adjacent to the two decommissioned USTs. These wells were subsequently sampled in October 2008 and October 2009 (K&S 2008c, 2009). The results detected the presence of TPH-Diesel Range Organics (DRO), TPH-GRO, BTEXN, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, isopropylbenzene, n-propyl-benzene, and/or certain polycyclic aromatic hydrocarbons (PAHs) in groundwater during both of the sampling events. Sampling results indicated increasing concentrations of certain constituents over time. Monitoring well MW-1 (located at the southwestern property boundary) contained the highest concentrations of petroleum COCs.

2.4.5 2010 and 2011 ODEQ Notice of Violation Letters and 2012 Final Order

On August 19, 2010, and February 8, 2011 (ODEQ 2011), ODEQ issued initial and follow-up notice of violation (NOV) letters to the property owner, M&G. The letters identified the following NOVs related to a UST release at the Site:

- A failure to complete investigations for the magnitude and extent of contamination at the Site. Four quarterly monitoring events were required to be completed following the installation of groundwater wells in July 2008. Three non-consecutive sampling events were performed in July 2008, October 2008, and August 2009. The letter indicated that groundwater monitoring results for TPH-GRO and other constituents in MW-1 exceeded RBC standards for one or more exposure pathways.
- Failure to submit the results from a November 2009 investigation of the railroad right-of-way located south of the site.

On January 17, 2012, ODEQ issued a Final Order which assessed a civil penalty of $28,961 for failure to comply. The Final Order includes the following violations:

- Failure to initiate and complete a sufficient investigation to determine the full nature, magnitude, and extent of soil and groundwater contamination at the property including an insufficient quantity and frequency of groundwater sampling events and an insufficient number of soil samples collected.

- Failure to obtain the appropriate permit registration prior to resuming operation of a temporarily closed UST system. ODEQ issued a General Permit Registration Temporary Closure Certificate for the UST system at the Site on March 10, 2009, which expired on March 10, 2010.
- Failure to maintain a valid financial responsibility mechanism for the UST system.
- Failure to submit a modification application within 60 days after a change in ownership of the UST certification.
- Failure to submit reports and data related to a release from a UST.

2.4.6 2017 Groundwater Sampling Results

The January 2017 Groundwater Sampling report prepared by Alpha Environmental for Greene & Markley, P.C., summarizes groundwater sampling activities completed in December 2012 and February, August, September, and December of 2016 (Alpha 2017). Samples were tested for TPH-GRO, DRO and Residual Range Organics (RRO), benzene, toluene, ethylbenzene, and total xylenes (BTEX), Risk-Based Decision Making (RBDM) volatile organic compounds (VOCs) and PAHs. A 2018 Work Plan from Evren Northwest, Inc. (ENW) summarized the same dataset and noted that TPH-GRO concentrations in groundwater appear to correlate to the depth to groundwater, where higher concentrations are encountered when the depth to groundwater was greater (Evren 2018). ENW suggested that this may be indicative of partitioning of contamination from groundwater to soil as the groundwater elevation increases.

2.4.7 2018 Groundwater Monitoring Report

During December of 2018, ENW sampled MW-2, MW-3, and MW-4. The report notes that MW-1 appeared to be partially filled and could not be sampled (Evren 2019a). TPH-GRO results from the wells ranged from 200 to 8,700 micrograms per liter (ug/L) (MW-2 being the highest).

2.4.8 2019 Focused Site Investigation

The May 2019 Focused Site Investigation report, prepared by ENW for Islam El Masry, presents soil gas, soil, and groundwater data collected in February and April 2019 to further delineate petroleum impacts at the Site (Evren 2019b). ENW advanced seven soil borings (EB01 through EB08) at depths ranging from 5.5 to 8.5 feet bgs and six soil gas borings (SG01 through SG06) at depths ranging from 4 to 5 feet bgs and collected groundwater from each of the seven soil borings using a temporary well screen at depths ranging from 2 to 9.5 feet bgs. Concentrations of soil, soil gas, and groundwater samples collected during the event were below ODEQ RBCs.

The Focused Site Investigation concluded that construction worker direct contact to soil and groundwater was the only complete exposure pathway and could be managed with a Contaminated Media Management Plan. ENW recommended decommissioning all on-site USTs, pump islands, and monitoring wells.

2.4.9 2019 Second Round Soil Gas Assessment

In July of 2019, supplemental soil gas sampling was performed by ENW for Islam El Masry at the request of ODEQ due to anomalies identified in the February 2019 soil gas sampling (Evren 2019c). Samples collected in July during the dry season supplemented the samples collected during the wet season in February. Six samples were collected at 5 feet bgs immediately adjacent to the locations of the February 2019 sampling event. An additional sample was taken near MW-2. The results were consistent with the 2019 Focused Site Investigation report with detections all under ODEQ RBCs.

Following the 2019 supplemental event, ODEQ published revised RBCs for vapor intrusion in March 2024 (ODEQ 2024). The March 2024 vapor intrusion RBC for TPH-GRO in soil vapor for commercial land use is 40,000 micrograms per cubic meter (µg/m^3). The July 2019 soil gas result for TPH-GRO collected at SG-06, just west of the center pump island at the Site, was 50,398.2 µg/m^3, which exceeds the 2024 RBC.

2.4.10 2024 Phase I Findings

ERG conducted a Phase I ESA in November 2024 which identified recognized environmental conditions (RECs) associated with known releases from the on-site USTs, the on-site USTs without proper closure documentation, and historic Site operations. The Phase I ESA identified a historical REC associated with a known release from on-site USTs with regulatory closure. In addition, the Phase I ESA identified the potential presence of hazardous building materials (HBMs) in the kiosk structure as an area of concern. The Phase I ESA recommended: 1) groundwater and soil vapor sampling in the western portion of the property to evaluate whether exceedances of ODEQ's RBCs remain at the Site, and 2) soil sampling to evaluate current impacts to surface and subsurface soil due to the potential for continued releases from Site USTs without closure documentation and metals contamination from the historic on-site rail spur. ERG also recommended abandonment of the on-site monitoring wells, proper closure of the five remaining USTs that have not been decommissioned in accordance with State and local requirements, development of a contaminated media management plan to ensure proper handling and management of petroleum-impacted subsurface soils and groundwater, and completion of a HBMS (ERG 2024).

2.4.11 2025 Phase II Environmental Assessment

ERG completed a Phase II ESA in January and February 2025, with the report finalized in April 2025. Phase II ESA activities included groundwater sampling, soil vapor sampling, subsurface soil grab sampling, surface and near-surface soil composite sampling within the former rail spur location, and a HBMS to quantify asbestos, lead, mercury, and PCBs in Site building materials.

Based on field observations, available information, and Site-specific data collected, ERG concluded the following:

- **Petroleum Impacts to Soil, Groundwater, and Soil Vapor.** All target petroleum COCs for soil and groundwater were below the ODEQ RBCs for Construction and Excavation Workers and Groundwater in Excavation.

  TPH-GRO was detected in vapor wells VP-3 and VP-5 above the ODEQ Residential Soil Vapor RBC. TPH-GRO at VP-5 also exceeded the ODEQ Commercial Soil Vapor RBC indicating that the documented releases at the Site continue to impact Site soil vapor in areas around the USTs.

  Due to the presence of the same COCs detected in groundwater and soil vapor, the groundwater to vapor intrusion pathway is considered complete.

  AULs designating the Site for commercial use would resolve some of the vapor intrusion concerns, except for the soil vapor exceedances in VP-5, which would require mitigation.

- **Metals in Surface Soil and Groundwater.** Arsenic was detected in four soil boring locations and lead was detected in one soil boring location within the footprint of the former rail spur at concentrations exceeding ODEQ RBCs for Residential and/or Occupational Soil. However, both the arsenic and lead concentrations identified in soil appear to fall within the expected range of natural background variation for arsenic and lead in the Portland Basin.

  In addition, thallium was detected in all soil boring locations within the former rail spur at concentrations exceeding the EPA RSL for Resident Soil (EPA 2024b). No ODEQ RBCs have been established for thallium. However, all thallium concentrations were below the 95% upper prediction limit for background concentrations for the Portland Basin.

- **Presence of Hazardous Building Materials.** The HBMS identified ACBM in samples along the seams of the main canopy's metal roof panels. Additionally, white caulking was observed on the main canopy roof and is presumed to contain asbestos. Mercury-containing high-intensity discharge (HID) light bulbs and suspect PCB-containing ballasts were also observed during the HBMS. These HBMs may pose a risk to current and future Site users and the environment.

Based on the findings and conclusions summarized above, ERG recommended that an ABCA be developed to evaluate cleanup alternatives and/or AULs related to vapor intrusion, HBMs, and closure of the inactive USTs (ERG 2025).

3.0 Development of Cleanup Goals

Cleanup goals vary depending on the current and reasonably likely future land uses at the Site. The following sections describe the current and future land uses and potential scenarios or pathways by which a Site user could be exposed to COCs at the Site and identifies applicable laws and regulations and cleanup goals for Site COCs.

3.1 Land Use

3.1.1 Current Land Use

The subject property is currently unused. The Site has five inactive USTs, two previously decommissioned USTs, a service kiosk underneath the fueling canopy, and a building that has a small bathroom and office space. As of the time of this report, the owner has covered all buildings in plywood due to concerns of vandalism. Three out-of-use fuel islands are present and several of the fuel pumps have been broken into and remain open and damaged.

3.1.2 Anticipated Future Land Use

Cleanup target levels vary depending on the current and reasonably likely future land uses at the Site. The proposed future use of the Site includes mixed commercial/residential use or commercial use only that is compatible with central mixed-use development.

3.1.3 Climate Considerations

EPA's Climate Change Adaptation Plan describes priority actions for EPA to integrate into its programs, policies, rules, and operations (EPA 2021a). The Adaptation Plan outlines the following potential impacts of changing weather conditions on contaminated sites:

- Wildfire, more intense flooding and coastal storms, and sea level rise, can release pollution from contaminated sites and/or industrial facilities.
- Increased temperatures and changes in runoff can adversely affect cleanups.
- Unexpected, climate-driven conditions can compromise the effectiveness of cleanup remedies selected without those impacts in mind.
- Climate impacts can increase the amount of debris sent to landfills and can also encroach on the landfills.

EPA Region 10's Climate Change Adaptation Implementation Plan (EPA 2022) further identifies vulnerabilities specific to the general geographic region where the Site is located, including:

1. Increased Precipitation Frequency and Intensity
2. Changes in Precipitation State, Snowpack, and Snowmelt
3. Flooding and Fluctuating Groundwater Elevation Levels Due to Precipitation Changes

4. Increased Drought
5. Increased Number and Severity of Wildfires
6. Sea-Level Rise
7. Permafrost Thaw
8. Increase in Average Annual Air Temperature

The Site is susceptible to several of the vulnerabilities identified above. Information obtained from the U.S. Climate Resilience Toolkit identifies potential impacts of changing weather conditions for Washington County, which encompasses the city of Cornelius, by comparing a historic period of 1976-2005 with modeled climate projections from mid-century (2035-2064) and late century (2070-2099).

Notable climate hazards identified for Washington County include extreme heat and flooding. During the historic period, Washington County had 7 days with a maximum temperature greater than 90°F; however, the climate projections indicate Washington County may experience 26 to 45 days with temperatures greater than 90°F in the mid and late portions of the 21st century using models that assume high levels of future emissions.

Although total annual precipitation is projected to remain relatively stable, the number of days per year with precipitation is expected to decrease from 200 days in the historic period to approximately 188 days in the late century. Additionally, the number of days that exceed 99th percentile precipitation is expected to increase from 6 days during the historic period to 9 days by the end of the century. Equivalent levels of annual precipitation spread out over fewer days, with an increasing number of precipitation events that are statistically abnormal which could increase risks associated with flooding.

Regarding cold weather, Washington County has historically had 3 days per year where the maximum temperature was less than 32°F. According to the high emissions model for late century, this number could go down to zero days per year. The EPA states that "the number of days below freezing during a year determines which plants can thrive, what food sources are available for animals, and when and how animals migrate or hibernate. Freezing temperatures also help reduce populations of certain insects and other pests" (EPA 2024a). While the difference between 3 and zero days per year is not particularly high, having no days in the year where the temperature stays below freezing could have a variety of ecological implications for the region.

FEMA's National Risk Index identifies the Washington County area, which encompasses the city of Cornelius, as having a relatively moderate risk of flooding and extreme heat. FEMA's Risk Index scores consider expected annual loss due to natural hazards, social vulnerability, and community resilience (FEMA 2024).

Based on the Site location and its proposed reuse, climate impacts are likely to affect the Site. The cleanup alternatives discussed in this report are accompanied by unquantifiable amounts of risk to their long-term performance due to uncertainties that may be introduced by extreme weather trends; however, to allow for relative comparison, the alternatives are discussed qualitatively. The alternatives include considerations of strategies for environmental adaptation and resilience, when practical, such as the topics outlined in EPA's Climate Smart Brownfields Manual (EPA 2021b).

3.2 Exposure Scenarios and Pathways

An exposure pathway is considered complete when a human or ecological receptor comes into contact with a contaminant in the environment (soil, air, and/or water) through ingestion, inhalation, or dermal exposure. A complete exposure pathway consists of four necessary elements: 1) a source and mechanism of chemical release to the environment, 2) an environmental transport medium for a released chemical, 3) a point of potential contact with the impacted medium (referred to as the exposure point), and 4) an exposure route (e.g., groundwater ingestion, vapor intrusion) at the exposure point.

When evaluating the need for cleanup actions, it is important to consider how Site users can be exposed to COCs at the Site (e.g., the relevant exposure scenarios and pathways).

Based on current and future Site uses the following exposure scenarios have been identified:

- Current and Future Adult and Child Site Visitor, Trespasser, or Recreational Scenarios
- Future Adult Occupational Worker Scenario
- Future Adult Excavation and Construction Worker Scenarios
- Future Adult and Child Residential Scenarios

ODEQ has not developed generic or site-specific RBCs for the Adult and Child Site Visitor, Trespasser, or Recreational scenarios, whether current or future. In addition, ODEQ typically does not evaluate these exposure scenarios for sites where commercial or mixed use development is planned, as the associated risks are generally considered low unless there are specific circumstances related to the development, such as the inclusion of a park or a large playground.

Depending on the exposure scenarios, Site users may come into contact with COCs in Site soil vapor on the western portion of the property, COCs in surface and near surface soils in the footprint of the former rail spur, groundwater during construction, and/or HBMs in Site structures.

The exposure pathways of concern are:

- Incidental ingestion and inhalation of, and dermal contact with arsenic and lead in surface or near surface soils.
- Incidental ingestion and inhalation of, and dermal contact with asbestos, PCBs, or mercury in HBMs within Site buildings.
- Incidental inhalation of TPH-GRO found in Site soil vapor in areas around the USTs.

As mentioned in Section 2.4.11, some petroleum COCs were identified during the 2025 Phase II ESA in Site soils and groundwater. However, no target petroleum COCs were detected in surface or near surface soils at concentrations exceeding Residential and Occupational ODEQ RBCs for direct contact nor were they detected in subsurface soils at concentrations above ODEQ RBCs for Construction and Excavation Workers. Additionally, petroleum COCs in groundwater did not exceed ODEQ RBCs for Groundwater in Excavation. Although some target petroleum COCs exceeded the EPA Maximum Contaminant Levels (MCL) or RSL for Resident Tapwater (EPA 2024b), the Site is connected to city water, and as such the groundwater ingestion pathways are considered incomplete. Some target COCs in groundwater may pose unacceptable risk due to vapor intrusion but were not compared to the groundwater RBCs for vapor intrusion as soil vapor sampling was conducted. With this said, the groundwater to vapor intrusion pathway is considered complete due to the presence of the same COCs detected in groundwater and soil vapor.

Thallium was detected in all soil boring locations within the former rail spur at concentrations exceeding the EPA RSL for Resident Soil (EPA 2024b). No ODEQ RBCs have been established for thallium. However, all thallium concentrations are below the 95% upper prediction limit for background concentrations for the Portland Basin.

Additionally, trace levels of lead were detected in each of the 7 representative paint samples taken from Site structures. Given that lead sampling results were sufficiently below criteria for lead-containing paint (LCP, 500 ppm) and lead-based paint (LBP, 5,000 ppm), none of the samples qualify as LCP or LBP.

3.3 Site Hazards and Contaminants of Concern

Several COCs were identified at concentrations above the ODEQ RBCs and EPA RSLs for Resident and Composite Worker Soil and/or Tapwater (EPA 2024b) and were above ODEQ RBCs and EPA Vapor Intrusion Screening Levels (VISLs) (EPA 2025) for soil vapor at the Site. However, the proposed cleanup criteria for surface soils to near surface soils and soil vapor (listed in Sections 3.3.1 and 3.3.2 below) are ODEQ RBCS for Residential and Occupational Soil and ODEQ RBCs for Residential and Commercial Soil Vapor, respectively. This section discusses Site COCs that exceed these cleanup criteria, in addition to hazardous materials identified during the 2025 HBMS.

3.3.1 Surface and Near Surface Soils

Arsenic was detected in surface and near surface soils (0-3 feet bgs) at concentrations above the ODEQ RBCs for Residential and Occupational soil (ODEQ 2024) and the 95th upper prediction limit for background concentrations at two boring locations within the footprint of the former rail spur; BH5 (9.45 milligrams per kilogram [mg/kg] at 0 - 1.5 feet bgs) and BH15 (12.6 mg/kg at 0 - 1.5 feet bgs)

Lead was also detected above the ODEQ RBC for Residential Soil and the 95th upper prediction limit for background concentrations in boring location BH3 (130 mg/kg at 1.5 -3.0 feet bgs).

3.3.2 Soil Vapor

TPH-GRO was detected in soil vapor at a concentration above the ODEQ Residential Soil Vapor RBC at well location VP-3 (11,000 $\mu g/m^3$) and above both the ODEQ Residential and Occupational Soil Vapor RBCs at well location VP-5 (650,000 $\mu g/m^3$).

No other target COC concentrations in soil vapor exceeded ODEQ RBCs (ODEQ 2024).

3.3.3 Asbestos-Containing Building Materials

Asbestos, commonly used in older buildings for insulation and fireproofing, becomes hazardous when disturbed. Its fibers can cause serious lung diseases, including cancer. Regulated ACBM is defined as containing greater than 1% asbestos content.

The 2025 HBMS identified black sealant containing greater than 1% asbestos on top of the attendant's station, underneath the main canopy. The material is along the seams of the structure's metal roof panels. Additionally, white caulking was observed on the main canopy roof and is presumed to contain asbestos. The material exists around the base of six structural steel posts.

3.3.4 Other Hazardous Building Materials

Based on visual inspection, PBS Engineering & Environmental identified 29 HID light bulbs under and on top of the main canopy. All 29 HID light bulbs are presumed to contain mercury. This assessment was based solely on visual observations, and no sampling was conducted. No mercury-containing electrical switches were observed within wall-mounted thermostats and gauges in any of the Site structures.

A damaged light fixture was observed inside the attendant's structure, but no bulbs were present. The fixture had been damaged by fire, and while no fluorescent bulb debris was found, a damaged light ballast remained with its labeling destroyed. Without identifying information, this ballast should be presumed to contain PCBs, and the fixture itself should be considered PCB-contaminated. This assessment was based solely on visual observations, and no sampling was conducted.

3.4 Applicable Laws and Regulations

Laws and regulations that are applicable to this cleanup are summarized in the following sections. All cleanup activities, including the removal, disposal, or handling of Site COCs, will be conducted in accordance with these and other applicable laws and regulations.

3.4.1 Metal in Surface and Near Surface Soils

ODEQ has established the following risk-based cleanup standard for arsenic and lead in soil for protection of residential and occupational users of the Site (ODEQ 2024):

- ODEQ Residential Soil RBCs
  - Arsenic – 0.43 mg/kg
  - Lead – 100 mg/kg
- ODEQ Occupational Soil RBCs
  - Arsenic – 1.9 mg/kg
  - Lead – 530 mg/kg

Background arsenic and lead concentrations in the Portland Basin are 8.8 mg/kg and 79 mg/kg, respectively. Typically, background levels are considered during cleanup and risk management decisions, and cleanup levels are not set below background levels.

3.4.2 Petroleum COCs in Soil Vapor

ODEQ has established a risk-based cleanup standard for TPH-GRO in soil vapor for protection of residential and occupational users of the Site (ODEQ RBCs for Residential and Commercial Soil Vapor, ODEQ 2024):

- Residential Soil Vapor RBC
  - TPH-GRO – 10,000 µg/m^3
- Occupational Soil Vapor RBC
  - TPH-GRO – 40,000 µg/m^3

3.4.3 Asbestos

EPA's Asbestos Hazard Emergency Response Act (AHERA) (40 CFR Part 763 Subpart E) defines building materials containing greater than 1% asbestos as ACBMs. AHERA establishes rules for conducting asbestos inspections and response actions (abatement) and tasked the EPA with developing a model plan for states that accredit personnel performing asbestos inspections and response actions.

EPA's Asbestos National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 61 Subpart M) requires an asbestos inspection to identify ACBMs prior to demolition or renovation. NESHAP requires the appropriate state agency be notified prior to initiating demolition/renovation when the building contains a certain threshold amount of asbestos or ACBM. NESHAP establishes emission control methods and requires the methods employed result in no visible emissions to outside air.

The OSHA's Asbestos General Standard (29 CFR Part 1910.1001 Subpart Z) specifies permissible exposure limits (PELs) for construction personnel, engineering controls, worker training, labeling, respiratory protection, and asbestos waste disposal requirements.

OSHA's Asbestos Construction Standard (29 CFR Part 1926.1101 Subpart Z) regulate construction work involving asbestos, including work practices during demolition and renovation, worker training, disposal requirements, and also specifies PELs.

ODEQ requires that friable asbestos abatement be performed by an ODEQ-licensed asbestos abatement contractor and that a 10-day notice of work and associated fee be submitted prior to conducting abatement. ODEQ also requires management of asbestos in proper containers and with proper labeling, and completion of an Asbestos Waste Shipment Report form to be provided to the permitted disposal facility at the time of disposal.

3.5 Cleanup Goal

The overall cleanup goal is to reduce or eliminate exposures to physical, environmental, and health hazards at the Site for future recreational, residential, commercial, and construction users. These goals will be achieved by addressing HBMs within Site structures, metal-containing soils, and the intrusion of VOCs from soil and groundwater to indoor air at the Site.

4.0 Identification of Brownfields Cleanup Alternatives

This section presents a range of reasonable and proven response actions and cleanup alternatives, based on COCs in Section 3.0, Site characteristics, current and future Site use, potential exposure pathways and associated risks, and overall cleanup goals.

These cleanup alternatives are designed to address the following media requiring cleanup (as identified in the 2025 Phase II ESA):

- Elevated levels of arsenic and lead (above ODEQ RBCs for Residential and/or Occupational Soil and the 95^{th} prediction limit for background concentrations) in surface and near surface soils in the vicinity of the former rail spur.
- Elevated levels of TPH-GRO in soil vapor (above ODEQ RBCs for Residential and/or Occupational Soil Vapor) in the vicinity of the USTs on the western and central portions of the subject property.
- Known and presumed HBMs in Site structures.

In addition, the Site currently has five inactive USTs that have not achieved any form of closure and two decommissioned-in-place USTs. The proposed cleanup alternatives are designed to address impacts at the Site in conjunction with or after decommissioning the remaining USTs; however, UST closure is not considered as part of the cleanup alternatives.

Potential cleanup alternatives are identified below and described in further detail in the following Sections.

Cleanup Alternatives for Metal-Containing Soils

- Alternative S1- Remove and Dispose of Metal-Containing Soils
- Alternative S2- Cap Metal-Containing Soils
- Alternative S3- No Action

Cleanup Alternatives for Petroleum COCs in Soil Vapor

- Alternative V1- In-Situ Injections, Vapor Intrusion Mitigation, and AULs [1]
- Alternative V2- Soil Removal, Vapor Intrusion Mitigation, and AULs [2]
- Alternative V3- No Action

Cleanup Alternatives for HBMs

- Alternative HBM1 – Abatement and Disposal of HBMs for Reuse of Site Structures
- Alternative HBM2 - Abatement and Disposal of HBMs for Demolition of Site Structures
- Alternative HBM3 – No action

It is possible with Alternatives S1, S2, and V1 that soils with metals and/or petroleum COC concentrations above ODEQ Residential and/or Occupational Soil RBCs (and regional background concentrations for metals) may remain at depth or under the existing structures or impervious surfaces following cleanup. For each of these cleanup alternatives, institutional controls, including an Exposure Mitigation Plan and a Soil Management and Disposal Plan, are required.

An Exposure Mitigation Plan outlines actions to reduce or eliminate exposure to soils with COC concentrations that exceed RBCs (and background concentrations for metals) and protect human health and the environment. This plan should identify the locations of the impacted soils, ways that residents, visitors, or workers could be exposed to these soils, and specific measures to control or limit these exposures. An Exposure Mitigation Plan should include the following components:

- Detailed information on the contaminants, including types, concentrations, and locations.
- A discussion of what activities could cause receptors to come into contact with the contaminants.
- Recommendations on ways to restrict or prevent direct contact with contaminated soil.
- AULs such as enforcing restrictions on excavation or soil disturbance in contaminated areas and periodic testing of clean soil caps, if applicable.
- Procedures for workers involved in excavation, construction, or any activities that may disturb contaminated soils, including personal protective equipment (PPE) requirements and decontamination practices.
- A plan to inform residents and visitors about the site, potential health risks, and behaviors to avoid (e.g., not digging, etc.).

A Soil Management and Disposal Plan should be developed prior to any excavation at the Site and addresses proper handling of metal-containing and/or petroleum contaminated soils (PCS) during future redevelopment activities. A Soil Management and Disposal Plan should include the following components:

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[1] For Alternative V1, it is assumed that the USTs will be decommissioned in place and the associated dispenser lines and dispensers will be removed. However, these activities are not considered part of the cleanup alternative.

[2] For Alternative V2, it is assumed that the USTs and the associated dispenser lines and dispensers will be removed. However, these activities are not considered part of the cleanup alternative.

- Procedures for identifying and segregating metal-containing and/or PCS from clean soils and safe storage methods including containment measures (such as liners, berms, or other methods) to prevent contaminants in excavated soils from impacting surface water, groundwater, or other Site soils.
- Procedures for the safe transportation of metal-containing and/or PCS including approved routes, handling procedures, and required documentation.
- Identification of approved disposal or treatment facilities that can accept the metal-containing and/or PCS.
- A system for tracking soil from the excavation site to its disposal location.
- References to applicable local, state, and federal regulations and disposal requirements.
- Identification of necessary permits for handling, transporting, and disposing of contaminated soil.

Development of Exposure Mitigation Plans and Soil Management and Disposal Plans are referenced within the specific descriptions of Alternatives S1, S2 and V1 below.

4.1 Cleanup Alternatives for Metal-Containing Soils

Metal-containing soils at the Site are capped with concrete and asphalt and do not currently pose a risk for direct contact if undisturbed. However, because future development of the Site could require excavation, Alternatives S1 and S2 address potential risks associated with the disturbance and disposal of soils at the Site.

4.1.1 Soil Cleanup Alternative S1 – Remove and Dispose of Metal-Containing Soils

Alternative S1 includes removing metal-containing soils for off-site disposal and development of Exposure Mitigation and Soil Management and Disposal Plans. Specifically, this alternative includes the following:

- Excavate arsenic-containing soils from between BH5 and BH15 up to 1.5 feet bgs and lead-containing soils around BH3 up to 3 feet bgs.
- Transport excavated soil offsite to a certified disposal landfill.
- Backfill excavated areas with clean fill or grade the Site at the excavated elevation.
- Develop and implement a Soil Management and Disposal Plan and an Exposure Mitigation Plan to address soils with metals concentrations above RBCs and background levels that may remain at depth and/or in soils under the existing structures and/or impervious surfaces following cleanup and that could be disturbed during future construction or excavation activities.

4.1.2 Soil Cleanup Alternative S2 – Cap Metal-Containing Soils

Alternative S2 manages metal-containing soils in place at the Site under existing or installed hard or soft caps. Alternative S2 includes the following:

- Maintain existing or install new hard or soft caps within target areas of the former rail spur to prevent exposure to arsenic and lead in surface and near surface soils. Buildings, parking lots, pavement, driveways, or other impervious surfaces can serve as hard caps. Soft caps are typically 4-12 inches of clean soil, compacted gravel, rock, or other non-organic material installed over a demarcation geotextile fabric.

- Develop and implement a Soil Management and Disposal Plan and an Exposure Mitigation Plan to address soils with metals concentrations above RBCs and background levels that could be disturbed during future construction or excavation activities.

4.1.3 Soil Cleanup Alternative S3 – No Action

The No Action Alternative assumes no cleanup will be undertaken at the Site and that risks associated with potential contact with metal-containing soil for current and/or future residents, visitors, and construction workers are not addressed.

4.2 Cleanup Alternatives for Soil Vapor

TPH-GRO was identified during the 2025 Phase II ESA in soil vapor above ODEQ Recreational and Occupational RBCs indicating potential risks associated with vapor intrusion to indoor air in existing and newly constructed buildings at the Site. TPH-GRO and other petroleum VOCs can move from PCS and groundwater into pore spaces in the subsurface and eventually migrate into indoor spaces through cracks in the building foundation. With this in mind, the alternatives presented for vapor intrusion also address petroleum contamination in soils and groundwater.

4.2.1 Alternative V1 – In-Situ Injections, Vapor Intrusion Mitigation, and Groundwater AULs

For this alternative, it is assumed that the USTs will be decommissioned in place and the associated dispenser lines and dispensers will be removed. However, these activities are not considered part of the cleanup alternative.

Alternative V1 includes in-situ injections to address target areas in the UST basin, vapor intrusion mitigation (e.g., vapor barriers and extraction systems), and the placement of AULs on groundwater and land use in conjunction with post-injection groundwater and soil vapor sampling results. Specifically, this alternative includes the following:

- Implement in-situ injections (of oxygen releasing compounds [ORCs] and/or activated carbon) around the UST basin to enhance degradation of petroleum-impacted media followed by post-injection groundwater and soil vapor monitoring.
- Install soil vapor barriers and sub-slab vapor extraction systems for new buildings constructed in the UST basin area to mitigate vapor intrusion.
- If necessary, place AULs on shallow groundwater extraction and restrict land use in areas near the UST basin until groundwater and soil vapor concentrations demonstrate reductions below RBCs.
- Develop and implement a Soil Management and Disposal Plan and an Exposure Mitigation Plan to address soils with petroleum COC concentrations above RBCs that remain at depth that could be disturbed during future construction or excavation activities.

4.2.2 Alternative V2 – Soil Removal, Vapor Intrusion Mitigation, and AULs

For this alternative, it is assumed that the USTs and the associated dispenser lines and dispensers will be removed. As with Alternative V1, these activities are not considered part of the cleanup alternative.

Alternative V2 includes the removal of PCS from the UST basin area, vapor intrusion mitigation (e.g., vapor barriers and extraction systems), and the placement of AULs on groundwater and land use in conjunction with post-injection groundwater and soil vapor sampling results. Specifically, this alternative includes the following:

- Implement removal of PCS from the UST basin following UST removals followed by post-removal groundwater and soil vapor monitoring.
- Install soil vapor barriers and sub-slab vapor extraction systems for new buildings constructed in the UST basin area to mitigate vapor intrusion.
- If necessary, place AULs on shallow groundwater extraction and restrict land use in areas near the UST basin until groundwater and soil vapor concentrations demonstrate reductions below RBCs.

4.2.3 Alternative V3 – No Action

The No Action Alternative assumes no cleanup will be undertaken at the Site and risks associated with potential contact with inhalation of petroleum VOCs in soil vapors are not addressed.

4.3 Cleanup Alternatives for HBMs

The HBMS identified ACBM in samples from black sealant along the seams of the main canopy's metal roof panels, and the white caulking observed on the main canopy roof is also presumed to contain asbestos. Mercury-containing HID light bulbs and suspect PCB-containing ballasts were also observed during the HBMS. These HBMs may pose a risk to current and future Site users and the environment.

Both Alternative HMB1 and HMB2 require that a licensed hazardous materials abatement and demolition contractor remove ACBM from the Site structures. The contractor would also remove all mercury-containing light fixtures and tubes and all PCB-containing ballasts and light fixtures for disposal at a regulated facility. Both alternatives require third-party oversight of all HBM abatement and demolition activities by a qualified industrial hygienist. This oversight will provide verification that proper work practices are followed, and all abatement and demolition activities are compliant with applicable regulations. Additionally, HMB2 includes demolition of remaining Site structures.

4.3.1 Alternative HBM1 – Abatement and Disposal of Hazardous Building Materials for Reuse of Site Structures

This alternative includes the following activities:

- Remove friable and non-friable ACBM and mercury- and PCB-containing light tubes by a qualified and licensed asbestos abatement contractor for offsite disposal per applicable local, state, and federal regulations.
- Retain the Site structures for future use. The cost of renovation is not included in this alternative, beyond tasks associated with removal or stabilization of regulated hazardous materials.

4.3.2 Alternative HBM2 – Abatement and Disposal of Hazardous Building Materials for Demolition of Site Structure

This alternative includes the following activities:

- Remove friable and non-friable ACBM and mercury- and PCB-containing light tubes by a qualified and licensed hazardous materials abatement and demolition contractor for offsite disposal per applicable local, state, and federal regulations.

- Demolition of Site structures and disposal of demolition materials in accordance with local, state and federal regulations.[3]

4.3.3 Alternative HBM3 – No Action

The No Action Alternative assumes no cleanup will be undertaken at the Site and risks associated with potential contact with HBMs in Site structures are not addressed.

4.4 Alternatives Considered but Not Carried Forward for Detailed Analysis

During ABCA development, ERG considered Soil Vapor Extraction and Dual Phase Extraction at the Site to address vapor intrusion concerns. However, given the high clay content in Site soils, these alternatives were deemed unsuitable and therefore were not pursued further.

Additionally, although not included as their own alternatives, it may be possible to select a subset of components of V1 and V2 to address vapor intrusion concerns (e.g. monitored natural attenuation through groundwater and soil vapor sampling, implementation of vapor intrusion measures, etc.).

5.0 Evaluation of Cleanup Alternatives

5.1 Description of Evaluation Criteria

The cleanup alternatives identified for the Site are evaluated in this section based on the following performance criteria:

1. Overall protection of human health and the environment
2. Ease of implementation
3. Cost
4. Sustainability, long-term effectiveness, and resilience of the remedial options to address potential adverse impacts caused by extreme weather events
5. Ability to meet proposed land use

The following sections describing these performance criteria serve as a basis for conducting a comparative analysis of the proposed remedial alternatives.

5.1.1 Overall Protection of Human Health and the Environment

This criterion is used to evaluate whether human health and the environment are adequately protected. Human health protection includes reducing risk to acceptable levels, either by reducing contamination concentrations or eliminating potential routes for exposure. Environmental protection includes minimizing or avoiding negative impacts to natural, cultural, and historical resources.

5.1.2 Ease of Implementation

Ease to implement refers to the technical and administrative feasibility of carrying out an alternative and the availability of the required services and materials. The following factors are considered for each alternative:

[3] A demolition alternative is analyzed for informational purposes, given that future project funding is unknown. Demolition may not be an eligible activity for EPA Brownfields funding resources, depending on site conditions.

- The likelihood of technical difficulties in constructing the alternative and delays due to technical problems.
- The potential for regulatory constraints to develop (e.g., as a result of uncovering buried cultural resources or encountering endangered species).
- The availability of necessary equipment, specialists, and provisions, as necessary.

5.1.3 Cost

This criterion considers the cost of implementing an alternative, including capital costs, Operations and Maintenance (O&M) costs, opportunity costs, and monitoring costs.

5.1.4 Sustainability, Long-term Effectiveness, and Resiliency

Sustainability and long-term effectiveness include an assessment for the potential need to replace the alternative's technical components in the long term. This criterion also considers the alternative's resiliency in light of reasonably foreseeable changing climate conditions at the Site. These changing climate conditions include a projected increase to winter temperatures, moderate risk of increased flooding, and extreme heat.

5.1.5 Ability to Meet Proposed Land Use

This criterion addresses the cleanup alternative's ability to meet the use and design requirements of the Site anticipated future use.

5.2 Detailed Analysis of Alternatives

All of the proposed alternatives (with the exception of the No Action Alternatives) have the potential to provide overall protection of human health and the environment and are designed in compliance with applicable laws and regulations. Because a No Action Alternative does not meet the goal for protection of human health and the environment, these alternatives are not included in the detailed analysis of cleanup alternatives.

5.2.1 Detailed Analysis of Soil Cleanup Alternative S1 – Remove and Dispose of Metal-Containing Soils

Alternative S1 includes removing metal-containing soils between BH5 and BH15 (0-1.5 feet bgs) and soils around BH3 (0-3 feet bgs) where arsenic and lead concentrations exceed the ODEQ RBCs for Residential and Occupational Soil (ODEQ 2024) and the 95th upper prediction limit for background concentrations in the Portland Basin.

This alternative also includes development and implementation of a Soil Management and Disposal Plan and an Exposure Mitigation Plan to address soils with metals concentrations above RBCs that may remain at depth and/or in soils under the existing structures and/or impervious surfaces following cleanup.

Overall Protection of Human Health and the Environment

The overall protection of human health and the environment would be met by this alternative which includes the removal of target areas of metal-containing soil and compliance with a site-specific Exposure Mitigation and Soil Management and Disposal Plans. Assuming adherence to these plans, this alternative would sufficiently protect human health and the environment by mitigating direct contact with contaminated soil by Site users.

Ease of Implementation

The implementation of Alternative S1 would require equipment and trained operators to excavate contaminated soils from the Site and would require the involvement of an environmental professional with knowledge of local, state, and federal laws and regulations that apply to occupational health and safety and characterization, transport, and disposal of contaminated media to oversee soil removal activities and development and implementation of Soil Management and Disposal and Exposure Mitigation Plans.

Cost

The cost for Alternative S1 is estimated to be approximately $43,000. The details for the cost estimate for Alternative S1 are provided in Appendix A.

The cost provided in Appendix A is based on the following assumptions:

- Soil excavation of approximately 72 cubic yards, which assumes the top 1.5 feet of soil are removed between the locations of BH5 and BH15 and the top 3 feet of soil are removed around BH3.
- Excavated areas will be backfilled with clean soils.
- The metal-contaminated soils will be transported from the Site to the nearest regulated facility by truck for disposal.
- The Exposure Mitigation Plan and the Soils Management and Disposal Plan will be developed by an environmental professional.
- All costs are planning level and are presented with a 15% contingency.

Alternative S1 is the most expensive alternative because of the high cost to excavate, transport, and dispose of metal-containing soils.

Sustainability, Long-term Effectiveness, and Resiliency

Alternative S1 will provide a high level of sustainability and long-term effectiveness to the extent that targeted areas of metal-containing soil would be removed from the Site for appropriate disposal and any potentially contaminated soil remaining beneath existing impervious surfaces will be managed appropriately (in accordance with site-specific Soil Management and Disposal and Exposure Mitigation Plans).

This alternative provides a high level of resiliency because metal-containing surface and near surface soils would be removed from the Site which reduces the vulnerability of impacts from extreme weather events. Alternative S1 requires the use of heavy equipment and burning of fossil fuels to excavate and transport contaminated soils for offsite disposal. Compared to Alternative S2, this alternative presents the greatest contribution to greenhouse gas emissions.

Environmental impacts associated with Alternative S1 are discussed further in the Environmental Footprint Analysis provided in Appendix B. Generally, the emissions and energy use estimated for Alternative S1 are high in comparison to other alternatives, due to the on-site use of heavy equipment for soil excavation and the offsite energy demands associated with transport of metal-containing soils to a disposal facility.

Ability to Meet Proposed Land Use

Alternative S1 would meet the desired future land use requirements because it removes soils with metals concentrations above ODEQ Residential and/or Occupational Soil RBCs and background levels from the Site. Additionally, it includes implementing plans to ensure that 1) safe work practices for construction or maintenance workers who handle soils are followed, and 2) soil that may be disturbed during Site development is handled and disposed of properly to mitigate inadvertent exposures or impacts to the environment.

5.2.2 Detailed Analysis of Soil Cleanup Alternative S2 – Cap Metal-Containing Soils

Alternative S2 includes maintaining existing or installed hard or soft caps over metal-containing soils in target areas (specifically the area within the former rail spur between BH5 and BH15 and around BH3 where metals concentrations exceed ODEQ Residential and/or Occupational Soil RBCs and background levels). As with Alternative S1, this alternative includes the development and implementation of a Soil Management and Disposal Plan and an Exposure Mitigation Plan to manage Site soils.

If existing caps and underlying soils are disturbed during Site development, the Soil Management and Disposal Plan and an Exposure Mitigation Plan must be followed, and the disturbed caps must be repaired or replaced. Newly constructed buildings and parking lots (hard caps) or landscaped areas (soft caps) could serve as caps in target areas and should be constructed and maintained in accordance with specifications outlined in the Exposure Mitigation Plan.

Overall Protection of Human Health and the Environment

The overall protection of human health and the environment would be met by this alternative which includes capping target areas and compliance with Site-specific Exposure Mitigation and Soil Management and Disposal Plans. Assuming maintenance of the cap and adherence to these plans, this alternative would sufficiently protect human health and the environment by eliminating potential risks associated with direct contact with contaminated soil by Site users.

Ease of Implementation

The Site is currently covered with an impervious cap; as a result, Alternative S2 can be partially implemented immediately followed by the development and execution of Site-specific Soil Management and Disposal and Exposure Mitigation Plans. As with Alternative S1, development of these plans requires the involvement of an environmental professional with knowledge of local, state, and federal laws and regulations that apply to occupational safety and characterization, transport, and disposal of contaminated media.

Cost

The cost for Alternative S2 is estimated to be approximately $15,000. The details for the cost estimate for Alternative S2 are provided in Appendix A.

The cost provided in Appendix A is based on the following assumptions:

- The existing hard caps at the Site are in good condition and do not require any immediate repairs or maintenance. In addition, if the existing caps are disturbed during redevelopment, the cost to replace or repair the existing caps will be included in Site redevelopment costs.
- An Exposure Mitigation Plan and Contaminated Soils Management and Disposal Plan are developed by an environmental professional.

- All costs are planning level and are presented with a 15% contingency.

Alternative S2 is less expensive to implement when compared to Alternative S1 because no soils will be removed from the Site for off-site disposal.

Sustainability, Long-term Effectiveness, and Resiliency

Alternative S2 will provide a high level of long-term effectiveness to the extent that targeted areas of metal-containing soil remain capped and are maintained in accordance with the Exposure Mitigation Plan.

This alternative provides a modest level of resiliency because metal-containing soils would remain onsite and could be vulnerable to impacts from increased flooding and potential erosion of existing or installed caps.

Environmental impacts associated with Alternative S2 are discussed further in the Environmental Footprint Analysis provided in Appendix B. Generally, the emissions and energy use sources estimated for Alternative S2 are low when compared to Alternative S1 due to the use of heavy equipment to excavate soils and transport for offsite disposal under Alternative S1.

Ability to Meet Proposed Land Use

Alternative S2 would meet the desired future land use requirements. This alternative would also require institutional controls to restrict activities in areas with metal-containing soils and to inform future property owners of potential contamination left on the property.

5.2.3 Detailed Analysis of Alternative V1 – In-Situ injections, Vapor Intrusion Mitigation, and AULs

For this alternative, it is assumed that the USTs will be decommissioned in place and the associated dispenser lines and dispensers will be removed. However, these activities are not considered part of the cleanup alternative.

Alternative V1 includes in-situ injections around the UST basin followed by groundwater and soil vapor sampling, installation of soil vapor barriers and vapor extraction systems for any newly constructed buildings to mitigate vapor intrusion, and placement of AULs on shallow groundwater extraction and use. AULs restricting land use within the UST basin may also be required depending on post injection groundwater and soil vapor sampling results.

The Phase II ESA identified the presence of petroleum COCs in subsurface soils (from 10 to 13 feet bgs) at concentrations above the ODEQ RBCs for Residential and Commercial Soil; however, these COCs did not exceed ODEQ RBCs for Construction and Excavation Workers. Based on this information, it is assumed that as long as residential and occupational Site users do not come into direct contact with subsurface soils in the UST basin, these soils are unlikely to pose a risk to Site users. For this reason, this alternative also includes development and implementation of a Soil Management and Disposal Plan and an Exposure Mitigation Plan to ensure that, if soil excavation is required in the vicinity of the UST basin for any reason (e.g., utility work, general maintenance, new construction etc.), PCS is handled, managed, and disposed of so that they do not pose unacceptable risks to Site users.

If developed in accordance with applicable laws and regulations and fully implemented, these plans would sufficiently protect human health and the environment, reduce potential risks associated with direct contact with contaminated soils during construction activities, and prevent mishandling of PCS.

Overall Protection of Human Health and the Environment

The overall protection of human health and the environment in the long-term would be met by this Alternative which includes 1) the reduction of petroleum COC concentrations in Site soil, groundwater, and soil vapor via in-situ treatment, 2) the prevention of vapor intrusion into new buildings through the installation of vapor barrier and extraction systems, and 3) AULs to restrict shallow groundwater extraction and use at the Site and land use within the UST basin, depending on post injection groundwater and soil vapor sampling results.

Ease of Implementation

The implementation of Alternative V1 would require equipment and trained operators to implement an injection treatment plan at the Site and would require the involvement of an environmental professional with knowledge of local, state, and federal laws and regulations that apply to occupational health and safety, underground injection programs, environmental covenants, and groundwater and soil vapor sampling procedures.

Alternative V1 requires post-injection soil vapor and groundwater sampling involving an environmental professional to demonstrate that the COCs at the Site no longer pose an unacceptable risk for human health or the environment.

Cost

The cost for Alternative V1 is estimated to be approximately $197,250. The details for the cost estimate for Alternative V1 are provided in Appendix A. Please note that although a line item for UST decommissioning is provided in Appendix A, this estimated cost does not include the cost for UST decommissioning.

The cost provided in Appendix Ais based on the following assumptions:

- In-situ injections would be completed within and around the UST basin (calculated to be approximately 7,500 square feet based on lateral PCS).
- It is estimated the injections will commence with a single mobilization will take three field staff (or field staff pay equivalent) approximately 15 field days to complete the injections. This injection event is considered single event.
- ORC or activated carbon will be used as the remedial product.
- The vapor mitigation costs are for a 1,500-square foot slab on grade commercial building. This cost is scalable.
- Post-injection groundwater monitoring costs are for quarterly sampling and soil vapor sampling for two events and reporting over the course of one year. The cost is estimated to be $25,000. This cost is scalable should multiple years of sampling be required.
- Soil vapor monitoring costs are for two post-injection events. This cost is scalable to include multiple years.
- AULs will be placed to restrict extraction and use of shallow groundwater at the Site and land use within the UST basin, depending on post injection groundwater and soil vapor sampling results.
- The cost to develop a Soil Management and Disposal Plan and an Exposure Mitigation Plan are included here, although it is also assumed under the cleanup alternative for metal-containing soil (Alternative S1 or S2).

- All costs are planning level and are presented with a 15% contingency.

Alternative V1 is less expensive compared to Alternative V2. In addition, the cost associated with UST decommission in place (which is assumed to be completed in conjunction with this alternative) is also less expensive compared to UST removal.

Sustainability, Long-term Effectiveness, and Resiliency

Alternative V1 will provide a high level of sustainability and long-term effectiveness to the extent that petroleum COCs in Site soil, groundwater, and soil vapor will be reduced via in-situ treatments.

Although in-situ injection technologies can be effective at reducing petroleum hydrocarbon concentrations in the short term, the potential for contaminant rebound presents a key consideration in evaluating the long-term reliability of this remedy. Rebound may occur as residual contamination in low-permeability zones or sorbed phases diffuses back into the treated groundwater plume after amendment concentrations decline. To address this, the injection design should incorporate considerations of subsurface heterogeneity and includes monitoring wells positioned to detect potential rebound. The performance monitoring plan should include groundwater sampling following injection to assess whether contaminant concentrations remain below cleanup levels. If rebound is observed, the Site may require additional injection events, transition to a different remedial strategy, or the implementation of contingency measures.

This alternative provides a high level of resiliency because the contaminated subsurface soils will remain buried at depth (10 to 13 feet bgs), reducing vulnerability to the impacts of changing weather trends and, if disturbed, will be handled in accordance with a Soil Management and Disposal Plan and disposed of in an offsite regulated facility, if required.

Alternative V1 requires the use of equipment and burning of fossil fuels to conduct in-situ treatment. Compared to Alternative V2 this alternative presents the least contribution to greenhouse gases due to the size of the equipment used and the duration of equipment use. It is important to consider that if the in-situ treatments do not achieve the intended reduction in contamination, even when combined with the proposed vapor mitigation, and if results suggest that active vapor treatment such as air stripping or thermal methods is required, there is potential for continued greenhouse gas emissions. This scenario was not included in the original Environmental Footprint Analysis. However, if future sampling provides new Site-specific information, the analysis should be revisited and updated accordingly.

Environmental impacts associated with Alternative V1 are discussed further in the Environmental Footprint Analysis provided in Appendix A. Generally, the emissions and energy use estimated for Alternative V1 are relatively less when compared to other alternatives.

Ability to Meet Proposed Land Use

Alternative V1 would meet the desired future land use requirements because the petroleum COCs in Site soil, groundwater, and soil vapor would be reduced and vapor mitigation systems and AULs would eliminate exposures to COCs in soil vapor and groundwater. However, closure in place of the USTs may limit redevelopment opportunities, including the ability to construct new structures on the western portion of the site above the USTs.

5.2.4 Detailed Analysis of Alternative V2 – Soil Removal, Vapor Intrusion Mitigation, and AULs

For this alternative, it is assumed that the USTs and the associated dispenser lines and dispensers will be removed. However, these activities are not considered part of the cleanup alternative. UST removal will also require geotechnical/structural engineering support to prevent damage to surrounding infrastructure.

Alternative V2 includes the removal of PCS within the UST basin area followed by groundwater and soil vapor sampling, installation of soil vapor barriers and vapor extraction systems for any newly constructed buildings to mitigate vapor intrusion, and placement of AULs on shallow groundwater extraction and use. AULs restricting land use within the UST basin may also be required depending on post injection groundwater and soil vapor sampling results.

Overall Protection of Human Health and the Environment

The overall protection of human health and the environment in the long-term would be met by this alternative which includes 1) the removal of PCS and subsequent reduction in petroleum COC concentrations in groundwater and soil vapor, 2) the prevention of vapor intrusion into new building through the installation of vapor barrier and extraction systems, and 3) AULs to restrict shallow groundwater extraction and use at the Site and land use within the UST basin, depending on post injection groundwater and soil vapor sampling results.

Ease of Implementation

The implementation of Alternative V2 would require heavy equipment and trained operators to implement the soil removal plan at the Site and would require the involvement of an environmental professional with knowledge of local, state, and federal laws and regulations that apply to occupational health and safety, environmental covenants, and soil, groundwater, and soil vapor sampling procedures. Additionally, geotechnical/structural engineering (for shoring etc.) will be required during the UST removal to prevent damage to surrounding infrastructure.

Alternative V2 requires post-removal confirmation soil, soil vapor, and groundwater sampling involving an environmental professional to demonstrate that the COCs at the Site no longer pose an unacceptable risk for human health or the environment.

Cost

The cost for Alternative V2 is estimated to be $298,250. The details for the cost estimate for Alternative V2 are provided in Appendix A. Please note that although a line item for UST decommissioning is provided in Appendix A, this is not included in the overall cleanup cost.

The cost provided in Appendix A is based on the following assumptions:

- Soil excavation (up to 15 feet bgs) will need to occur in the area of the UST basin (the extent of the excavation is dependent on the results of the photo-ionization detector [PID] screening during excavation). The total soil volume to be excavated is estimated to be 800 cubic yards for the cost estimate. Backfilling will occur after all excavated soils have been removed.
- The vapor mitigation costs are for a 1,500 square foot slab on grade commercial building. This cost is scalable.
- Post-excavation groundwater monitoring costs are for quarterly sampling and soil vapor sampling for two events and reporting over the course of one year. The cost is estimated to be $25,000. This cost is scalable should multiple years of sampling be required.
- AULs will be placed to restrict extraction and use of shallow groundwater at the Site and land use within the UST basin, depending on post injection groundwater and soil vapor sampling results.

- All costs are planning level and are presented with a 15% contingency.

Alternative V2 is the most expensive alternative because of the high cost to excavate, transport, and dispose of all accessible PCS in the UST basin.

Sustainability, Long-term Effectiveness, and Resiliency

Alternative V2 will provide a high level of sustainability and long-term effectiveness to the extent that any PCS would be removed from the Site and disposed of in an off-site regulated facility and petroleum COCs in Site groundwater and soil vapor will be reduced.

This alternative provides a high level of resiliency because the contaminated subsurface soils would be removed from the Site and disposed of in an off-site regulated facility, reducing vulnerability to the impacts from changing weather trends.

Alternative V2 requires the use of heavy equipment and burning of fossil fuels to conduct soil removals. Compared to Alternative V1, this alternative presents the greatest contribution to greenhouse gases due to the size of the equipment used and the duration of equipment use. It is important to consider that if soil removals do not achieve the intended reduction in contamination, even when combined with the proposed vapor mitigation, and if results suggest that active vapor treatment such as air stripping or thermal methods is required, there is potential for continued greenhouse gas emissions. This scenario was not included in the original Environmental Footprint Analysis. However, if future sampling provides new Site-specific information, the analysis should be revisited and updated accordingly.

Environmental impacts associated with Alternative V2 are discussed further in the Environmental Footprint Analysis provided in Appendix B. Generally, the emissions and energy use estimated for Alternative V2 are relatively greater when compared to other alternatives.

Ability to Meet Proposed Land Use

Alternative V2 would meet the desired future land use requirements because the PCS would be removed, concentrations of petroleum COCs in Site soil, groundwater, and soil vapor would be reduced, and vapor mitigation systems and AULs would eliminate exposures to COCs in soil vapor and groundwater.

5.2.5 Detailed Analysis of Alternative HBM1 – Abatement and Disposal of Hazardous Building Materials for Reuse of Site Structures

Alternative HBM1 includes the removal and disposal of friable and non-friable ACBM and mercury- and PCB-containing building materials from the Site structures in preparation for reuse.

Overall Protection of Human Health and the Environment

The overall protection of human health and the environment in the long-term would be met by this alternative which includes the removal of all ACBM and mercury- and PCB-containing building materials from the Site structures (in accordance with applicable regulations).

Although disturbance of HBMs may increase the potential for short-term exposure to asbestos, mercury, and/or PCBs during removal if proper regulatory procedures are not followed, the removal of HBMs will effectively reduce the risk of future long-term exposures to Site COCs. Transportation of HBMs for offsite disposal may pose a potential, but negligible, short-term risk to human health and the environment.

Ease of Implementation

The implementation of Alternative HBM1 requires a licensed hazardous materials contractor and accessible disposal facilities that accept HBMs. Cornelius is located in an area where there are numerous licensed contractors qualified to perform the hazardous materials removal and waste facilities to receive the materials.

Abatement of hazardous materials for retainment of the structures is more difficult than abatement for demolition purposes, due to the need for more precise and careful abatement required if a structure will be reused.

Alternative HBM1 may require additional rehabilitation of the Site structures after hazardous materials abatement, which is outside the scope of this ABCA.

Cost

The cost for Alternative HBM1 is estimated to be $6,100. The details for the cost estimate for Alternative HBM1 are provided in Appendix A.

The cost provided in Appendix A is based on the following assumptions:

- Abatement prior to renovation will occur for ACBMs. Additionally, mercury- and PCB-containing materials will be removed. The abatement costs include the costs of transportation and disposal of HBMs at the Hillsboro Landfill.
- All costs are planning level and are presented with a 15% contingency.

Alternative HBM1 is the least expensive alternative because the Site structures will remain and reduce overall demolition waste disposal costs. Given the potential scope of the removal and availability of contractors in the region, multiple abatement bids could be solicited to ensure competitive pricing.

Sustainability, Long-term Effectiveness, and Resiliency

Alternative HBM1 will provide a high level of long-term effectiveness because all HBMs will be removed and disposed of offsite. Clearance monitoring, third-party oversight, and confirmation sampling will verify the proper removal of all HBM. Removal of all hazardous materials eliminates the need for long-term management, monitoring, or maintenance of HBMs.

This alternative provides a high level of resiliency because, following cleanup, there would be no hazardous materials remaining onsite that could be vulnerable to impacts from changing weather trends.

Alternative HBM1 generates less non-hazardous debris to be transported and disposed of in offsite landfills compared to Alternative HBM2.

Environmental impacts associated with Alternative HBM1 are discussed further in the Environmental Footprint Analysis provided in Appendix B. Generally, the emissions and energy use estimated for Alternative HMB1 are relatively low in comparison to Alternative HBM2, due to less use of heavy equipment on-site and the lower volume of waste to be managed.

Ability to Meet Proposed Land Use

Alternative HBM1 would meet the desired future land use requirements.

5.2.6 Detailed Analysis of Alternative HBM2 – Abatement and Disposal of Hazardous Building Materials for Demolition of Site Structures

Alternative HBM2 includes the removal and disposal of friable and non-friable ACBM and mercury- and PCB-containing building materials from and demolition of Site structures for offsite disposal.

Overall Protection of Human Health and the Environment

The overall protection of human health and the environment in the long-term would be met by this Alternative which includes the removal of all ACBM and mercury- and PCB-containing building materials from and demolition of Site structures (in accordance with applicable regulations).

As with Alternative HBM1, although disturbance of HBMs may increase the potential for short-term exposure to these materials during removal and demolition if proper regulatory procedures are not followed, removal and demolition will effectively reduce the risk of future long-term exposures to Site COCs. Transportation of HBMs and demolition waste for offsite disposal may pose a potential, but negligible, short-term risk to human health and the environment.

Ease of Implementation

The implementation of Alternative HBM1 requires a licensed hazardous materials and demolition contractor and accessible disposal facilities that accept HBMs. Cornelius is located in an area where there are numerous licensed contractors qualified to perform the hazardous materials removal and waste facilities to receive the materials.

Abatement of hazardous materials for demolition is generally easier to implement than abatement for renovation due to the need for more precise and careful abatement if a structure is to be reused.

Selection of a contractor to conduct both hazardous materials abatement and demolition activities may offer additional ease of implementation; however, abatement and demolition services could be contracted separately

Cost

The cost for Alternative HBM2 is estimated to be $32,200. The details for the cost estimate for Alternative HBM2 are provided in Appendix A.

The cost provided in Appendix A is based on the following assumptions:

- Abatement prior to demolition will occur for ACBMs. Additionally, mercury- and PCB-containing materials will be removed. The abatement costs include the costs of transportation and disposal of HBMs at the Hillsboro Landfill.
- After removal of ACBMs, mercury, and PCBs, the buildings will be demolished, and the remaining building debris will be disposed of at the Hillsboro Landfill.
- All costs are planning level and are presented with a 15% contingency.

Alternative HBM2 is the most expensive alternative because the Site structures will be demolished and disposed of offsite. Given the potential scope of the removal and availability of contractors in the region, multiple abatement and demolition bids could be solicited to ensure competitive pricing.

Sustainability, Long-term Effectiveness, and Resiliency

Alternative HBM2 will provide a high level of long-term effectiveness because all HBMs will be removed and disposed of offsite. Clearance monitoring, third-party oversight, and confirmation sampling will verify the proper removal of all HBM. Demolition of all Site buildings eliminates the need for long-term management, monitoring, or maintenance of HBMs.

This Alternative provides a high level of resiliency because, following cleanup, there would be no buildings with hazardous materials remaining onsite that could be vulnerable to impacts from changing weather trends.

Considering full demolition of Site structures, Alternative HBM2 generates more non-hazardous debris to be transported and disposed of in landfills than Alternative HBM1.

Environmental impacts associated with Alternative HBM2 are discussed further in the Environmental Footprint Analysis provided in Appendix B. Generally, the emissions and energy use estimated for Alternative HBM2 are relatively high in comparison to other alternatives, due to increased use of heavy equipment on-site to demolish site structures and the higher volume of waste to be managed due to demolition. These estimates do not take into account waste, energy use, and emissions associated with rehabilitation of the site buildings.

Ability to Meet Proposed Land Use

Alternative HBM2 would meet the desired future land use requirements.

6.0 Comparison of Cleanup Alternatives

Section 6.1 compares each of the proposed alternatives based on the performance criteria described in Section 5.1. The ability of each alternative to meet the performance criteria is measured on a three-point scale with:

- 1= Low Success
- 2= Moderate Success
- 3= High Success

Based on the comparative analysis discussed in the following sections and the total performance scores shown in Table 1, Table 2, and Table 3, the following are the preferred alternatives:

- Alternative S2 - Cap Metal-Containing Soils
- Alternative V1- In-Situ injections, Vapor Intrusion Mitigation, and AULs
- Alternative HBM2- Abatement and Disposal of Hazardous Building Materials for Demolition of Site Structures

6.1 Comparison of Cleanup Alternatives for Metal-Containing Soils

6.1.1 Overall Protection of Human health and the Environment

With the exception of the No Action Alternative, Alternatives S1 and S2 will provide adequate levels of protection to human health and the environment. The alternatives will provide the necessary protection to human health and the environment over a long period of time because they either remove (Alternative S1) or cap (Alternative S2) metal-containing soils and development and implementation of Soil Management and Disposal and Exposure Mitigation Plans prevent releases to the environment and exposure to Site users. Considering that target areas of metal-containing soil are removed under Alternative S1, it is considered slightly more protective than Alternative S2.

6.1.2 Ease of Implementation

The work practices required for Alternatives S1 and S2 are well established. There are accessible disposal facilities within a reasonable distance of the Site such that Alternative S1 can be implemented with relative ease. The ease of implementation is considered to be moderately high for Alternative S1 and high for Alternative S2. The No Action Alternative does not require any work to be completed and therefore the ease of implementation is considered high. Although Alternatives S1 and S2 are not considered within the context of potential UST and tank line removals, the ease of implementation for Alternative S1 may be increased if performed in conjunction with potential tank line removal activities as it would reduce the need to navigate soil removal around subsurface tank piping.

6.1.3 Cost of Remediation

The cost for each cleanup alternative is presented in Appendix A, along with the assumptions associated with the cost estimates. These costs are planning level estimates intended only for the relative comparison of the alternatives and should not be used as budget- or design-level estimates. Solicitation of bids from multiple local contractors during project planning will help ensure competitive pricing.

Overall, the cost for Alternative S1 is considered to be moderate while the cost for Alternative S2 is considered to be low. The costs of Alternatives S1 and S2 are both higher than the No Action alternative due to labor and costs associated with excavation and management of contaminated soil under Alternative S1 and maintenance of existing caps under Alternative S2. Alternative S2 assumes no metal-containing soil is removed from the Site, making it more cost effective than Alternative S1.

6.1.4 Sustainability, Long-term Effectiveness and Resiliency

Both Alternative S1 and Alternative S2 are considered to be sustainable and effective over the long term. The long-term effectiveness of Alternative S2 is dependent on the extent to which the caps are maintained and the Soil Management and Disposal and Exposure Mitigation Plans are implemented at the Site. Alternative S1 offers greater resiliency to possible future extreme weather trends risks due to the targeted removal of metal-containing soil for offsite disposal when compared to Alternative S2, which allows for these soils to remain in place which could be affected by future extreme weather events. However, by leaving metal-containing soils in place, the environmental footprint of Alternative S2 is less than Alternative S1.

The No Action Alternative is considered to be the least effective alternative in the long term and is the least resilient to extreme weather trends of all the Alternatives.

6.1.5 Ability to Meet Proposed Land Use

The proposed future land use is expected to include mixed commercial/residential use or commercial use only that is compatible with central mixed-use development. Alternatives S1 and S2 will both meet future land use requirements by eliminating exposure to metal-containing soils. Alternatives S1 or S2 could be implemented over time in conjunction with future site improvements.

Table 1. Comparative Analysis of Cleanup Alternatives for Metals-Containing Soils

Cleanup Alternative	Overall Protection of Human Health and the Environment	Ease of Implementation	Cost-Effective Approach towards Remediation	Sustainability -O&M and Long-term Effectiveness	Ability to Meet Proposed Land Use	Total Score

Alternative S1- Remove and Dispose of Metal-Containing Soils[a]	3	2	2	3	3	**13**
Alternative S2- Cap Metal-Containing Soils[a]	2	3	3	2	3	**13**
Alternative S3 – No Action	0	3	3	1	1	**8**

Notes:
[a] This alternative includes a Soil Management and Disposal Plan and Exposure Mitigation Plan.
(0 = does not achieve the criteria, 1=Low Success, 2=Medium Success, 3=High Success)
(For Cost: 1=High Cost, 2=Medium Cost, 3=Low Cost)

6.2 Comparison of Cleanup Alternatives for Petroleum COCs in Soil Vapor

6.2.1 Overall Protection of Human health and the Environment

With the exception of the No Action Alternative, Alternatives V1 and V2 will provide high levels of protection to human health and the environment. The alternatives will provide the necessary protections to human health and the environment over a long period of time because they remove or treat PCS to reduce petroleum COC concentrations in environmental media and prevent exposure to petroleum COCs in soil vapor and groundwater. Under Alternative V1, Site soils remain in place and are treated in-situ and under Alternative V2 the Site soils will be removed for offsite disposal. Under both alternatives vapor barriers and vapor extraction systems mitigate vapor intrusion and AULs restrict extraction and use of shallow groundwater at the Site and land use within the UST basin, depending on post injection groundwater and soil vapor sampling results.

6.2.2 Ease of Implementation

The work practices required for Alternatives V1 and V2 are similar and are well established in the industry. The ease of implementation for Alternative V1 is considered moderate. Alternative V1 relies on an in-situ treatment work plan drafted and managed by an environmental professional with knowledge of in-situ petroleum remediation and local, state, and federal laws. Comparatively, the ease of implementation for Alternative V2 is considered low due to the engineering design, shoring, and heavy equipment needed to remove the USTs prior to PCS removal. PCS removal will also require the use of heavy equipment to excavate, load, and transport PCS to a regulated facility. Additionally, both alternatives include installation and maintenance of vapor mitigation systems and groundwater monitoring for long term success of the Site, which should also be conducted by an environmental professional.

The No Action Alternative does not require any work to be completed and therefore the ease of implementation is considered high.

6.2.3 Cost of Remediation

The cost for each cleanup alternative is presented in Appendix A, along with the assumptions associated with the cost estimates. These costs are planning level estimates intended only for the relative comparison of the alternatives and should not be used as budget- or design-level estimates.

Overall, the cost for Alternative V1 is considered to be moderate while the cost of Alternatives V2 is considered to be high. Alternative V2 involves excavating, loading, and transportation of up to 800 cubic yards of PCS for disposal while Alternative V1 does not require that PCS be removed for treatment. Both alternatives include costs for soil vapor and groundwater monitoring, vapor intrusion mitigation measures, and AULs. The costs for decommissioning of USTs are not included in the cleanup cost estimate, but UST removal is considerably more expensive than UST closure-in-place, if paired with either V1 or V2.

6.2.4 Sustainability, Long-term Effectiveness and Resiliency

Alternatives V1 and V2 have a high level of sustainability, long-term effectiveness, and resiliency because the petroleum source will be removed or treated via in-situ injections, petroleum COCs in Site soil, groundwater, and soil vapor will be reduced, and any remaining risks would be mitigated by AULs and vapor barrier systems.

Although in-situ injection technologies can be effective at reducing petroleum hydrocarbon concentrations in the short term, the potential for contaminant rebound presents a key consideration in evaluating the long-term reliability of this remedy.

The No Action Alternative is considered to be the least effective in the long term and least resilient to extreme weather trends of all the Alternatives.

6.2.5 Ability to Meet Proposed Land Use

Alternatives V1 and V2 will both meet future land use requirements by reducing concentrations of petroleum COCs in environmental media and applying vapor mitigation measures and AULs to eliminate exposure to COCs in soil vapor and shallow groundwater at the Site.

Table 2. Comparative Analysis of Cleanup Alternatives for Petroleum COCs in Soil Vapor

Cleanup Alternative	Overall Protection of Human Health and the Environment	Ease of Implementation	Cost-Effective Approach towards Remediation	Sustainability -O&M and Long-term Effectiveness	Ability to Meet Proposed Land Use	Total Score
Alternative V1- In-Situ Injections, Vapor Intrusion Mitigation, and AULs[a]	3	2	2	2	3	**12**
Alternative V2- Soil Removal, Vapor Intrusion Mitigation, and AULs	3	1	1	2	3	**10**
Alternative V3 – No Action	0	3	3	1	1	**8**

Notes:
[a] This alternative includes a Soil Management and Disposal Plan and Exposure Mitigation Plan.
(0 = does not achieve the criteria, 1=Low Success, 2=Medium Success, 3=High Success)
(For Cost: 1=High Cost, 2=Medium Cost, 3=Low Cost)

6.3 Comparison of Cleanup Alternatives for HBMs

6.3.1 Overall Protection of Human health and the Environment

Both Alternatives HBM1 and HMB2 provide a high level of protection to human health and the environment over a long period of time because they completely remove HBMs to prevent exposure to Site users. The No Action Alternative is not protective of human health and the environment.

6.3.2 Ease of Implementation

The work practices required for hazardous materials abatement assuming demolition under Alternative HBM2 are potentially easier to implement compared to those for abatement assuming Site structures are retained under Alternative HBM1. There are qualified hazardous materials and demolition contractors and accessible disposal facilities within a reasonable distance of the Site such that either alternative can be implemented with relative ease; however, abatement for structure retention requires more precise and careful removal of HBMs in order to protect the building for reuse. The ease of implementation is considered to be low for Alternative HBM1 and moderate for Alternative HBM2.

The No Action Alternative does not require any work to be completed and therefore the ease of implementation is considered high.

6.3.3 Cost of Remediation

The cost for each cleanup alternative is presented in Appendix A, along with the assumptions associated with the cost estimates. These costs are planning level estimates intended only for the relative comparison of the alternatives and should not be used as budget- or design-level estimates. Overall, the cost for Alternative HBM1 and Alternative HBM2 are both considered to be moderate. While Alternative HBM2 is slightly more expensive than Alternative HBM1 due to additional costs to demolish the buildings, it results in vacant land ready for redevelopment.

6.3.4 Sustainability, Long-term Effectiveness and Resiliency

Alternatives HBM1 and HBM2 have a high level of sustainability, long-term effectiveness, and resiliency because all HBMs will be removed for offsite disposal in a regulated facility.

The No Action Alternative is considered to be the least effective alternative in the long term, is the least resilient to extreme weather trends of all the Alternatives and takes little to no energy consumption or emissions.

6.3.5 Ability to Meet Proposed Land Use

Both alternatives have the ability to meet the proposed land use. Under both alternatives, all HBMs would be removed from the Site. The primary difference is that Alternative HBM2 results in vacant land ready for redevelopment, while Alternative HBM1 results in existing Site structures remaining.

The No Action Alternative does support the future land use because the known HBMs are a deterrent for future use of the Site structures.

Table 3. Comparative Analysis of Cleanup Alternatives For HBMs

Cleanup Alternative	Overall Protection of Human Health and the Environment	Ease of Implementation	Cost-Effective Approach towards Remediation	Sustainability -O&M and Long-term Effectiveness	Ability to Meet Proposed Land Use	Total Score

Alternative HBM1-Abatement and Disposal of Hazardous Building Materials for Reuse of Site Structures	3	2	3	2	2	**12**
Alternative HBM2-Abatement and Disposal of Hazardous Building Materials for Demolition of Site Structure	3	1	2	3	3	**12**
Alternative HBM3 – No Action	0	3	3	1	1	**8**

Notes:

(0 = does not achieve the criteria, 1=Low Success, 2=Medium Success, 3=High Success)

(For Cost: 1=High Cost, 2=Medium Cost, 3=Low Cost)

6.4 Summary

6.4.1 Cleanup Alternatives for Metal-Containing Soils

In summary, both Alternatives S1 and S2 would adequately protect human health and the environment, are relatively easy to implement, are sustainable, and would meet future land use goals. The main difference between Alternatives S1 and S2 is the cost of each alternative. However, Alternative S2 is the preferred alternative because of the ease of implementation and cost when compared to Alternative S1.

The No Action Alternatives would not protect human health and the environment and is not compatible with future land use goals

6.4.2 Cleanup Alternatives for Petroleum COCs in Soil Vapor

In summary, both Alternatives V1 and V2 would adequately protect human health and the environment, are relatively easy to implement, are sustainable, and would meet future land use goals. The main difference between Alternatives V1 and V2 is the cost of each alternative. However, Alternative V1 is the preferred alternative because of the ease of implementation and cost when compared to Alternative V2.

The No Action Alternatives would not protect human health and the environment and is not compatible with future land use goals.

6.4.3 Hazardous Building Materials Cleanup Alternatives

Both Alternatives HBM1 and HBM2 would protect human health and the environment, achieve a moderate to high level of sustainability in the long term, and meet the future land use goals. However, Alternative HBM2 is the preferred alternative because it removes all Site structures for redevelopment.

The No Action Alternative would not protect human health and the environment and is not compatible with future land use goals.

7.0 Limitations and Additional Assessment Needs

This ABCA provides cleanup alternatives but is not intended to be used as a cleanup workplan. The cost estimates presented are planning-level estimates presented solely for comparison purposes and should not be used as budget- or design-level estimates. The cleanup costs presented in this ABCA are estimates based on available information; actual Site conditions may vary. Following the completion of a cleanup workplan for the Site, the alternatives and cost estimates presented in this ABCA should be reevaluated and adjusted as appropriate.

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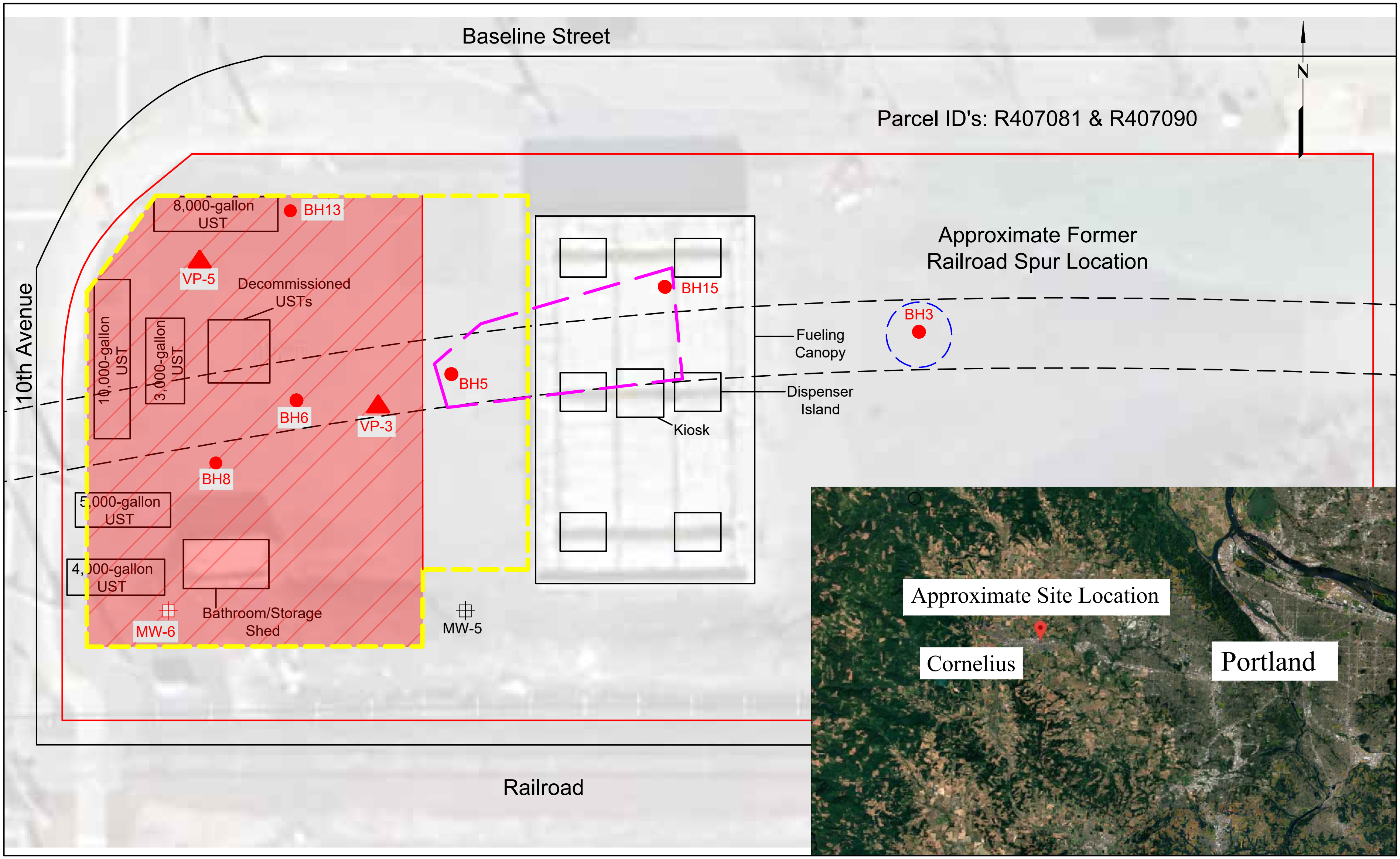

EXPLANATION:

- Railroad Spur
- Site Boundary
- Proposed Injection Area
- Proposed PCS Soil Removal Area
- Proposed Arsenic-Containing Soil Removal Area
- Proposed Lead-Containing Soil Removal Area

APPROXIMATE SCALE

0 | 32.5 | 65 Feet

Alta Science & Engineering, Inc.	PRINT DATE: April 28, 2025	PROJECTION: UTM NAD 83, Zone 11N	PROJECT NAME: 1021 & 1037 Baseline Street Cornelius, Oregon 97113	FIGURE 1: Site Location Map	This map was produced using information obtained from several different sources that have not been independently verified. These sources have also not provided information on the precision and accuracy of the data. Information on this map is not a substitute for survey data.
	PROJECT NUMBER: 22136 - Task 10	PROJECT MANAGER: B. McLees			
		CARTOGRAPHER: B. Brantley			

Appendix A

Cost Estimate

Cost Estimates for Site Cleanup for Metal-Containing Soils[1]						
	Alternative S1 – Remove Metal-Containing Soils and Develop a Soil Management and Disposal Plan.		*Alternative S2 – Cap Metal-Containing Soils and Develop a Soil Management and Disposal Plan.*		*Alternative S3 – No Action*	
Cost Factor	**Assumptions**	**Cost**	**Assumptions**	**Cost**	**Assumptions**	**Cost**
Soil Management and Disposal and Exposure Mitigation Plans	Develop a soil management and disposal and an exposure mitigation plan	**$15,000**	Develop a soil management and disposal and an exposure mitigation plan	**$15,000**	No Costs Associated with the No Action Alternative.	
Cap Metal Contaminated Soils[2]	Not Applicable	**-**	The Site is currently capped with asphalt and/or concrete. Maintain either a hard or soft cap per the ABCA. No costs are associated with this action.	**$0**		
Soil Removals	Remove and dispose of surface (0-1.5 feet bgs) metal-containing soils between BH5 and BH15 and near surface (1.5-3 feet bgs) metal-containing around BH3. Approximately 72 cubic yards.	**$28,000**	Not Applicable	**-**		
Total Cost		**$43,000**		**$15,000**		

[1]Planning level cost estimates are associated w/ regional vendors and are subject to change based on year, plus a 15% contingency.

[2]Exposure Mitigation Plan and the Soil Management and Disposal Plan, along with associated cost estimates, apply to both the site cleanup alternatives for metal-containing soils (S1 and S2) and Alternative V1.

<table>
<tr><th colspan="7">Cost Estimates for Site Cleanup of Soil Vapor[1]</th></tr>
<tr><th rowspan="2">Cost Factor</th><th colspan="2">Alternative V1 – In-Situ Injections, Vapor Intrusion Mitigation, and Activity and Use Limitations (AULs)</th><th colspan="2">Alternative V2 – Soil Removal, Vapor Intrusion Mitigation, and AULs</th><th colspan="2">Alternative V3 – No Action</th></tr>
<tr><th>Assumptions</th><th>Cost</th><th>Assumptions</th><th>Cost</th><th>Assumptions</th><th>Cost</th></tr>
<tr><td>Excavation and Disposal of Petroleum Contaminated Soils (PCS)</td><td>Not applicable</td><td>-</td><td>Excavate approximately 800 cubic yards of PCS from the UST basin and backfill. Post-removal soil vapor and groundwater monitoring. [2]</td><td>$291,000</td><td rowspan="5">No costs are associated with the no action alternative.</td><td rowspan="5">--</td></tr>
<tr><td>In-Situ Treatment of PCS</td><td>In-situ injections. [3] Includes post-injection soil vapor and groundwater monitoring. [2]</td><td>$175,000</td><td>Not applicable</td><td>-</td></tr>
<tr><td>Soil Management and Disposal and Exposure Mitigation Plans</td><td>These costs are also include under the cleanup alternatives for metal-containing soils but are also applicable to this alternative. [4]</td><td>$15,000</td><td>Not applicable</td><td>-</td></tr>
<tr><td>Vapor Intrusion Mitigation [5]</td><td>Install vapor barriers and active/passive sub-slab mitigation for new buildings</td><td>$2,250</td><td>Install vapor barriers and active/passive sub-slab mitigation for new buildings</td><td>$2,250</td></tr>
<tr><td>AULs</td><td>Implement AULs on shallow groundwater and land uses. Administrative costs associated with permitting and/or legal fees.</td><td>$5,000</td><td>Implement AULs on shallow groundwater and land uses. Administrative costs associated with permitting and/or legal fees.</td><td>$5,000</td></tr>
<tr><td colspan="2">Total Cleanup Costs</td><td>$197,250</td><td>Total Cleanup Costs</td><td>$298,250</td><td colspan="2"></td></tr>
<tr><td rowspan="2">UST Closure/Removal</td><td rowspan="2">Close USTs in place; Inert, clean and fill with controlled density fill. Remove dispensers and lines prior to cleanup.</td><td rowspan="2">$106,000</td><td>Complete removal of six underground storage tanks (USTs), including five inactive and two previously decommissioned units, along with associated piping and dispensers prior to site cleanup.</td><td>$63,000</td><td rowspan="2">No costs are associated with the no action alternative.</td><td rowspan="2">--</td></tr>
<tr><td>Shoring costs, including design and engineering .[6]</td><td>$250,000</td></tr>
<tr><td colspan="2">UST Decommissioning Costs</td><td>$106,000</td><td>UST Decommissioning Costs</td><td>$313,000</td><td colspan="2"></td></tr>
</table>

[1]Planning level cost estimates are associated w/ regional vendors and are subject to change based on year, plus a 15% contingency.

[2] Assumes that four quarterly groundwater monitoring events and two soil vapor sampling events will be conducted. Costs include estimates for 1 year of sampling; however, additional sampling may be needed to achieve site closure. Estimated to be approximately $25,000 for four quarterly groundwater sampling events and two soil vapor sampling events, plus reporting.

[3] The costs presented assume that different ORC or activated carbon remediation products will be used at the Site.

[4] The cost to develop and implement these plans is included in the total costs for this Alternative for comparison purposes and is also included in the total costs for Alternatives S1 and S2.

[5] Assumes a typical 1,500 square foot single-story commercial building with slab-on-grade construction. Cost is for one building.

[6] A 50% contingency is included in the engineering and shoring costs due to uncertainties associated with the type of shoring that may be utilized during UST removals.

Cost Estimates for Hazardous Building Materials Cleanup Alternatives						
	Alternative HBM1 – ACBM Abatement and Hazardous Material Disposal		*Alternative HBM2 – ACBM Abatement, Hazardous Material Disposal, and Structure Demolition*		*Alternative HBM3 – No Action*	
Cost Factor	**Assumptions**	**Cost**	**Assumptions**	**Cost**	**Assumptions**	**Cost**
Asbestos-Containing Building Material (ACBM) Abatement[2]	Abate ACBMs in existing site structures	**$5,200**	Abate ACBMs in site structures prior to demolition	**$5,200**	No costs are associated with the no action alternative.	**--**
Hazardous Building Material Disposal	Dispose of hazardous building materials (ACBMs, mercury-containing bulbs, PCB-containing ballasts)	**$900**	Dispose of hazardous building materials (ACBMs, mercury-containing bulbs, PCB-containing ballasts)	**$900.00**		
Structure Demolition	Not Applicable	**$0**	Demolish existing site structures	**$26,100**		
Total Cost		**$6,100**		**$32,200**		

[1]Planning level cost estimates are associated w/ regional vendors and are subject to change based on year, plus a 15% contingency.

[2] Assumes 20 linear feet of black roof sealant and 30 linear feet of white caulking are required to be abated, based on PBS' 2025 Hazardous Building Material Survey (HBMS)

Appendix B

Environmental Footprint Analysis

Appendix B – Environmental Footprint Analysis

In support of the Analysis of Brownfields Cleanup Alternatives (ABCA) report for the 1021 & 1037 Baseline Street Site, ERG conducted an environmental footprint analysis to assist in the evaluation of potential cleanup alternatives. This analysis is based on the U.S. Environmental Protection Agency's (EPA) set of analytical workbooks called the Spreadsheets for Environmental Footprint Analysis (SEFA) (EPA 2019) and assists in quantifying the environmental footprint of the cleanup alternatives identified in the ABCA. Summaries by pollutant emitted for each of the alternatives can be found in Table B-1. The SEFA analysis is based on the components of each alternative as defined in the ABCA.

The SEFA analytical workbooks were developed to assist in the analysis of the environmental footprint of a site cleanup project, determine which cleanup activities are most responsible for the size of the footprint, and adjust project parameters to reduce the size of the footprint. Information to be input into the spreadsheets was gathered from the Phase II ESA, field records, vendor quotes and other existing resources. Automated calculations within SEFA generate outputs that quantify 21 metrics corresponding to core elements of a greener cleanup. An analysis with the SEFA tools for each alternative was conducted for the Site.

The SEFA tools require input of different equipment types, distances to transport personnel, on-site electricity use, materials use and transportation, waste disposal and transportation, and type of water used. These inputs were required for each component of the cleanup alternative. SEFA tools then automatically calculate the energy and emissions derived from the inputs. The different types of energy and emissions include total energy consumed, greenhouse gas emissions, nitrate emissions, sulfate emissions, particulate matter emissions, and listed air pollutants emissions. Methane emissions are not directly calculated by SEFA but are included as part of greenhouse gases emissions.

B.1.1 Assumptions per Alternative

B.1.2 Metal Contaminated Soil

The following cleanup alternatives were considered for metal contaminated soil at the Site:

- **Alternative S1**– Remove Metal Contaminated Soils and Develop a Soil Management and Disposal Plan
- **Alternative S2** – Cap Metal Contaminated Soils and Develop a Soil Management and Disposal Plan
- **Alternative S3** – No Action

Given that the Site is already capped with asphalt and concrete, Alternative S2 does not involve any significant travel or onsite activity that would have significant environmental impacts and is not included in the SEFA analysis. However, because Alternative S1 involves soil excavation and disposal, it was included for scale and reference to impacts associated with cleanup Alternatives for other matrices.

For cleanup Alternative S1, it is assumed that all workers are local to the area given the availability and proximity of demolition and excavation companies. Given this, there are no emissions calculated for personnel travel and transportation to the Site. Alternative S1 involves demolishing asphalt and scraping the metal contaminated soil in the areas between BH5 and BH15, which was calculated to be 60 feet long, 8 feet wide, and 4 feet deep, which results in approximately 72 cubic yards (CY) of soil. To accomplish this, Alternative S1 assumes the following equipment:

- One 175 HP excavator to excavate and load soil for 12 equipment hours at a 75% load capacity.
- Two 10 CY dump trucks making a total of four (4) trips each to the Hillsboro Landfill, which is 16 roundtrip miles away from the Site.

For backfill of clean fill material, the same assumptions used for excavation apply, except the source location for clean fill was within Cornelius given the availability of bulk topsoil suppliers in the area. The assumptions are as follows:

- One 175 HP excavator to backfill clean soil for 12 equipment hours at a 75% load capacity.
- Two 10 CY dump trucks making a total of four (4) trips each to a local bulk soil vendor, which is 2 roundtrip miles away from the Site.

B.1.3 Vapor Intrusion

The following cleanup alternatives were considered for soil vapor at the Site:

- **Alternative V1**– In-Situ Injections and Vapor Intrusion (VI) Mitigation
- **Alternative V2**– Soil Removal and VI Mitigation
- **Alternative V3**– No Action

Since Alternatives associated with cleaning up or managing Site soil vapor involve extensive travel, onsite activity, and management and disposal of waste materials, they were included as components of the SEFA analysis.

For all cleanup Alternatives associated with Site soil vapor, it is assumed that quarterly groundwater monitoring will commence following the completion of onsite activities. Given this, four 50-mile roundtrip visits in a light-duty passenger truck are included to account for the assumption that samplers would likely be coming from Portland. For Alternative V1, it is assumed that drilling and injection equipment would mobilize from Portland, but that workers would stay in Cornelius for the duration of the work. This gives one 50-mile roundtrip drive in a heavy-duty truck to account for mobilization. All other demolition and excavation equipment and workers are assumed to be local and transportation was not calculated for either Alternative.

For Alternative V1, it is assumed onsite USTs are closed in place. It is assumed that closing USTs in place would take place over approximately three days, and that the following significant equipment would be used:

- One 175 HP excavator being used for 20 equipment hours (two of the three days) to remove duel dispensers and lines).
- One 400 HP vacuum truck to clean and wash out tanks prior to filling for 6 equipment hours.
- One dump truck traveling 8 miles to the Hillsboro landfill to dispose of fuel dispensers and lines.

Alternative V1 also assumes in-situ groundwater injections, which would require approximately 15 days according to engineering cost estimating. It is assumed that the work would occur as one mobilization utilizing a crew of three workers that would stay within Cornelius for the duration of the injection event. The following equipment assumptions were made for groundwater injections:

- One 60 HP direct-push drill rig being used for 150 equipment hours at 75% load capacity.
- One 4,400-watt, 7 HP generator being used to operate the pump for injection for 150 equipment hours at 75% load capacity.

For Alternative V2, it is assumed that USTs will be removed prior to excavation of petroleum contaminated soil. It is assumed that UST removal would occur over the course of approximately eight days, and the following equipment would be used:

- Two 175 HP excavators running for 40 equipment hours each, one for scraping and revealing tanks and the other for driving piles and installing shoring.
- One 350 HP crane truck for loading USTs onto trucks for disposal for 10 equipment hours.
- Two large dump trucks making two 8-mile roundtrips each (four trips total) to dispose of tanks and soil.

Alternative V2 also assumes the removal of petroleum contaminated soils in the areas within the vicinity of the USTs. Cost estimates have estimated approximately 80 hours of excavator hours to remove 800 CY of soil. This would be disposed of 80 16-mile roundtrips to the Hillsboro Landfill via 10 CY dump trucks. For backfill of clean fill, the same assumptions apply for excavation except the distance for soil hauling is reduced from 16 roundtrip miles to 2 roundtrip miles.

B.1.4 Hazardous Building Materials

The following cleanup alternatives were considered for Vapor Intrusion into Buildings at the Site:

- **Alternative HBM1** – Abatement of ACBMs and Disposal of Hazardous Building Materials
- **Alternative HBM2** – Abatement and Demolition of Site Structures and Disposal of Hazardous Building Materials
- **Alternative HBM3** – No Action

Since Alternatives associated with abating and disposing of hazardous building materials involve extensive travel, onsite activity, and transportation of materials, they were included as components of the SEFA analysis.

For all cleanup Alternatives associated with hazardous building materials, it is assumed that an abatement crew of three and one industrial hygienist would travel 50 roundtrip miles from Portland each, and that all workers would stay in Cornelius for the duration of the work.

For HBM1, the following assumptions were made for onsite equipment requirements and material disposal:

- One 5 HP generator for 30 equipment hours at 75% load capacity to aid in abatement activities.

- One dump truck travelling 16-roundtrip miles to dispose of approximately one ton of hazardous materials.

For HBM2, the following assumptions were made for onsite equipment requirements and material disposal:

- One 5 HP generator for 15 equipment hours to abate hazardous building materials for demolition.
- One 175 HP excavator for 8 equipment hours to demolish Site structures.
- Two 10 CY dump trucks to dispose of 440 CY of demolition debris over 22 8-mile roundtrips each.

B.2 Findings and Conclusions

Result summaries of the green remediation analyses can be found in Table B-1. The relative impacts of these summaries is shown in Table B-2 and are a qualitative assessment of the relative footprint of each alternative; a rating of High for an alternative is assigned if it is 50 percent of the maximum footprint, a rating of Medium is assigned if it is between 20 and 50 percent of the maximum footprint, and a rating of Low is assigned if it is less than 20 percent of the maximum footprint. Note that the maximum footprint is calculated for each cleanup dimension and not for the overall project, i.e. the maximum footprint for the hazardous building material cleanup alternatives is separate from that of the vapor intrusion cleanup alternatives. Calculating the relative footprint of each alternative allows for a comparative representation of how each alternative will impact climate change compared to each other.

Given that the only Alternatives associated with cleaning up metal contaminated soil considered for the SEFA was Alternative S1, the impact for all emissions and total energy usage for that Alternative are automatically High. However, Table B-1 and Figures B-1 and B-2 allow for comparison of this cleanup Alternative against those of other matrices. For example, emissions and energy usage for Alternative S1 are roughly similar to those for HBM2, but very small in comparison to those associated with V2. Onsite equipment usage for the excavation of soil is the highest driver of emissions for Alternative S1.

For Alternatives associated with vapor intrusion, the impacts associated with both V2 were High, while those associated with V1 were considered Medium with the exception of particulate matter, which was also High. The primary driver of emissions and energy usage associated with these Alternatives is onsite equipment usage and soil hauling, which were all higher in Alternative V2 due to the removal of the USTs and the excavation and disposal of petroleum contaminated soil.

For Alternatives associated with hazardous building material, HBM2 was given a rating of High, while all calculations associated with energy and emissions for HBM1 were considered Low. HBM1 had approximately 10% of the environmental impact as HBM2 due to the increased volume of debris required for Site demolition. Figures B-1 through B-4 illustrate the breakdown of emissions and energy usage between onsite, offsite, and transportation.

B.3 References

U.S. Environmental Protection Agency (EPA). 2019. "EPA Spreadsheets for Environmental Footprint Analysis (SEFA)." Office of Superfund Remediation and Technology Innovation. https://cluin.org/greenremediation/SEFA/.

Tables & Figures

Table B-1 – Summary of Results

Category	Total Energy	Greenhouse Gases (GHG)	NOx	SOx	PM	HAPs
	MMBtu[1]	Tons CO2e[2]	lbs	lbs	lbs	lbs
Metal Contaminated Soil						
S1 - Remove Metal Contaminated Soils and Develop a Soil Management and Disposal Plan	31.71	5,156.88	34.72	3.68	9.33	0.23
S2 - Cap Metal Contaminated Soils and Develop a Soil Management and Disposal Plan	0	0	0	0	0	0
S3 - No Action	0	0	0	0	0	0
Vapor Intrusion						
V1 - In-Situ Injections and Vapor Intrusion Mitigation	108.13	17,076.74	105.49	8.00	24.59	0.83
V2 - Soil Removal and Vapor Intrusion Mitigation	311.95	50,955.82	347.42	25.08	22.43	2.29
V3 - No Action	0	0	0	0	0	0
Hazardous Building Materials						
HBM1 - Abatement of ACBMs and Disposal of Hazardous Building Materials	3.13	477.15	2.03	0.24	0.53	0.09
HBM2 - Abatement and Demolition of Site Structures and Disposal of Hazardous Building Materials	33.50	5,371.17	32.88	2.92	5.02	0.45
HBM3 – No Action	0	0	0	0	0	0

[1] MMBtu = millions of BTUs
[2] CO2e = carbon dioxide equivalents of global warming potential

Table B-2 – Relative Impact

Category	Total Energy	GHG	NOx	SOx	PM	HAPs
	MMBtu	Tons CO2e	lbs	lbs	lbs	lbs
Metal Contaminated Soil						
S1 - Remove Metal Contaminated Soils and Develop a Soil Management and Disposal Plan	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
S2 - Cap Metal Contaminated Soils and Develop a Soil Management and Disposal Plan	LOW	LOW	LOW	LOW	LOW	LOW
S3 - No Action	LOW	LOW	LOW	LOW	LOW	LOW
Vapor Intrusion						
V1 - In-Situ Injections and Vapor Intrusion Mitigation	MEDIUM	MEDIUM	MEDIUM	MEDIUM	HIGH	MEDIUM
V2 - Soil Removal and Vapor Intrusion Mitigation	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
V3 - No Action	LOW	LOW	LOW	LOW	LOW	LOW
Hazardous Building Materials						
HBM1 - Abatement of ACBMs and Disposal of Hazardous Building Materials	LOW	LOW	LOW	LOW	LOW	LOW
HBM2 - Abatement and Demolition of Site Structures and Disposal of Hazardous Building Materials	HIGH	HIGH	HIGH	HIGH	HIGH	HIGH
HBM3 – No Action	LOW	LOW	LOW	LOW	LOW	LOW

Figure B-1 – All Energy Use by Alternative (in MMBtu)

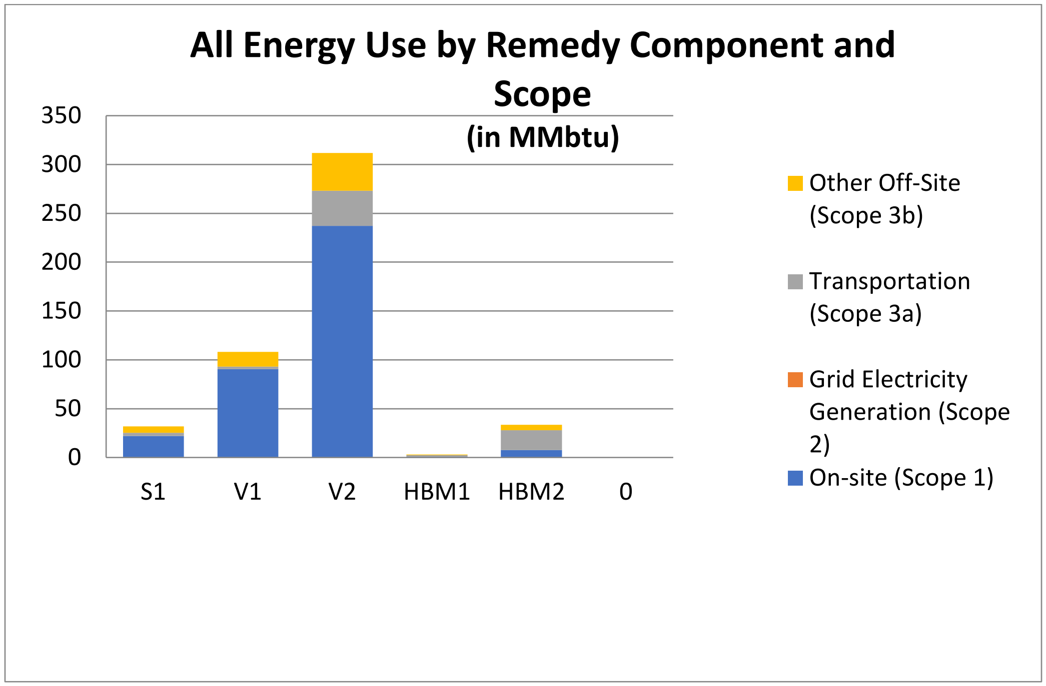

Figure B-2 – All GHG Emissions Use by Alternative (in Tons)