Analysis of Brownfield Cleanup Alternatives – Report Update
Former King Salvage Site
Toledo, Oregon
ECSI No. 2751

Prepared for:
Oregon Department of Environmental Quality
Task Order No. 066-23-14

June 27, 2024
32-23010077/Task 4

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1.0 Introduction

This report documents the site conditions and assessment of cleanup alternatives for the former crusher area of the King Salvage facility located in Toledo, Oregon (the Site; Figures 1 and 2). The main purpose of this analysis of brownfield cleanup alternatives (ABCA) is to determine the most reasonable cleanup technologies that would address soil contamination in the vicinity of the former car crusher area encountered during solid and hazardous waste removal (SHWR) activities completed in 2020 and 2021 (Apex Companies, LLC [Apex], 2022a), follow up test pit exploration activities in 2022 (Apex, 2022b), and the supplemental site investigation (SSI) completed in 2024 (Apex, 2024a). This ABCA was done in general accordance with U.S. Environmental Protection Agency (EPA) guidelines for conducting an ABCA (NCP 300.415(4)(i)) and Oregon Administrative Rules (OAR) for conducting feasibility studies (OAR 340-122-085). This ABCA was initially prepared for the Oregon Department of Environmental Quality (DEQ) under Task 6 of Task Order 71-18-25 and updated under Task 4 of Task Order 066-23-14.

2.0 Background

The former King Salvage facility is located off Highway 20 at 109 King Place in Toledo, Lincoln County, Oregon. The Site is located within Township 11 South, Range 11 West, Section 11. The former King Salvage facility is split into two tax lots with different zoning: tax lot 11-11-11-00-00901-00, 6.56 acres zoned for timber conservation and associated with the operation of King Salvage Co (the Site); and tax lot 01000-00, 1.68 acres zoned for agricultural conservation and associated with a residence. Significant amounts of solid and hazardous wastes have historically been present on the King Salvage Site but not the residential property. Most of the solid and hazardous waste has been removed by Lincoln County and DEQ, but some buried and exposed materials still remain.

The former King Salvage facility is identified as Cleanup Project #2751, record #3376 within DEQ's Your DEQ Online (YDO) public information database.

2.1 Site History

The Site (the vicinity of the former crusher) is within the facility formerly operated by King Salvage Co., which was primarily an automobile wrecking and salvage yard that operated for over 30 years, though historical use of the property involved the receipt of a variety of waste materials. Lincoln County obtained the Site through tax foreclosure on August 22, 2017. DEQ became aware of the former King Salvage facility via a pollution complaint made in July 2000 from the Oregon Department of Transportation (ODOT). ODOT reported oil migrating from King Salvage into the unnamed tributary that runs through the facility. Subsequent inspection by DEQ documented releases of hazardous substances to on-site soils and large quantities of accumulated solid waste throughout the facility. A surface water sheen was also observed. DEQ issued several notices of violation (NOVs) to the property owners related to storing solid waste and an excess amount of waste tires without a permit, the release of hazardous substances to the ground, failure to clean up hazardous substance releases, improper storage of used oil, and open burning of prohibited materials.

2.2 Site Assessment Findings

Several rounds of investigation and waste removal have been conducted at the former King Salvage facility since 2009. Between June 2020 and October 2021, Apex sampled, profiled, and removed a significant volume of solid waste, hazardous and non-hazardous wastes, and asbestos-containing materials from the facility. A total of 117 tons of miscellaneous solid waste, 80 tons of vehicle tires, and 110 tons of metal were removed from the facility by Table Mountain and disposed of or recycled by Dahl. In addition, Table Mountain removed 26 vehicles from the facility (19 vehicles from near-stream areas and seven vehicles from upland areas). The removed vehicles consisted of travel trailers, motor homes, a school bus, vans, and miscellaneous passenger vehicles. Prior to removing the vehicles, Table Mountain removed approximately 20 gallons of oil, 8 gallons of gasoline, and 1 gallon of coolant from the vehicles. The vehicle liquids were subsequently recycled.

Following completion of the 2020 through 2021 removal activities, most of the bulky, large solid waste at the former King Salvage facility has been removed. Remaining wastes consist of small miscellaneous solid waste, and while no excavation was conducted as part of the previous waste removal activities, it was suspected based on field observations and anecdotal information that additional buried wastes were present at the facility. Therefore, on October 28 and 29, 2021, a geophysical survey was completed across the accessible areas of the facility to assess the potential extent of buried wastes. The findings of the geophysical survey were summarized in the *Solid and Hazardous Waste Removal Report* (Apex, 2022a). In addition to the 30 identified anomalies that may contain buried wastes, Apex identified approximately 15 small areas with remaining miscellaneous solid waste (i.e. scrap metal, tires, plastic, car parts, an empty flat drum, and a small tank). These wastes are generally located in vegetated areas which are more difficult to access. It is also likely that additional wastes exist at the former King Salvage facility, either buried in areas inaccessible to the geophysical survey or obscured by dense brush.

Based on the results of the geophysical survey, four discrete areas were identified for additional investigation, including debris in the vicinity of the former crusher, a potential buried tank or drum in the wetland area in the northwest portion of the facility, and buried debris in two areas in the southern portion of the facility (in the south-central area and the southwestern areas of the facility). It was determined that test pits would be completed at each of these areas to facilitate evaluation of remaining significant waste materials such as potential buried drums, storage tanks, or large quantities of unknown debris. On July 15, 2022, test pits were completed in each area to identify and quantify to the extent practical the nature and volume of waste materials present within the four areas selected.

Observations noted during test pit activities included a variety of metal objects (steel rods, scrap metal, aluminum sheeting) and other debris. An area of paint and/or solvent odors was noted about 150 feet north-northwest of the former office building, and significant evidence of petroleum hydrocarbons was noted in the vicinity of the former crusher (including strong petroleum odors, gray staining, and sheens).

In addition to the test pit investigation, in October 2021, Stantec Consulting Services, Inc. (Stantec) completed a limited Phase II Environmental Site Assessment (ESA) to evaluate soil conditions across the former King Salvage facility. A detailed discussion of the investigation purpose, methodology, and findings is included in the Phase II Report (Stantec, 2022). The accessible areas of the facility were divided into seven decision units (DUs) for the purpose of facilitating shallow soil sampling using Incremental Sampling Methodology (ISM). Thirty aliquots were collected from each DU in a randomly generated pattern to ensure adequate spatial distribution across each DU. One ISM sample from each DU was submitted for laboratory analysis of diesel-range total petroleum hydrocarbons (TPH-Dx), gasoline-range TPH (TPH-Gx), oil-range TPH (TPH-O), semi-volatile organic compounds (SVOCs), volatile organic compounds (VOCs), Resource Conservation and Recovery Act (RCRA) metals, dioxins, and furans. Based on analytical results, concentrations of TPH-Dx, TPH-O, SVOCs, dioxins, furans, and several metals exceeded appropriate DEQ human health risk-based concentrations (RBCs) for the facility. The ISM soil sample DU-4 was collected from the portion of the facility that includes the former car crusher area.

During the Phase II ESA, one groundwater sample was also collected from the vicinity of the former car crusher area. The groundwater sample (GP-01) contained concentrations of TPH-O, naphthalene, arsenic, and lead which exceeded RBCs for the residential and/or occupational direct contact (ingestion and inhalation) scenarios, but did not exceed the vapor intrusion RBCs or the construction and excavation worker RBCs. Two downgradient groundwater samples (GP-02 and GP-03, located near the southern edge of the Site adjacent to the ODOT right of way) had concentrations of arsenic that were also above the residential and occupational direct contact (ingestion and inhalation) RBCs.

2.3 Supplemental Site Investigation – April 2024

In April 2024, Apex completed the Supplemental Site Investigation (SSI) direct-push soil sampling at the King Salvage (former) Site. The scope of work was performed in accordance with the Apex SSI Work Plan that included collecting and analyzing additional shallow subsurface soil and streambed sediment samples (Apex, 2023). The additional work was completed to refine previous incremental sampling data collected by Stantec as summarized in their *Phase II Environmental Site Assessment Report* (dated May 6, 2022) and follow-up test pit exploration activities conducted by Apex as summarized in the Apex Test Pit Investigation Summary (August 10, 2022). The focus of the recent SSI was to refine the understanding of the source, magnitude and extent of contamination that is addressed in this revised ABCA. The SSI scope of work and findings was discussed in the SSI data memorandum (Apex, 2024a).

Based on the findings of this work, the contamination identified within the shallow Site soils extends beyond decision unit DU-6 and the former car crusher area to the subunits of decision unit DU-4, particularly subunit DU-4F where contamination was localized and exceeded construction worker DEQ RBCs for generic diesel and lead. The most significant impacts were observed in the vicinity of the former car crusher and to the west (subunit DU-4F). In addition, more widespread metals and dioxin concentrations exceeded the ecological risk based concentrations (ecological RBCs) in subunits DU-4C, DU-4E, DU-4F, DU-4G, and DU-4I. The layout of the decision units is shown on Figure 3.

2.4 Ecological Risk Assessment

Data were screened against applicable ecological RBCs in Apex's ecological risk assessment in accordance with Oregon DEQ's *Conducting Ecological Risk Assessments, September 2020* guidance to assess whether the Site may pose an unacceptable risk to the environment. Laboratory analytical results are presented below along with a brief discussion of the source, magnitude, and extent of contamination. The ecological RBCs used in the risk screening were chosen based on the current and reasonably likely future receptors and probable exposure pathways. The referenced ecological RBCs are presented in the SSI (Apex, 2024a).

Diesel by Method NWTPH-Dx. No ecological RBCs are established for TPH.

Dioxins and Furans by EPA Method 8290. Calculated dioxin toxic equivalency (TEQ) for each composite soil sample (except for DU-4B-Comp-1 and composite streambed sediment samples DU-3-SS-Comp-1 and DU-5-SS-Comp-1) exceeded applicable ecological RBCs for soil when compared to the 2,3,7,8-TCDD (dioxin) equivalent for several receptor scenarios, including *Ground Feeding Birds and Mammals* and *Top Consumer Birds and Mammals Threatened and Endangered (T&E) and non-T&E*. No ecological RBCs are established for dioxin in surface water exposure pathways. Dioxin and furans screening levels reflected moderate exceedances in various portions of the Site generally attributable to historic use of these areas. However, screening levels were significantly exceeded in the central portion of the Site in association with the former crusher area.

Select Metals by EPA Method 6010. Several discrete and composite soil samples and streambed sediment samples exceeded several ecological RBCs for soil and surface water. The highest exceedances of ecological RBCs for soil and surface water were detected in discrete soil sample DU-4F-5-2, composite soil sample DU-4F-Comp-1, and composite streambed sediment sample DU-6-SS-Comp-1. Metal exceedances were identified across the Site but appear to represent background levels of metal content. Relatively higher concentrations are centered in the vicinity of the former crusher operations.

Polycyclic Aromatic Hydrocarbons (PAHs) by EPA Method 8270SIM. Discrete soil samples DU-4F-2-2 and DU-4F-5-2 and composite soil sample DU-4F-Comp-1 exceeded several ecological RBCs for soil, including *Direct Toxicity to Plants* and *Ground Feeding Birds T&E and non-T&E*. The details of the ecological risk assessment are included in the associated report (Apex, 2024b). PAH exceedances are also concentrated in the vicinity of the former crusher operations in the central portion of the Site.

Due to the widespread nature of the contaminants that exceed the ecological RBCs and the uncertainties identified in the ecological risk assessment, it is concluded that additional assessment will be needed to quantify the extent of ecological risks and potential corrective actions. Therefore, the cleanup action considered in this analysis will be limited to addressing human health risks and gross ecological risks in areas of more significant contamination (generally correlated to the central portion of the investigation area and the vicinity of the former crusher operation).

3.0 Nature and Extent of Contamination

Conclusions based on the test pit explorations, Phase II ESA, and SSI are as follows: no tanks or other vessels that could contain hazardous liquids were encountered during the investigation activities, and encountered materials were generally solid waste (such as metal debris). The former crusher area was visibly impacted by petroleum-stained soil, and analytical results of soil samples collected from the decision units west of the former crusher (DU-4, DU-4F, DU-4G, and DU-4I) indicate that concentrations of TPH-Dx, bis(2-ethylhexyl)phthalate, mercury, dioxins, and furans exceed ecological RBCs in that area. In addition, the concentrations of benzo(a)pyrene and the calculated 2,3,7,8-TCDD total TEQ detected in sample DU-4 also exceeded their respective residential direct contact RBCs. The soil impacted by elevated concentrations of these contaminants in the former crusher area and the adjacent decision units (DU-4F, DU-4G, and DU-4I) is therefore the subject of this ABCA, and the following sections relate specifically to cleanup of this area. Any references to “the corrective action area” for the remainder of this document refer specifically to this area.

The extent of the corrective action area is shown on Figure 4 and covers an area of 10,900 square feet (6,000 square feet for the area around the former car crusher, 2,600 square feet for decision units DU-4F and DU-4G to the west, and 2,300 square feet for decision unit DU-4I to the south). Based on the findings of the site investigations, the depth of contamination is limited to about 2.5 feet below ground surface (bgs) within the area of the car crusher and decision units DU-4F and DU-4G, and to a depth of about 1 foot bgs in decision unit DU-4I, resulting in a total volume of about 880 cubic yards.

3.1 Locality of the Facility

The locality of the facility (LOF) is defined as locations where a human or ecological receptor contacts or is reasonably likely to come into contact with facility-related hazardous substances. The term “facility” is defined (in both ORS 465.200 and OAR 340-122-0115) to include the equipment or property where the release occurred and where the release has come to be located. A contaminant release to soil would be expected to remain at the surface (solid release), migrate downward under the influence of gravity (liquid release), be leached downward by precipitation infiltration (solid or liquid release), and/or volatilize into the atmosphere where it would dissipate (typically volatile constituents in a liquid release). Other secondary contaminant transport mechanisms could include soil erosion or windblown transport. The extent of potential impact to soil or groundwater from the corrective action area is most significant in the area at or near the former car crusher and the immediately downgradient decision units, but it is likely that contamination from historical activities is present across the full extent of the corrective action area and also across most of the larger Site, including the associated streambeds within the property boundary (though based on sampling of groundwater along the southern boundary of the former King Salvage facility, it does not appear to continue off-site). Therefore, the LOF is being defined as the former King Salvage facility boundary. While significant contamination was not encountered in the streambed samples, no information is available from areas further downstream to assess whether Site-related contaminants have migrated off-site through surface water flow or sediment erosion via the unnamed tributary and associated drainage channels.

4.0 Exposure Evaluation

A detailed evaluation of potential receptors and exposure pathways is presented in the SHWR Work Plan (Apex, 2020) and the Phase II ESA Report (Stantec, 2022). The following sections discuss the potentially complete exposure pathways. Current and reasonably likely future land uses were assessed to develop a model describing potentially complete exposure pathways for human and ecologic receptors at the Site.

4.1 Beneficial Land and Water Use

Current and future land uses were assessed to develop a model describing potentially complete exposure pathways for human and ecological receptors within the corrective action area. The potentially complete pathways established in this section will be used in conjunction with contaminant concentrations to evaluate risk in this area.

Summary of Land Use. Based on review of the Lower Yaquina zoning map produced by Lincoln County, the Site is currently zoned for agricultural conservation along the highway and timber conservation in the northern portion of the former King Salvage Site. The Site is currently owned by Lincoln County and is not being used for residential, commercial, or industrial activities. Apex's reconnaissance of the project area confirmed the Site use as containing solid waste, with no other activities or land uses observed. Apex's reconnaissance of the surrounding area identified adjacent properties to be undeveloped forested land, cleared meadows, and remote single-family residential properties. The reasonably likely future use of the Site is expected to remain the same as the current Site use.

Summary of Water Use. A search for water well logs was previously conducted during the preparation of the SHWR Work Plan in the fall of 2020 on the Oregon Water Resources Department database for Township 11S, Range 11W, Sections 11 through 14 (Apex, 2020). Well records indicate that groundwater has been used in the surrounding area for domestic purposes but not at the Site. Domestic wells were found across Highway 20 from the Site and associated with residences located nearly a mile to the north-northwest and over 1,000 feet west-southwest of the Site. A concrete cistern was observed near the residence immediately south of the Site and adjacent to the creek. Based on the visual observation of the water intake at the cistern, it appears that the associated residence is using the creek as a water supply source. No alternate source of potable water has been identified for the residence. In addition, the Lincoln County representative interviewed in 2021 indicated that there may have been a former water well on-site for the residence; however, no domestic well was identified for the Site in the online well search. Two domestic wells, Linc 50097 and Linc 50098, were identified adjacent to the Site, with a listed address of 3544 Hwy 20, Newport, OR. It is unclear if these wells are associated with the former King Salvage site or the adjacent residence.

Water for public supply in Lincoln County was reported to be obtained primarily from surface water sources, with small amounts of groundwater pumped from wells and used for mobile homes, parks, private residences, and farms. Water demand projections have been published by the City of Toledo in their Water Master Plan Update (City of Toledo, 2017) and by the City of Newport Water System Master Plan (City of Newport, 2008). Future water use is expected to increase within both cities; however, the surface water sources for drinking water are not expected to change. Additional surface water rights may be obtained by the City of Toledo and/or the City of Newport to support expected population growth in the area.

4.2 Exposure Pathway Analysis

Potential Receptors. Potential receptors include those that may be exposed to the chemicals of potential concern (COPCs) under the current or reasonably likely future land and water use scenarios. The following potential receptors were identified:

1. Construction workers (potential future);
2. Excavation workers (potential future); and
3. Ecological receptors (specifically for plant, bird, and mammal exposures; current and potential future).

It is unlikely that the future use of the Site will include residential or occupational scenarios. It is possible that a trespasser may be exposed to contaminants at the Site, but this would be a short-term exposure, similar to the construction worker scenario, and thus not considered a separate exposure scenario.

Exposure Pathways for Soil. Potentially complete exposure pathways for soil are listed below.

- *Direct Contact (Soil Ingestion, Dermal Contact, and Inhalation).* This is a potential future exposure pathway for the construction worker and excavation worker scenarios (such as for future cleanup of the property).
- *Ecological Receptors*. The property is currently abandoned, largely undeveloped, and includes significant wetland areas. Ecological exposures could reasonably be expected.

Exposure Pathways for Groundwater. During the Phase II ESA, one groundwater sample was collected from the vicinity of the former car crusher area (GP-01) and two groundwater samples were collected near the south edge of the Site near the ODOT right of way (GP-02 and GP-03). Groundwater sample GP-01 contained concentrations of TPH-O, naphthalene, arsenic, and lead which exceeded applicable RBCs for the residential and/or occupational direct contact scenarios, but not the construction or excavation worker scenarios. Similarly, groundwater samples GP-02 and GP-03 contained concentrations of arsenic that exceeded the direct contact RBC for residential and occupational exposure, but not for construction or excavation worker exposure. The arsenic concentrations are similar across the Site and may represent naturally occurring conditions.

The potential exists for groundwater in the vicinity of the former car crusher to migrate toward the unnamed tributary located approximately 150 feet west of the crusher. However, no groundwater contaminants were detected at concentrations exceeding ecological risk screening levels in the groundwater sample collected from boring GP-01. The potential for impacts to the tributary or downstream surface water bodies from contamination outside of the former car crusher is not included in this evaluation.

Exposure Pathways for Vapors. No soil or groundwater contaminant concentrations in samples collected during the site assessment have exceeded risk screening levels for the vapor inhalation pathway.

5.0 Applicable Regulations and Cleanup Standards

As outlined in previous sections of this document, contaminants of concern (COCs) have been detected in soil at concentrations exceeding DEQ screening criteria. Exceedances of these levels indicate potential risk to human health and the environment. The following describes applicable regulations and cleanup standards that will apply to future remediation efforts.

5.1 Cleanup Oversight Responsibility

DEQ will have oversight of the cleanup activities at the Site. Additionally, work plans and cleanup activities conducted throughout the implementation of this project will be overseen by qualified professional geologists and/or professional engineers licensed in the state of Oregon.

5.2 Cleanup Standards for Major Contaminants

As the reasonably likely future Site use is to remain the same and not include residential or occupational use, the DEQ RBCs for soil ingestion, dermal contact, and inhalation pathways for the construction worker and excavation worker scenarios will be used to evaluate the effectiveness of remedial actions.

The Site is currently vacant and is not being used; as such, ecological exposures can reasonably be expected. In general, evaluated exposure pathways were determined to be open and connected for potential ecological exposure. The screening level values for plants, birds, and mammals were compared to the default Tier I

RBCs from the *DEQ Guidance for Ecological Risk Assessment* (DEQ, 2020), in addition to other accepted industry standards for ecological risk assessment including the EPA and the Texas Commission on Environmental Quality (TCEQ) ecological screening benchmarks. Additional investigation will ascertain potential risk for off-site exposure pathways versus on-site exposure through contaminated soil media and provide recommendations to limit exposure where possible in association with cleanup activities and future land use.

5.3 Laws and Regulations Applicable to the Cleanup

The applicable cleanup standards are:

- OAR 340 Division 122 – Environmental Cleanup Rules: The rules established under this chapter establish 1×10^{-6} as the maximum excess lifetime cancer risk for individual carcinogenic hazardous substances, 1×10^{-5} as the cumulative maximum excess lifetime cancer risk for all carcinogens, or a hazard index (HI) of 1 for non-carcinogens.
- Oregon Revised Statutes Chapter 496 provides framework for protection of threatened and endangered species.

Based on data collected during the site assessment, impacted soil would be classified as non-hazardous solid waste. Contaminated soil removed from the corrective action area would be disposed of at an RCRA Subtitle D facility, such as South Lincoln Recycling & Transfer Center or Toledo Recycling & Transfer Center.

5.4 Ecologic and Cultural Resource Considerations

Ecologic Considerations. A review of the US Fish and Wildlife Service Information for Planning and Consultation (*IPaC*) database identifies three threatened, one proposed threatened, and one candidate species occurring in the immediate vicinity of the Site: marbled murrelet (*Brachyramphus marmoratus*), northern spotted owl (*Strix occidentalis caurina*), western snowy plover (*Charadrius nivosus nivosus*), northwestern pond turtle (*Actinemys marmorata, proposed*), and monarch butterfly (*Danaus Plexippus,* canddidate). Additionally, the bald eagle (*Haliaeetus leucocephalus*) is likely within the project vicinity. While not a bird of conservation concern (BCC) in this area, it is protected by additional regulatory programs including the Bald and Golden Eagle Protection Act of 1940. Of these species, the northern spotted owl and monarch butterfly were potential for "likely occurrence."

According to Oregon Department of Fish & Wildlife (ODFW) and Oregon Biodiversity Information Center, Lincoln County includes 13 state-listed rare or protected species within a 2-mile radius of the Site. These include: green sturgeon (*Acipenser medirostris*), white-footed vole (*Arborimus albipes*), Pacific lamprey (*Entospherus tridentalus*), bald eagle, Oregon plant bug (*Lygus oregonae*), chum salmon (*Oncorhynchus keta*), Coho salmon (O*ncorhynchus kisutch*), Steelhead (*Oncorhynchus mykiss*), Hotroot polypody

(*Polypodium calirhiza*), Green marine alga (*Prasiola linearis*), purple martin (*Progne subis*), Pacific alkaligrass (*Puccinella nutkaensis*), and Oregon silverspot (*Speyeria zerene Hippolyta*).

Per ODFW and Oregon Explorer, Coho salmon (Oncorhynchus kisutch) and essential salmonoid habitat is present within the Site vicinity, including Beaver Creek. For each of these species, no known critical habitat is associated with the Site for listed threatened or endangered species. Sensitive species of fish may be associated with essential salmonid habitat within the Beaver Creek watershed. On-site wetlands and streams drain generally south towards Beaver Creek, discharging downstream and contributing surface water to the greater Yaquina River watershed. Work conducted at the Site will be assessed for potential to impact these species during the planning and implementation stages.

Effects on Cultural Resources. An inadvertent discovery plan (IDP) was prepared as part of the SHWR Work Plan (Apex, 2020) to protect cultural resources that are significant to local tribes and to develop a plan to proceed with the solid waste removal activities while minimizing impacts to cultural resources. No cultural resources were encountered during the waste removal or site assessment work; however, the cleanup alternatives include potential excavation and will require project review with the Oregon State Historic Preservation Office (SHPO). Advanced coordination with tribal resources were favorable in support of cleanup activities associated with the Site.

Consistent with Section 106 of the National Historic Preservation Act, the project review will be performed in coordination with the Oregon SHPO to determine if the proposed alternative would have impacts on properties of historic significance. To initiate the project review, Oregon SHPO requires notification of the agencies involved in the project (including local tribes) and a brief description of the proposed activity. This information will be provided to SHPO after DEQ review of public comments and their final decision regarding the cleanup alternatives presented herein. Within 30 days of submittal of that information, the Oregon SHPO will advise on avoidance or minimization of project impacts to properties of historic significance, if applicable.

5.5 Screening of Site Data

To assess the potential risks associated with current Site conditions, the data collected at the Site in October 2021 and April 2024 for soil and groundwater have been screened against the June 2023 RBCs that correspond to the potentially complete exposure pathways identified above. The data are included in Stantec's Phase II ESA Report (Stantec, 2022) and the SSI report (Apex, 2024) and are summarized below.

Data collected on-site were screened against the occupational and residential RBCs, as well as the less conservative construction and excavation worker RBCs. As it is unlikely that the future use of the Site will include residential or occupational uses, Apex limited the comparison of the data to the construction and excavation worker RBCs and ecological RBCs.

5.6 Analytical Data and Risk-Based Screening

Supplemental Site Investigation. The SSI completed in April 2024 included advancing a total of 48 shallow boreholes (3 to 5 feet bgs) in and around the former car crusher area of the Site, collecting 5-point composites (3 separate depth intervals), and submitting to a laboratory for the following analysis: diesel- and oil-range TPH by Method NWTPH-Dx, dioxins and furans by EPA Method 8290, select metals (RCRA 8, plus copper, zinc, and nickel) by EPA Method 6010, and PAHs by EPA Method 8270SIM. Additionally, four discrete soil samples were selected for TPH and PAH analysis based on observations of localized contaminated soils as exhibited by petroleum-like odors, staining/discoloration (black), and relatively high photoionization detector (PID) readings.

The following analytes in discrete and composite soil samples and streambed sediments were detected at concentrations that exceed the applicable DEQ human health and ecological RBCs:

- **Diesel by Method NWTPH-Dx.** The highest concentrations of diesel-range TPH were detected in composite soil sample DU-4I-Comp-1 and discrete soil sample DU-4F-5-2 at 4,070 parts per million (ppm) and 15,900 ppm respectively, with the latter result being above the DEQ RBC for the soil ingestion, dermal contact, and inhalation exposure pathway and construction worker receptor scenario. The discrete soil sample DU-4F-5-2 was selected for analysis due to field observations of a localized impacted area, including petroleum-like odor, staining and discoloration, and relatively high PID readings. No ecological RBCs are established for TPH.
- **Dioxins and Furans by EPA Method 8290.** The highest dioxin TEQ was calculated from composite soil sample DU-4C-Comp-1 at 51.67 nanograms per kilogram and was below the applicable construction worker DEQ RBC. Calculated dioxin TEQs for all composite soil samples, except for DU-4B-Comp-1, exceeded applicable ecological RBCs for soil when compared to the 2,3,7,8-TCDD (dioxin) equivalent for several receptor scenarios, including *Ground Feeding Birds and Mammals* and *Top Consumer Birds and Mammals T&E and non-T&E*. No ecological RBCs are established for dioxin in surface water exposure pathways.
- **Select Metals by EPA Method 6010.** Select metals were detected in concentrations above DEQ's regional background concentrations for the Coast Range (DEQ, 2018) in all the composite soil samples analyzed except for composite streambed sediment sample DU-3-SS-Comp-1. Lead (1,460 ppm) was detected in discrete soil sample DU-4F-5-2 at concentrations exceeding the DEQ RBC for the soil ingestion, dermal contact, and inhalation exposure pathway and construction and excavation worker receptor scenarios. Several discrete and composite soil samples and streambed sediment samples exceeded several ecological RBCs for soil and surface water. The highest exceedances of ecological RBCs for soil and surface water were detected in discrete soil sample DU-4F-5-2, composite soil sample DU-4F-Comp-1, and composite streambed sediment sample DU-6-SS-Comp-1.

- **PAHs by EPA Method 8270 SIM.** The highest total TEQ (1.08 ppm) was detected in discrete soil sample DU-4F-5-2. All PAHs tested were detected in concentrations below the applicable DEQ RBCs for the soil ingestion, dermal contact, and inhalation exposure pathway and construction and excavation worker receptor scenarios, including the DEQ RBCs for benzo(a)pyrene (BaP) equivalents. The highest toxic mobility equivalent concentration (TMEQ; 0.799 ppm) was detected in discrete soil sample DU-4F-5-2. The highest analytical results for cPAHs benzo(a)pyrene and dibenzo(a,h)anthracene with a toxic equivalency factor of 1 were detected from discrete soil sample DU-4F-5-2 at 0.786 ppm and 0.127, respectively. No PAHs were detected above the method limit of detection in the following composite soil and streambed sediment samples: DU-4B-Comp-1, DU-4D-Comp-1, DU-6-Comp-1, DU-3-SS-Comp-1, and DU-5-SS-Comp-1. Discrete soil samples DU-4F-2-2 and DU-4F-5-2 and composite soil sample DU-4F-Comp-1 exceeded several ecological RBCs for soil, including *Direct Toxicity to Plants* and *Ground Feeding Birds T&E and non-T&E*.

The exceedances above present potentially unacceptable human health or ecological risk associated with soil across the corrective action area.

6.0 Cleanup Alternatives

The purpose of this section is to define and evaluate applicable cleanup alternatives that reduce contaminant concentrations in the corrective action area to levels protective of human health and the environment. This ABCA was completed in general accordance with EPA guidelines for conducting an ABCA [NCP 300.415(4)(i)] and OARs for conducting feasibility studies (OAR 340-122-085). This ABCA contains the following elements:

- Corrective action areas;
- Evaluation of proposed cleanup alternatives;
- Presentation of the recommended alternative; and
- Discussion of the residual risks associated with the recommended alternative.

6.1 Corrective Action Area

The corrective action area covers the former car crusher area (an area of about 6,000 square feet and 2.5 feet deep), decision units DU-4F and DU-4G (west of the former car crusher; an area of 2,800 square feet and 2.5 feet deep), and decision unit DU-4I (south of the former car crusher, an area of 2,300 square feet and 1 foot deep). Therefore, a total of approximately 10,900 square feet of impacted soil is included to depths of between 1 and 2.5 feet bgs. The impacted soil volume is expected to be approximately 880 cubic yards. The extent of the corrective action area is shown on Figure 4.

6.2 Evaluation of Cleanup Alternatives

The evaluation of potential cleanup alternatives included screening of potentially viable technologies to identify those remediation strategies that would be most applicable to the corrective action area given the Site conditions and types and extent of the contamination. Table 1 provides an initial screening and evaluation of technologies for soil, including the rationale for the inclusion or exclusion of each technology. Technologies remaining after the initial screening include:

General Response Action	Technology
No Action	None
Institutional and Engineering Controls	Deed Restrictions/Soil Management Plan, Monitoring, Access Restrictions
Removal/Off-Site Disposal	Excavation Off-Site Disposal
Containment	Capping
In Situ Biological Treatment	Enhanced Bioremediation Phytoremediation

The assessment of cleanup alternatives includes a Baseline or No Action alternative, which is required to be carried through for comparison. However, the No Action alternative is not considered protective to human or ecological exposure pathways. The institutional and engineering controls (i.e., soil management plan and access restrictions) are considered separately and are also potentially applicable to any action at the Site. The following sections detail the review of the applicable technologies. Table 2 provides a summary of the comparative evaluation of the retained treatment technologies.

Alternative 1 – No Action. No Action is used as a comparison to assure that at least some cleanup is warranted; the no-action response assumes that no cleanup or protections of any kind are implemented.

Alternative 2 – Institutional and Engineering Controls. Institutional controls are non-engineered instruments, such as administrative and legal controls, that reduce the potential for human exposure to contamination. Examples include deed restrictions limiting future property use and/or groundwater use, easements and equitable servitudes, contaminated media management plans, etc. Institutional controls do not treat or remove the hazard but are usually combined with other responses and are almost always required when at least some hazard remains at the site. Engineering controls are constructed systems that restrict exposure or control the hazard at its source, such as fencing, signage, increased ventilation, etc. Engineering controls do not treat or remove the hazard and are usually combined with other responses. Because there are no imminent plans for redevelopment of the Site and the Site is currently vacant, institutional controls such as a deed restriction limiting future use of the property to exclude residential use and forbidding the use of groundwater on site for human consumption would be protective of human health. Engineering controls such as signage and access restrictions would also reduce the potential for exposure to contamination remaining on site and would therefore meet the protectiveness criteria. Neither of these controls would significantly affect the potential for ecological exposures.

Alternative 3 – Removal and Off-Site Disposal. This alternative calls for the removal of the COC-impacted soil by excavation and off-site disposal. Off-site disposal has the benefit that contaminated soil would be removed from the corrective action area and disposed of offsite at a Subtitle D landfill. The identified volume of impacted soil (880 cubic yards, or an estimated 1,300 tons of soil) would be removed by excavation, focusing on protection of human and ecological receptors while incorporating institutional controls to address the residual contamination at deeper depths. Confirmation sampling would be performed after soil removal to document residual soil conditions following the removal action. The alternative includes import of 1,300 tons of soil backfill to fill the void of the excavation volume and restore the pre-excavation surface. The backfill would be comprised of topsoil meeting Oregon Department of Transportation specification 0140.14 and would be obtained from commercial sources with documentation of soil testing as appropriate. To the extent possible, the topsoil material would be obtained from a borrow source in the vicinity of the Site to reduce trucking costs. It is anticipated that removal of the source-area soil would be sufficient to achieve the Site cleanup goals and no other active treatment would be needed (any residual contamination would be addressed by natural attenuation). Following completion of the backfilling, the soil surface would be seeded with native grasses (such as Pacific Northwest erosion control seed blend amended to also include mycorrhizae, straw mulch with tackifier, fertilizer, and sterile wheat grass in order to improve erosion control and germination) to address soil erosion. It is not expected that there would be any long-term maintenance required following implementation.

Alternative 4 – Capping. In this alternative, the area of impacted soil would be capped with approximately 3 feet of imported clean fill and graded to minimize erosion. As discussed in Section 6.1, for the purpose of evaluating this alternative, it is assumed a total of 10,900 square feet would need to be capped (a total of 1,210 cubic yards of cap material). The cover soil would include a bottom rock layer and/or a geotextile layer to minimize the potential for burrowing animals to penetrate the cap, covered by a soil appropriate for the area (i.e., an imported topsoil). It is not intended that the cap be impermeable; rather, it is designed to prevent human and ecological direct exposure. To the extent possible, the cap material would be obtained from a borrow source in the vicinity of the Site to reduce trucking costs. Following placement of the cap, the soil surface would be seeded with native grasses to address soil erosion. Long-term maintenance of the cap would require periodic inspection to verify the continued integrity of the cap and identify any required repairs.

Alternative 5 – Phytoremediation. Phytoremediation uses vegetation and its associated microbiota, soil amendments, and agronomic techniques to remove, contain, or reduce the toxicity of environmental contaminants. Phytoremediation is implemented by establishing a community of plants that have been selected to provide the required remediation mechanisms across the treatment area. The technology exploits the natural hydraulic and metabolic processes of the plants, providing some control of the contaminant migration and removal or breakdown of the organic contaminants. Design would require the selection of plant species that would be suitable for the site conditions (shallow marshy soil during some of the year, with shallow root systems that would be consistent with the contaminant depths to at least 3 feet). Implementation would involve the planting of these selected species across the treatment area. Some initial care would be needed to ensure that the plants are able to establish themselves, and long-term maintenance would include inspection and as-needed replacement of plants, likely for a minimum of 10 years.

An alternative to an engineered phytoremediation approach would be to augment and support naturally occurring plants (such as with the broadcasting of compatible seed mixes) to provide some benefit to the restoration of the Site. Such an application could increase the root-zone binding of contaminants and reduce the potential for erosion of contaminants to the local surface water, and as larger plant species become established, it is expected that some uptake of contaminants would occur. Given the existing unimproved condition of the Site and supportive climate for plant growth, it is expected that significant plant growth would be established at the Site within a couple of years. This relatively passive approach would be best suited in combination with an active removal technology (such as excavation or *in-situ* bioremediation) to address residual low-level and wide-spread contamination.

Alternative 6 – *In-Situ* Enhanced Bioremediation. In this alternative, the volume of petroleum-impacted soil (assumed 880 cubic yards) would be injected with a solution of biological amendments and beneficial bacteria to reduce contaminant mass through enhanced biological remediation. The solution delivery would be completed through a series of direct-push probes through the thickness of the treatment area (3 feet), terminating near the ground surface. Due to the shallow nature of the injections, they would need to be completed under a low pressure and with numerous closely spaced injection points.

6.3 Effectiveness

Alternative 1. The no-action alternative would not be effective in controlling the risk to human health or the environment posed by the petroleum-contaminated soil at the Site.

Alternative 2. Institutional and engineering controls are an effective alternative to address the risk associated with human contact with the impacted soil, but not ecological risk. This would not be effective as a stand-alone technology but could be combined with other technologies as part of a comprehensive alternative.

Alternative 3. Removal by excavation and off-site disposal is an effective alternative to address the risk associated with human and ecological contact with the impacted soil by removing the impacted material from the Site. Excavation would not be able to remove all site-related contaminants, only targeting the relatively higher concentrations and allowing natural processes to address the residual contamination. The possibility exists for a treatment amendment to be added to the excavation prior to backfilling, but it is not expected that such an amendment would have a significant affect away from the excavation area. Therefore, the effectiveness of the amendment would not be proportional to the cost.

Alternative 4. Capping the impacted soil material would create a barrier which would effectively prevent human contact and may also be effective at reducing or preventing ecological contact with the contaminated material. However, the contaminated soil would remain on-site (making this alternative less effective than the removal alternative). Maintenance of the cap would be needed for the protectiveness to continue, and the duration of the maintenance period would be indefinite as the alternative does not address mass removal.

Alternative 5. Phytoremediation will take some time for the plants to establish themselves but can be effective by removing the organic contaminants (through phytodegradation, transpiration, and other mechanisms) and stabilizing the inorganic contaminants (by sequestration in the plant tissue or enzymatic/rhizomatic binding in the root-zone soil). Maintenance would include inspection and replacement of plants as needed. The process is relatively slower than more direct removal technologies (such as excavation) but does address mass removal, so the maintenance period would be shorter than that of the capping alternative. The passive phytoremediation alternative would be less effective than an engineered system, but would be expected to bind contaminants and reduce the potential for erosion.

Alternative 6. If the amendments can be well-distributed through the shallow soil, *in-situ* enhanced bioremediation of the petroleum contamination can be effective at addressing the risk associated with human and ecological contact with the impacted soil, as contaminant concentrations would be reduced. To achieve the cleanup goals, multiple applications of the amendments would be needed (each with a significant mobilization and site disturbance). The bioremediation process is relatively slower than more direct removal technologies (such as excavation), but it does address mass removal, so the maintenance period would be shorter than that of the capping alternative.

Comparative Effectiveness. Alternative 1 would not be effective. Alternative 2 would not be effective as a stand-alone technology but would be useful with other alternatives. Alternative 3 would be the most effective in the short term, with most of the mass removal occurring during implementation. Alternatives 5 and 6 would be expected to achieve a similar effectiveness to Alternative 3 but would require a significantly longer timeframe. Alternative 4 may be effective at preventing contact but does not address source removal and would require indefinite maintenance to remain effective.

6.4 Implementability

Alternative 1. The no-action alternative would require no effort to implement.

Alternative 2. Controls would be relatively easy to implement, as they would require mostly administrative work, development of plans such as a contaminated media management plan (CMMP), and minimal site work (installing signs).

Alternative 3. Excavation and disposal would be moderately difficult to implement as it would require the use of heavy equipment in a relatively swampy area at a remote site. Crane mats would likely be needed to facilitate truck access to the area for removal of soil and backfilling. Additional soil sampling would likely be necessary to characterize the material for disposal for Alternative 3. The excavated soil will likely require dewatering or solidification prior to transport, and implementation will require a local backfill source, transportation of the excavated soil to a disposal facility, and transportation of the backfill material from the supplier to the Site.

Alternative 4. Capping would also require the use of heavy equipment in a relatively swampy area at a remote site. Crane mats would likely be needed to facilitate truck access to the area for placement of the cap material. Implementation will require a local backfill source and transportation of the backfill material from the supplier to the Site.

Alternative 5. Phytoremediation will be relatively easy to implement compared to Alternatives 3, 4, and 6 as the on-site effort will require the establishment of a plant community across the treatment area and periodic inspection/maintenance site visits. No heavy equipment is needed for implementation, nor significant highway truck mileage. The passive phytoremediation variation would be easy to implement (the easiest of all alternatives besides the No Action alternative).

Alternative 6. Enhanced bioremediation would be relatively difficult to implement as not only would it involve the same logistical issues as Alternatives 3 and 4 with moving heavy equipment in the swampy soil, but injecting an enhanced bioremediation solution into an area of relatively saturated soil would likely result in significant daylighting of the solution. Daylighting (or return surface flow) would minimize the ability of the injected solution to achieve contact with (and therefore destruction of) chemical contaminants. Effective implementation would also require multiple applications.

Comparative Implementability. Alternative 1 is the easiest to implement, and Alternative 2 is simpler than Alternatives 3 through 6. Alternative 5 is the next easiest to implement (though the passive version would be the second-easiest to implement). The remaining alternatives are significantly more complex, with decreasing implementability progressing from Alternative 4 to Alternative 3, and Alternative 6 being the least implementable.

6.5 Cost

The costs associated with implementing the various alternatives are summarized below; detailed costs for the implementation of Alternatives 3 through 6 are presented in Tables 3 through 6. Alternative 2 is incorporated into each of those alternatives.

Alternative 1. The cost for implementing the No Action alternative is $0.

Alternative 2. The cost for implementing the institutional and engineering controls alternative is estimated to be approximately $15,000.

Alternative 3. The cost for excavation and off-site disposal of COC-impacted soil in the corrective action area to a depth of 1 to 2.5 feet bgs (a total of 880 cubic yards of impacted soil) is estimated to be approximately $350,000, including a 10 percent contingency and DEQ oversight costs.

Alternative 4. The cost to cap the corrective action area, an estimated total of up to 10,900 square feet, with 3 feet of imported clean fill is estimated to be approximately $514,000.

Alternative 5. The cost for design, planting, and long-term inspection and maintenance of purpose-specific vegetation for phytoremediation over the corrective action area is estimated to be approximately $557,000. The potential exists for this cost to be reduced or shared with DEQ either self-performing the long-term inspection and maintenance of the vegetation or coordinating with Lincoln County (potentially reducing the costs to under $300,000).

Alternative 6. The cost to conduct enhanced bioremediation injections to treat the estimated 880 cubic yards of petroleum-impacted soil in the corrective action area is estimated to be approximately $890,000, assuming repeated injections every three years with a reducing volume each event).

Comparative Cost. Based on review of the estimated costs for the five alternatives for mitigating the impacted soil areas, Alternative 3 is the most cost effective. The addition of the institutional controls and passive phytoremediation variation would not significantly affect costs.

7.0 Conclusions and Recommendations

Based on the results of the Phase II ESA, test pit investigation, and SSI, widespread contamination is present throughout much of the former King Salvage facility at levels exceeding appropriate DEQ RBCs or ecological RBCs. Specifically, an area of petroleum-contaminated soil has been observed in the area of the former car crusher, and soil samples collected from decision units west of the former car crusher (DU-4, DU-4F, DU-4G, and DU-4I) contained concentrations of several COCs above human health or ecological RBCs. Due to the widespread nature of some contaminants that exceed the ecological RBCs and the uncertainties identified in the ecological risk assessment, it was concluded that additional assessment will be needed to quantify the extent of ecological risks and potential corrective actions, and the cleanup action considered in this analysis is limited to addressing human health risks and gross ecological risks in areas of more significant contamination.

A summary of the comparative analysis of the treatment technologies is included in Table 2. Based on the assessment of cleanup alternatives, it is recommended that the area of petroleum-impacted soil be addressed with the implementation of Alternative 3 (excavation and disposal) in conjunction with the passive phytoremediation variation (augmenting natural plants with a hardy seed mix) and institutional and engineering controls (Alternative 2) to limit contact with residual soil contamination and restrict the use of groundwater at the Site. With this combination, the surficial petroleum contamination would be addressed, residual contamination will be less likely to erode, and the controls would prevent future human health risks. While the addition of the passive phytoremediation alternative will extend the time to be fully effective and achieve the cleanup goals, the excavation and institutional controls components are quick to complete and will provide significant protectiveness while the plants are establishing.

8.0 References

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Table 1
ABCA Screening and Evaluation of Technologies for Soil
Former King Salvage
Toledo, Oregon

General Response Actions	Technology	Description	Screening Criteria: Effectiveness	Screening Criteria: Implementability	Screening Criteria: Cost	Screening Comments
NO ACTION	None	No Action	Not effective in achieving RAOs.	Easy to implement.	No capital or O&M costs incurred.	Not effective.
INSTITUTIONAL CONTROLS	Deed Restrictions/ Soil Management Plan	Can prevent disturbance of engineering controls, address notification of site hazards, and ensure proper controls are implemented during future site activities.	Effective at regulating human health direct contact on-site. Requires adherence to restrictions. Not effective at mitigating ecological risk.	Easy to implement on-site, but difficult to enforce and maintain due to remote nature of site and lack of supervision.	Low costs associated with implementing soil management plan.	May be effective to preclude other site uses or disturbance of contaminated soil. Soil management plan may be appropriate for potential future on-site construction activities.
	Monitoring	Laboratory analysis of soil samples.	Effective for documenting site conditions to evaluate current and potential future site risks. Does not affect potential contaminant exposures.	Easy to implement for shallow soil.	Low to moderate costs for monitoring.	Applicable to document site conditions and effectiveness of any treatment.
ENGINEERING CONTROLS	Access Restrictions	Use of fencing or other controls to limit access to soil contamination.	Effective at preventing human health direct contact, but does not affect contaminant mass or concentration. Not effective at mitigating ecological risk.	Reasonable to implement at Site. Difficult to enforce and maintain due to remote nature of site and lack of supervision.	Low to moderate costs associated with implementing controls. Will likely require regular maintenance of control structures.	May be applicable for specific conditions for limiting access to contaminated soil not addressed by other technologies.
CONTAINMENT	Capping	Installation of cap (e.g., soil, asphalt, impermeable liner) over impacted soils.	Effective at preventing direct contact with contaminated soils. Low-permeability caps can reduce rainwater infiltration thereby reducing the potential for contaminants leaching from soil. May not control exposure to burrowing animals, but armored caps would minimize potential for disturbance.	Moderately easy to implement at Site. Swampy nature of target area would likely require crane mats to be utilized during construction. Periodic inspection and maintenance of cap would be required.	Moderate costs to install new cap(s). Low to moderate costs for upkeep and maintenance of cap(s).	May be applicable to prevent human or ecological contact with site contaminants.
REMOVAL/OFF-SITE DISPOSAL	Excavation	Excavation of contaminated soils for subsequent disposal or treatment.	Effective for removing contaminated soil from site. Addresses direct exposure pathways for human health and ecological exposures by removing contaminant concentrations and mass from the Site.	Moderately easy to implement at Site. Swampy nature of treatment area would likely require crane mats to be utilized during construction. Implementation involves conventional construction equipment and methods. Easy to coordinate.	Moderate costs for excavation of shallow soil.	Applicable to shallow soil contamination.
	Off-site Disposal	Off-site disposal at licensed landfill. Soils would require characterization to determine type of disposal facility (hazardous or non-hazardous).	Effective for containing contaminated soils and reducing risks associated with direct exposure.	Implementation involves transportation of contaminated soils on public roads for potentially long distances.	Moderate to high costs depending upon soil volumes.	Applicable to excavated soil.
IN SITU PHYSICAL/ CHEMICAL/ THERMAL TREATMENT	Soil Vapor Extraction (SVE)	SVE involves extraction of vapors from vadose zone using system of vertical wells or horizontal vents and vacuum pumps/blowers.	Highly effective at removing volatile organic compounds (VOCs) from unsaturated soils and controlling vapor migration. Not effective in areas of shallow groundwater (would require inclusion of groundwater removal/ dewatering).	Conventional technologies available for implementation. Would require long-term access to power for equipment.	Generally moderate to high capital and O&M costs. Treatment of vapors increases costs significantly.	Not applicable to site conditions (shallow groundwater).
	Chemical Oxidation	Chemically converts hazardous contaminants to less toxic compounds. Effective in destroying organic contaminants and oxidizing inorganic contaminants to less toxic/less mobile forms. Can include oxidant chemicals such as peroxides, permanganates, or ozone.	Can be highly effective at destruction of organic contaminants. Can be difficult to achieve full coverage (contact between oxidant and COIs), particularly in shallow soils.	Equipment and vendors are readily available. Oxidation most efficient for areas of high concentration. Would likely require multiple applications. Difficult to safely control in near-surface applications.	High to Very High implementation cost.	While applicable to site contaminants, would be difficult to implement due to shallow (near-surface) injection and costs would be very high. Likely would require very closely-spaced injections and multiple oxidation events.

Please refer to note at end of table.

Table 1
ABCA Screening and Evaluation of Technologies for Soil
Former King Salvage
Toledo, Oregon

General Response Actions	Technology	Description	Screening Criteria			Screening Comments
			Effectiveness	Implementability	Cost	
IN SITU PHYSICAL/ CHEMICAL/ THERMAL TREATMENT *(CONTINUED)*	Soil Flushing	Water (or water containing an additive to enhance contaminant solubility) is circulated through the soil to desorb contaminants, recovered, and treated. Single-well implementation can involve injection followed by removal (such as via vacuum truck).	Less effective for organic contaminants and would require water extraction/treatment operation.	Extracted water would require treatment and disposal.	High implementation cost.	Not suitable for site conditions with shallow groundwater near wetlands.
	Solidification/ Stabilization/ Vitrification	Contaminants are physically bound or enclosed within a stabilized mass (solidification and vitrification), or chemical reactions are induced between the stabilizing agent and contaminants to reduce their mobility (stabilization).	Most suitable to inorganic contaminants to prevent leaching.	Coverage of impacted saturated soil would be difficult and expensive.	High implementation cost.	Less suitable to site contaminants and difficult to implement with site conditions.
	Thermally Enhanced Removal	High energy injection (steam/hot air, electrical resistance, electromagnetic, fiber optic, radio frequency) is used to increase the recovery rate of semi-volatile or non-volatile compounds to facilitate extraction (enhanced volatilization or decreased viscosity).	Most suitable to semi-volatile organic contaminants or viscous compounds that are not otherwise extractable with vapor extraction or fluid extraction technologies. Vapor recovery not effective in saturated soil.	Generally used in conjunction with soil vapor extraction system or other recovery system (i.e., groundwater extraction). Has high energy requirements, particularly in saturated soil. Would require power supply provided during extent of treatment.	High to Very High implementation cost.	Difficult to implement for scattered shallow soil contamination, and not feasible to provide vapor recovery. No benefit to the high additional cost.
IN SITU BIOLOGICAL TREATMENT	Bioventing	Bioventing involves inducing air or oxygen flow in the unsaturated zone to promote biodegradation of hydrocarbons and VOCs. Applications include injection of air or oxygen into subsurface, or extraction of air at rates lower than SVE.	Effective in reducing contaminant concentrations in deeper unsaturated soils. Not suitable for site conditions with shallow groundwater.	Venting can be done passively, but is not suitable to address shallow saturated soil.	Generally has moderate capital and O&M costs.	Not suitable for site conditions (shallow saturated soil contamination).
	Enhanced Bioremediation (Bioaugmentation, Biostimulation)	Adding nutrients, electron acceptor, or other amendments to enhance bioremediation.	Suitable for saturated soils with addition of suitable amendments, but is most effective at relatively low concentrations. Process requires saturation of shallow soil to be effective (consistent with site conditions).	Implementation would require mixing of amendments into soil, which can be completed using readily available equipment. Amendments for petroleum contamination are available, generally consisting of oxygen-releasing compounds and bacterial cultures.	Generally moderate costs depending on number of injection/mixing events required.	May be applicable to addressing residual soil contamination in shallow saturated soil conditions.
	Land Treatment	Combination of aeration (tilling) and amendments to enhance bioremediation in surface soils.	Effective for organic contaminants in shallow soil that can be degraded aerobically. Less effective for heavy organics encountered at the Site.	Reasonable implemenation in shallow soil using readily available equipment. Would require frequent trips to the remote site. Heavy-chain organics would degrade slowly.	Low to moderate implementation cost for each tilling event, but would require numerous events.	Impractical to implement at remote site for types of contamination found in shallow soil - would require numerous trips.
	Monitored Natural Attenuation	Using natural processes to reduce contaminant concentrations to acceptable levels. Process is closely monitored to verify exposures are acceptable prior to concentrations reaching acceptable levels.	May be effective, especially in areas of low concentrations, but is dependant upon site conditions. Not efficient for source areas; other technologies will likely be required.	Easy to implement. Monitoring of unsaturated soil may require repeated intrusive sampling events. Likely will require significant timeframe to reach cleanup goals.	Low costs for monitoring.	May be applicable to address residual low-concentration organic contamination not efficiently addressed by active remediation.
	Phytoremediation	Phytoremediation is a process that uses plants to remove, transfer, stabilize, and destroy contaminants in soil or sediment.	Can be effective at removing a variety of organic and inorganic compounds from soil through plant uptake in vicinity of roots (rhizosphere).	Can be implemented for shallow soil contamination but difficult to control at remote site. Would require frequent maintenance of plants until established.	Moderate implementation cost.	Would require selection of appropriate plants for site conditions, but once established could be effective.

Please refer to note at end of table.

Table 1
ABCA Screening and Evaluation of Technologies for Soil
Former King Salvage
Toledo, Oregon

General Response Actions	Technology	Description	Screening Criteria			Screening Comments
			Effectiveness	Implementability	Cost	
EX SITU PHYSICAL/ CHEMICAL/ THERMAL TREATMENT	Chemical Extraction	Excavated soil is mixed with an extractant which dissolves the contaminants. The resultant solution is placed in a separator to remove the contaminant/extractant mixture for treatment.	Most suitable to removal of semi-volatile and inorganic contamination from excavated soil.	Somewhat effective in removing most organic contaminants from soil. Difficult to remove all contaminant/extractant mixture from soil - would likely require finish treatment. Requires area for soil treatment or transport to off-site facility. Extractant fluid would need subsequent treatment process or disposal.	High to very high implementation cost.	Additional treatment would be required for both soil and recovered extractant. Not cost effective for types of contamination and volume of excavated soil.
	Incineration	High temperatures are used to combust (in the presence of oxygen) organic constituents in hazardous wastes.	Effective at removing organic contaminants from excavated soil, but particularly suitable for recalcitrant contaminants.	Requires transport to off-site facility (long-distance transport).	High implementation cost.	Significant cost for transportation and treatment and not cost effective for types of contamination (no benefit of significantly higher cost over disposal alternative)
	Soil Washing	Contaminants are separated from the excavated soil with wash-water augmented with additives to help remove organics.	Most suitable for semi-volatile organics or inorganic contamination.	Requires area for soil treatment or transport to off-site facility. Resultant fluid would need subsequent treatment process or disposal. Would need additives to assist with removal of organics.	Moderate to high implementation cost.	Additional treatment would be required for recovered extractant. Not cost effective for types of contamination and volume of excavated soil. Could be implemented at the Site, but would require mobilization and power.
	Solar Detoxification	Contaminants are destroyed by photochemical and thermal reactions using ultraviolet energy in sunlight or artificial UV light. Usually involves application of catalyst agent.	Can be effective at treating a variety of organic compounds. Most effective when used with catalyst agent (e.g., titanium dioxide).	Implementation with sunlight limited by availability (not effective during nighttime and limited effectiveness in cloudy/wet seasons). Requires significant area for treatment or transport to off-site facility. Existing shallow soil has had long-term exposure to sunlight without sufficient improvement.	Moderate to high implementation cost.	Would require significant processing and management of soil during treatment. No commercial treatment facility available.
	Thermal Desorption/ Pyrolysis/ Hot Gas Decontamination	Waste soils are heated to either volatilize (desorption and hot gas) or to anaerobically decompose (pyrolysis) organic contaminants. Off-gas is collected and treated.	Effective at removing organic materials from excavated soil (particularly volatile organics). Pyrolysis generally used for semi-volatiles or pesticide wastes.	Requires transport to off-site treatment facility. Off-gas treatment required.	Moderate to high implementation cost.	Significant cost for transportation and treatment and not cost effective for types of contamination (no benefit of significantly higher cost over disposal alternative)
EX SITU PHYSICAL/ CHEMICAL/ THERMAL TREATMENT - CONTINUED	Separation	Separation techniques concentrate contaminated solids through physical, magnetic, and/or chemical means. These processes remove solid-phase contaminants from the soil matrix.	Effective only for removal of solids with distinct physical characteristics (size, density, composition, etc).	Commercial equipment available for separation by size (sieving) or for removing iron (magnetic removal).	Low to moderate cost.	Not compatible with site contaminants.
	Vapor Phase Oxidation	Chemicals in the vapor stream are oxidized in the presence of elevated temperatures (thermal oxidation), or with the addition of a catalyst (catalytic oxidation).	Effective at removal of organics from a vapor stream.	Commercial equipment available for vapor phase oxidation. Requires energy source (electric or flammable gas).	Moderate capital cost; low to moderate O&M costs.	Not applicable without vapor extraction technology.
	Vapor Phase Adsorption	Concentrating solutes on the surface of a sorbent material, such as activated carbon, to remove the solute from a vapor stream.	Highly effective at removing many organic compounds from vapor stream.	Treatment equipment is readily available. Media requires periodic replacement as adsorption sites are used up.	Moderate capital and O&M costs.	Not applicable without vapor extraction technology.
EX SITU BIOLOGICAL TREATMENT	Biopiles	Excavated soils are mixed with soil amendments and placed in aboveground enclosures and aerated with blowers or vacuum pumps.	Effective for removal of organic contaminants from excavated soil. Most effective with control of moisture, heat, nutrients, oxygen, and pH to enhance biodegradation	Requires area for soil treatment or transport to off-site facility. May generate leachate that would need to be collected and managed.	Moderate to high cost.	Inefficient for treatment of heavy organics. Would require significant management of soil and leachate at remote site.

Please refer to note at end of table.

Table 1
ABCA Screening and Evaluation of Technologies for Soil
Former King Salvage
Toledo, Oregon

General Response Actions	Technology	Description	Screening Criteria			Screening Comments
			Effectiveness	Implementability	Cost	
EX SITU BIOLOGICAL TREATMENT *(CONTINUED)*	Composting	Excavated soil is mixed with bulking agents and organic amendments to promote microbial activity.	Effective for removal of organic contaminants from excavated soil. Most effective with control of moisture, heat, nutrients, oxygen, and pH to enhance biodegradation	Requires area for soil treatment or transport to off-site facility. May generate leachate that would need to be collected and managed.	Low to moderate cost.	Inefficient for treatment of heavy organics. Would require significant management of soil and leachate at remote site.
	Landfarming	Excavated soil is placed in lined beds and periodically tilled to aerate the soil.	Effective at removing organic contaminants from excavated soil.	Would require frequent trips to the remote site. Heavy-chain organics would degrade slowly.	Low to moderate implementation cost for shallow soils.	Impractical to implement at remote site for types of contamination found in shallow soil.
	Slurry Phase Biological Treatment	An aqueous slurry of soil, sediment, or sludge with water and other additives is mixed to keep solids suspended and microorganisms in contact with the soil contaminants. When complete, the slurry is dewatered and the soil is disposed of.	Can be effective at treating a variety of organic compounds.	Requires area for soil treatment or transport to off-site facility. Slurry dewatering generates water that requires treatment or disposal.	Moderate to high implementation cost.	Handling of slurry and wastewater is complicated and expensive; would require significant on-site management of soil during long-term treatment process.

Note:
1) Shading indicates technologies that have been eliminated from consideration.

Table 2
Comparative Evaluation of Alternatives
King Salvage Analysis of Brownfield Alternatives
Toledo, Oregon

Remedial Alternatives		Protective	Balancing Factors: Effectiveness						Long-Term Reliability						Implementability						Reasonableness of Cost						Score	Rank
			1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6	1	2	3	4	5	6		
1	No Action	No		-	-	-	-	-		-	-	-	-	-		+	+	+	+	+		+	+	+	+	+	0.0	**na**
2	Institutional and Engineering Controls	Yes	+		-	-	-	-	+		-	-	-	-	-		+	+	+	+	-		+	+	+	+	0.0	**3**
3	Excavation and Offsite Disposal	Yes	+	+		+	+	+	+	+		+	+	+	-	-		-	-	+	-	-		0	0	+	6.0	**1**
4	Capping	Yes	+	+	-		-	-	+	+	-		-	-	-	-	+		-	+	-	-	0		0	+	-4.0	**4**
5	Phytoremediation	Yes	+	+	-	+		0	+	+	-	+		-	-	-	+	+		+	-	-	0	0		+	3.0	**1**
6	Bioremediation Injections	Yes	+	+	-	+	0		+	+	-	+	+		-	-	-	-	-		-	-	-	-	-		-5.0	**5**

Notes:

+ = The alternative is favored over the compared alternative (score=1)

0 = The alternative is equal with the compared alternative (score=0)

- = The alternative is less favorable than the compared alternative (score=-1)

na = Not protective, therefore not ranked

Alternatve	Compared Against:					
1		2	3	4	5	6
2	1		3	4	5	6
3	1	2		4	5	6
4	1	2	3		5	6
5	1	2	3	4		6
6	1	2	3	4	5	

Table 3
Cost Estimate - Alternative 3
Former King Salvage
Toledo, Oregon

Alternative 3: Removal and Off-Site Disposal of Soil

Item Description - Management Costs	Quantity	Unit	Unit Cost	Extension
Project Management (implementation)	5	%		$14,000
DEQ Oversight Costs	10	%		$28,000
		Management Costs Subtotal:		**$42,000**

Item Description - Capital Costs	Quantity	Unit	Unit Cost	Extension
Project review with the Oregon State Office of Historic Preservation, ODFW	1	est	$3,000	$3,000
Impacted Soil Survey and Marking	1	day	$1,500	$1,500
Equipment mobilization and site setup	1	est	$10,000	$10,000
Excavation Removal, Transport, and Disposal	880	cubic yards	$200	$176,000
Engineering/Institutional Controls Coordination and Implementation	1	est	$10,000	$10,000
Confirmation Sampling After Removal	1	est	$2,500	$2,500
Excavation Backfill Transport and Placement	1,300	tons	$40	$52,000
Travel Mileage	4	trip	$150	$600
Per-Diem	12	days	$157	$1,890
Labor/Oversight	12	days	$1,500	$18,000
Completion Report	1	each	$5,000	$5,000
		Capital Costs Subtotal:		**$280,490**

Item Description - O&M Costs (Present Value @ 5%)	Quantity	Unit	Unit Cost	Extension
No Long Term Costs				
		O&M Costs Subtotal:		**$0**

Contingency	10	%		**$28,000**
		TOTAL ESTIMATED COST:		**$350,000**

Table 4
Cost Estimate - Alternative 4
Former King Salvage
Toledo, Oregon

Alternative 4: Capping

Item Description - Management Costs	Quantity	Unit	Unit Cost	Extension
Project Management (implementation)	5	%		$10,000
Project Management (long-term PV @ 5%)	50	years	$3,000	$54,770
DEQ Oversight	10	%		$20,500
		Management Costs Subtotal:		**$85,500**
Item Description - Capital Costs	**Quantity**	**Unit**	**Unit Cost**	**Extension**
Project review with the Oregon State Office of Historic Preservation, ODFW	1	est	$3,000	$3,000
Cap Material Sourcing	1	est	$2,000	$2,000
Impacted Soil Survey and Marking	1	days	$1,500	$1,500
Engineering/Institutional Controls Coordination and Implementation	1	est	$10,000	$10,000
Equipment mobilization and site setup	1	est	$10,000	$10,000
Cap area grubbing/vegetation removal	10,900	sf	$0.55	$6,000
Cap Material, Delivered	1,800	tons	$20	$36,000
Cap Placement and Compaction	1,210	cy	$35	$42,350
Geotextile (Burrowing deterrant)	10,900	sf	$6	$65,400
Travel Mileage	4	trip	$150	$600
Per-Diem	15	days	$157	$2,360
Labor/Oversight	15	days	$1,500	$22,500
Completion Report	1	each	$5,000	$5,000
		Capital Costs Subtotal:		**$206,710**
Item Description - O&M Costs (Present Value @ 5%)	**Quantity**	**Unit**	**Unit Cost**	**Extension**
Long-Term Inspection and Reporting (annual)	50	years	$5,000	$91,500
Periodic Maintenance (biannual)	25	events	$10,000	$91,000
		O&M Costs Subtotal:		**$182,500**
Contingency	10	%		**$39,000**
		TOTAL ESTIMATED COST:		**$514,000**

Table 5
Cost Estimate - Alternative 5
Former King Salvage
Toledo, Oregon

Alternative 5: Phytoremediation- Apex Performs O&M

Item Description - Management Costs	Quantity	Unit	Unit Cost	Extension
Project Management (implementation)	5	%		$35,000
Project Management (long-term PV @ 5%)	15	years	$3,000	$31,140
DEQ Oversight	10	%		$70,000
			Management Costs Subtotal:	**$136,140**

Item Description - Capital Costs	Quantity	Unit	Unit Cost	Extension
Project review with the Oregon State Office of Historic Preservation, ODFW	1	est	$3,000	$3,000
Impacted Soil Survey and Marking	1	days	$1,500	$1,500
Plant Suitability Evaluation (biologist)	1	est	$5,000	$5,000
Plant Material (average 1 plant per 9 sf; large less frequent, small more frequent)	1,250	each	$30.00	$37,500
Plant Installation	1,250	each	$40.00	$50,000
Year 1 establishment inspection and upkeep	1	est	$45,000	$45,000
Engineering/Institutional Controls Coordination and Implementation	1	est	$10,000	$10,000
Travel Mileage	4	trip	$150	$600
Per-Diem	10	days	$157	$1,570
Labor/Oversight	10	days	$1,500	$15,000
Completion Report	1	each	$5,000	$5,000
			Capital Costs Subtotal:	**$174,170**

Item Description - O&M Costs (Present Value @ 5%)	Quantity	Unit	Unit Cost	Extension
Long-Term Inspection and Reporting (annual)	15	years	$5,500	$57,000
Progress sampling	15	events	$3,500	$36,500
Periodic Maintenance (annual)	15	events	$8,000	$83,000
			O&M Costs Subtotal:	**$176,500**
Contingency	20	%		**$70,000**
			TOTAL ESTIMATED COST:	**$557,000**

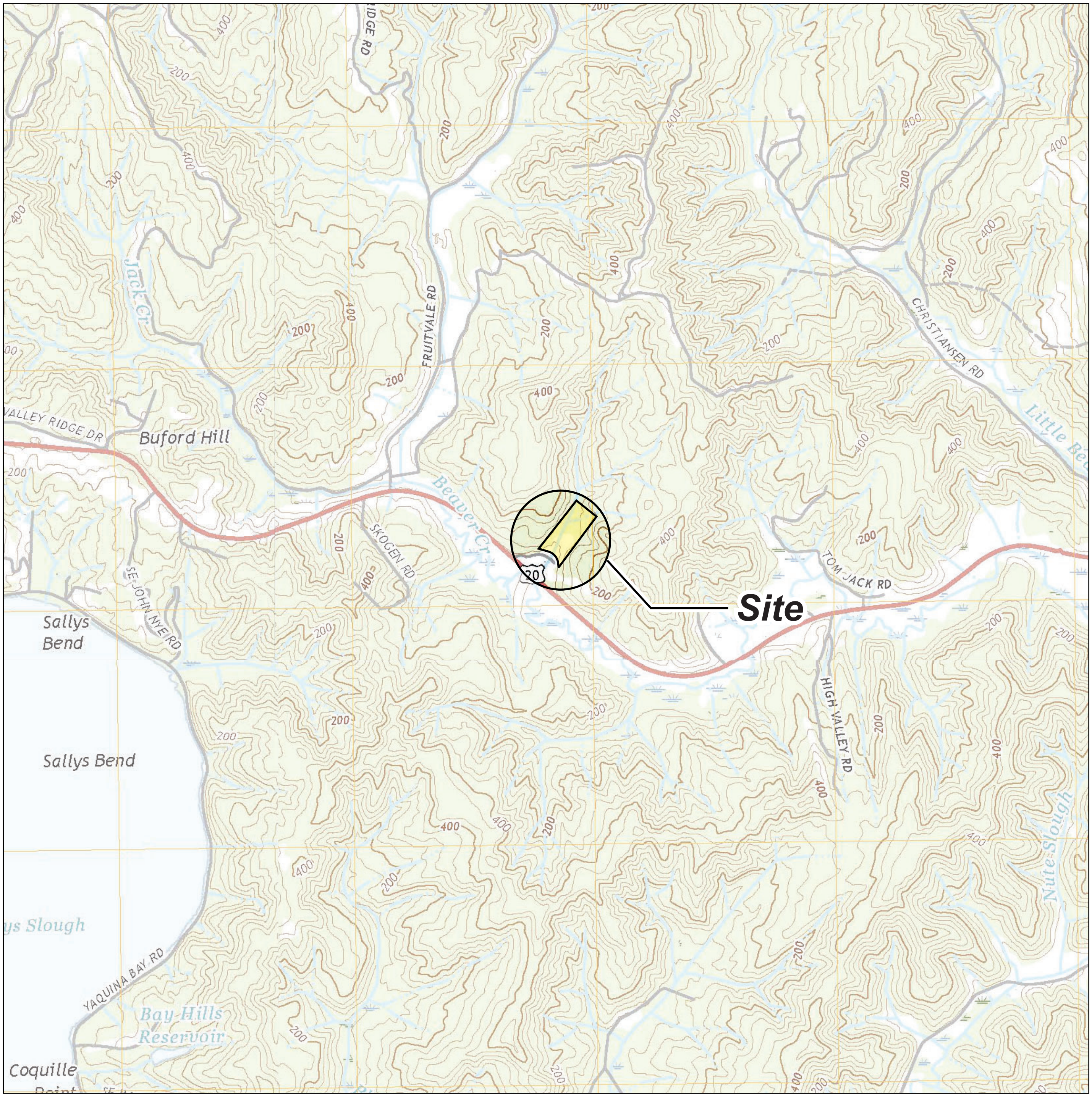
Table 6
Cost Estimate - Alternative 6
King Salvage Analysis of Brownfield Alternatives

Alternative 6: In-Situ Enhanced Bioremediation

Item Description - Management Costs	Quantity	Unit	Unit Cost	Extension
Project Management (implementation)	5	%		$11,400
Project Management (long-term PV @ 5%)	15	years	$3,000	$31,200
DEQ Oversight	10	%		$22,800
			Management Costs Subtotal:	**$65,400**

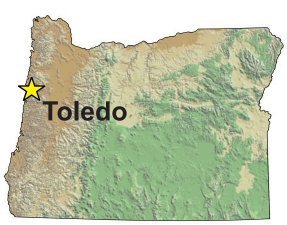
Item Description - Capital Costs	Quantity	Unit	Unit Cost	Extension
Project review with the Oregon State Office of Historic Preservation, ODFW	1	est	$3,000	$3,000
Impacted Soil Survey and Marking	1	days	$1,500	$1,500
Equipment mobilization and site setup	1	est	$10,000	$10,000
Specialty Subcontractor - In-Situ Enhanced Bioremediation Products	1	est	$64,000	$64,000
In-Situ Treatment Implementation	1	est	$100,000	$100,000
Travel Expenses	6	trip	$150	$900
Per-Diem	20	days	$157	$3,140
Labor/Oversight	20	days	$1,500	$30,000
Engineering/Institutional Controls Coordination and Implementation	1	est	$10,000	$10,000
Completion Report	1	each	$5,000	$5,000
			Capital Costs Subtotal:	**$227,540**

Item Description - O&M Costs (Present Value @ 5%)	Quantity	Unit	Unit Cost	Extension
Follow-up Injection (Year 3; 100% of initial coverage)	1	event	$208,100	$163,100
Follow-up Injection (Year 6; 80%)	1	event	$166,500	$124,200
Follow-up Injection (Year 9; 50%)	1	event	$104,100	$67,100
Follow-up Injection (Year 12; 30%)	1	event	$65,500	$36,500
Progress sampling (annual)	15	events	$4,000	$41,500
			O&M Costs Subtotal:	**$432,500**
Contingency	25	%		**$165,000**
			TOTAL ESTIMATED COST:	**$890,000**



Note: Base map prepared from USGS 7.5-minute quadrangles of Newport North and South and Toledo North and South, OR, dated 2020 as provided by USGS.gov.

0 2,000 4,000
Approximate Scale in Feet



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Site Location Map

Revised Analysis of Brownfield Cleanup Alternatives
Former DEQ King Salvage Site - 109 King Place
Toledo, Oregon

APEX — Apex Companies, LLC 15618 SW 72nd Avenue Tigard, Oregon 97224	Project Number: 32-23010077	Drawn: JP	Approved: MWS	Figure 1
	June 2024			

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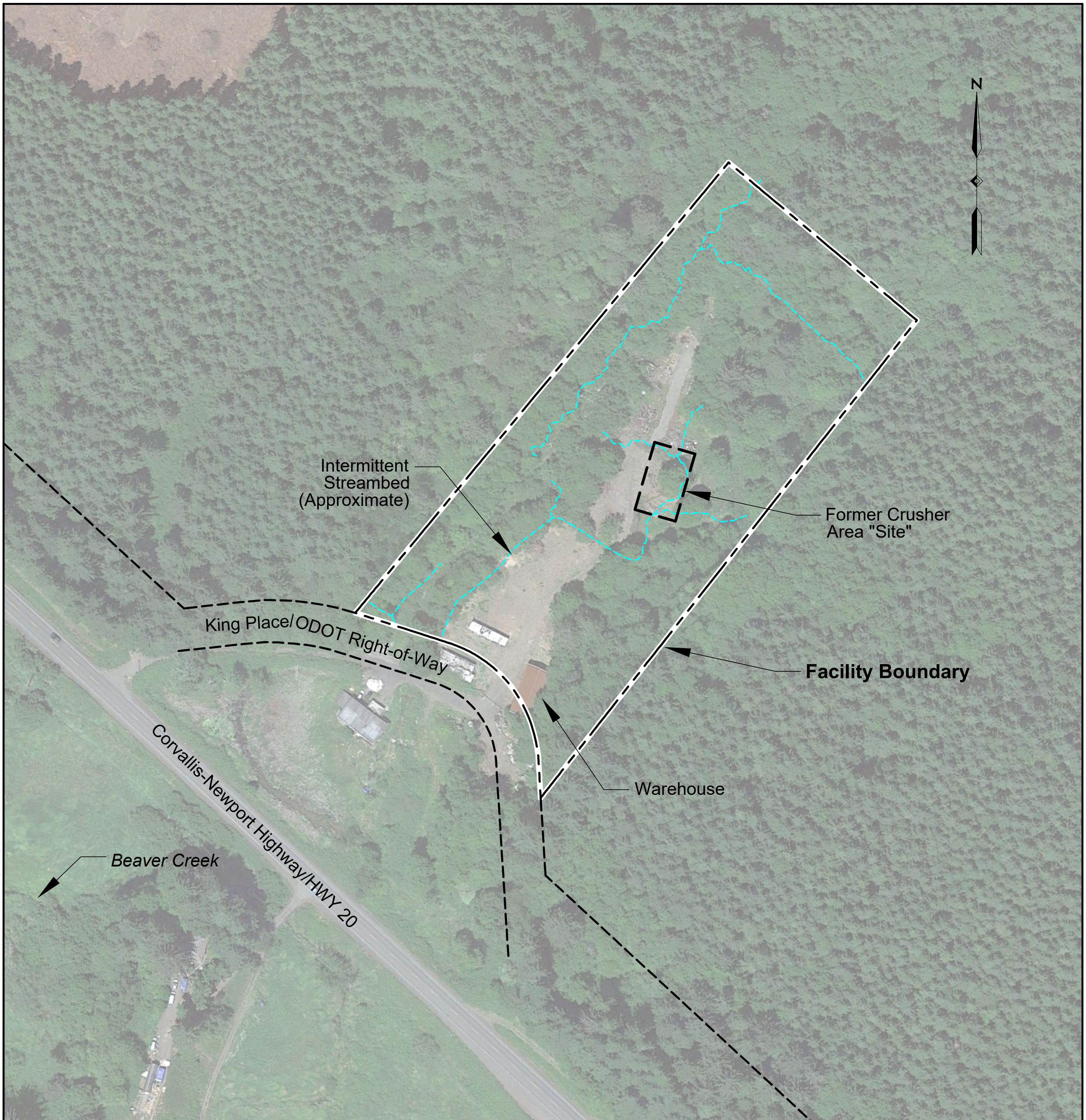

NOTE: Base map prepared from Google Earth Pro Imagery.
Aerial dated September 24, 2019. Tax Lot lines are approximate.

0 200 400
Scale in Feet

Site Plan

Revised Analysis of Brownfield Cleanup Alternatives
Former DEQ King Salvage Site - 109 King Place
Toledo, Oregon

APEX Apex Companies, LLC 15618 SW 72nd Avenue Tigard, Oregon 97224	Project Number: 32-23010077	Drawn: JP	Approved: MWS	Figure **2**
	June 2024			

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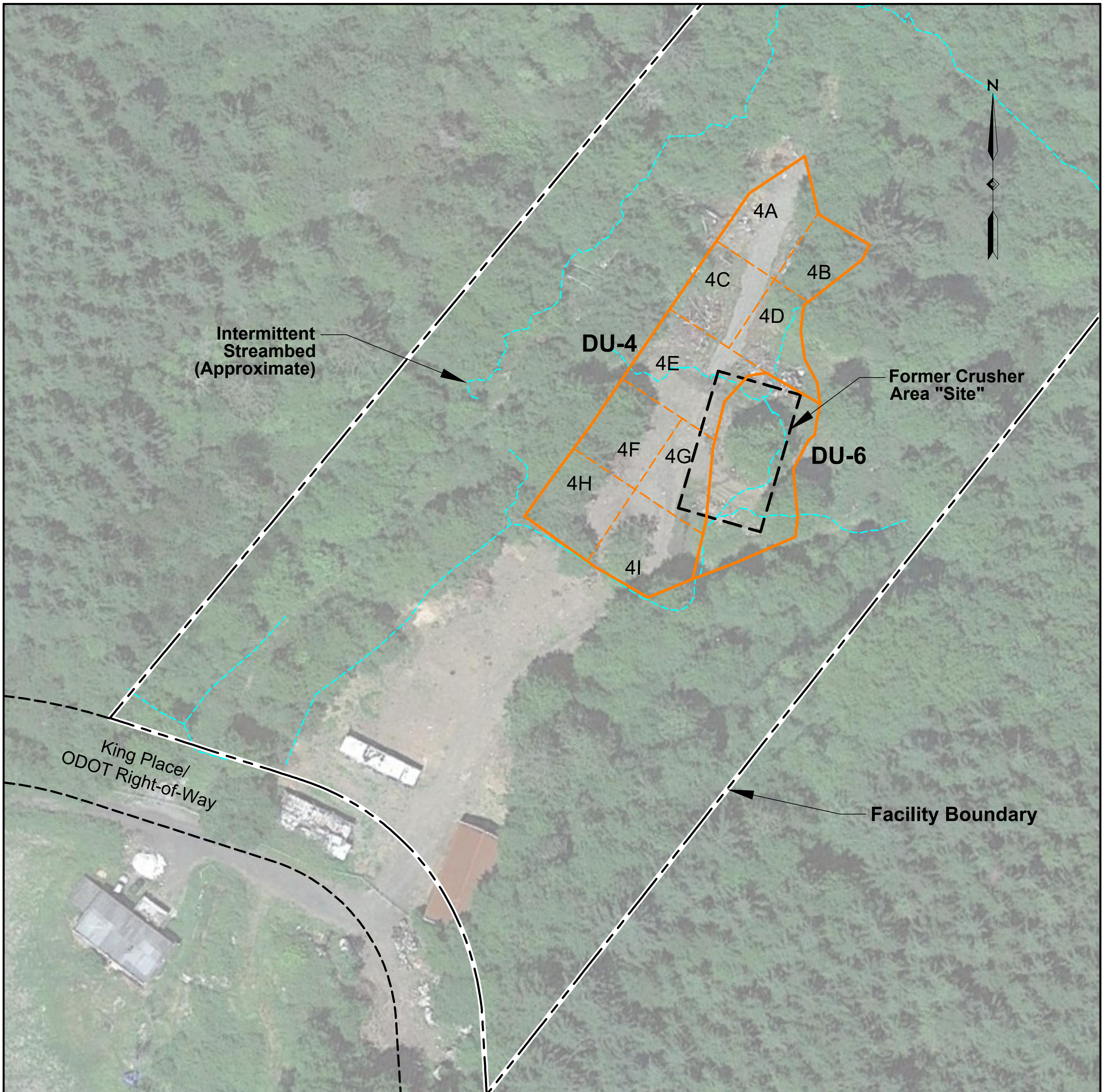

NOTE: Base map prepared from Google Earth Pro Imagery.
Tax Lot lines are approximate.

Legend:

DU-4 Decision Unit Boundary and Designation

4A Subunit Boundary and Designation

0 100 200
Scale in Feet

Decision Units

Revised Analysis of Brownfield Cleanup Alternatives
Former DEQ King Salvage Site - 109 King Place
Toledo, Oregon

APEX Apex Companies, LLC 15618 SW 72nd Avenue Tigard, Oregon 97224	Project Number: 32-23010077	Drawn: JP	Approved: MWS	Figure 3
	June 2024			

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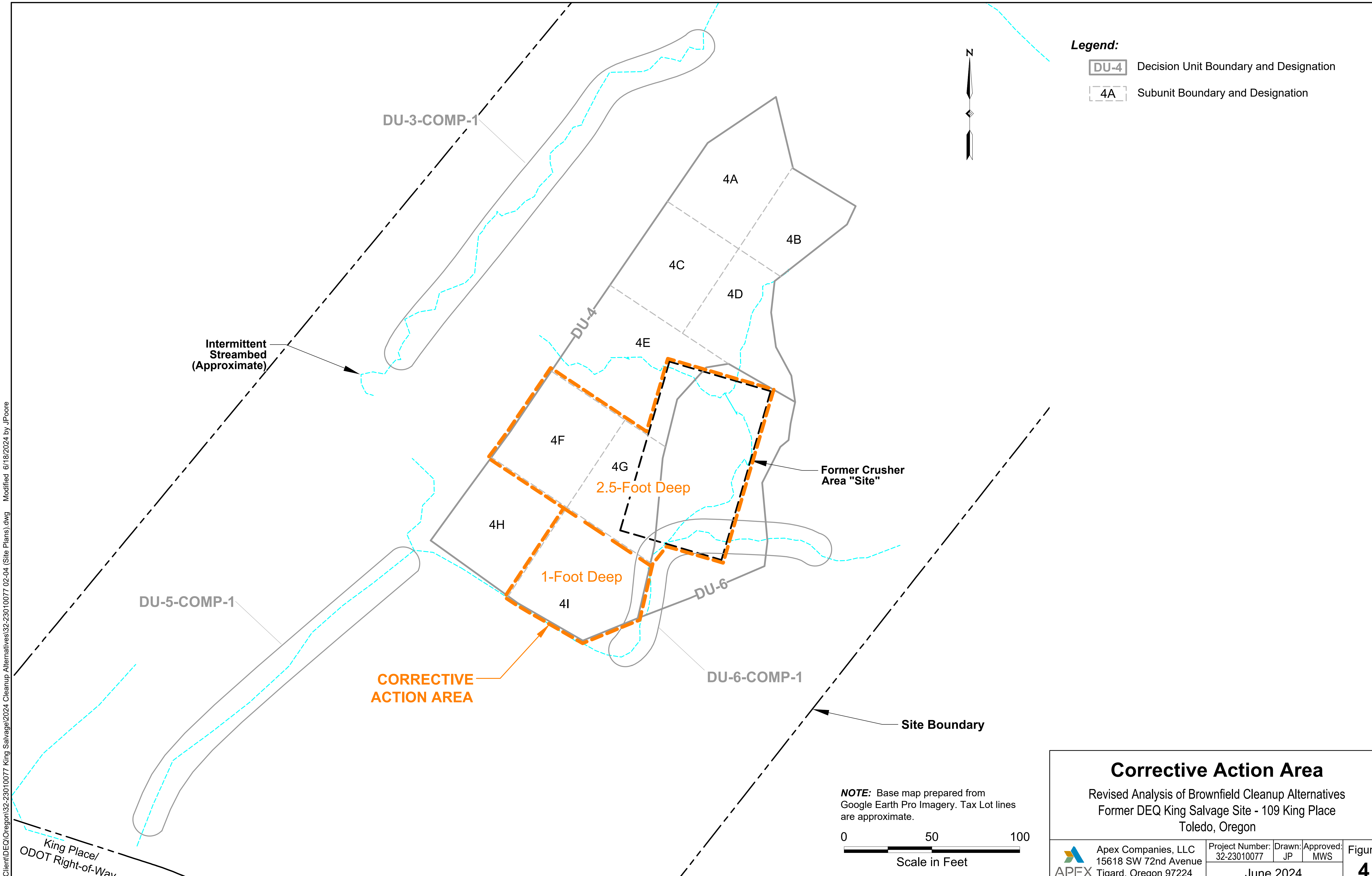

Corrective Action Area

Revised Analysis of Brownfield Cleanup Alternatives
Former DEQ King Salvage Site - 109 King Place
Toledo, Oregon

APEX
Apex Companies, LLC
15618 SW 72nd Avenue
Tigard, Oregon 97224

Project Number:	Drawn:	Approved:	Figure
32-23010077	JP	MWS	4
June 2024			

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