ANALYSIS OF BROWNFIELD CLEANUP ALTERNATIVES

Former Frontier Leather Tannery Property

1210 SW Oregon Street

Sherwood, Oregon

Cooperative Agreement BF-00J93201

Prepared for:

City of Sherwood
22580 SW Pine Street
Sherwood, OR 97140

Prepared by:

Amec Foster Wheeler Environment & Infrastructure, Inc.
7376 SW Durham Road
Portland, Oregon 97224
(503) 639-3400

August 2017

Project No. 5-61M-130820

August 8, 2017
Project No. 5-61M-130820

City of Sherwood
22580 SW Pine Street
Sherwood, Oregon 97140

Attention: Ms. Julia Hajduk

Subject: Analysis of Brownfield Cleanup Alternatives – Draft
Former Frontier Leather Tannery Property
1210 SW Oregon Street – Sherwood, Oregon
Cooperative Agreement BF-00J93201

Dear Julia:

Amec Foster Wheeler Environment & Infrastructure, Inc. is pleased to submit this Analysis of Brownfield Cleanup Alternatives (ABCA) for the above-referenced property in Sherwood, Oregon.

We appreciate the opportunity to serve you on this project. If you have any questions or require further information, please feel free to contact us at (503) 639-3400.

Sincerely,

Amec Foster Wheeler
Environment & Infrastructure, Inc.

DRAFT

Michelle Peterson, RG
Project Manager

DRAFT

Russ Bunker, RG
Associate Geologist

Attachments

GT/CE/MLP/ay

Amec Foster Wheeler Environment & Infrastructure, Inc.
7376 SW Durham Road
Portland, Oregon
USA 97224
Tel+1 (503) 639-3400
Fax+1 (503) 620-7892
www.amecfw.com

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Former Frontier Leather Tannery Property
Sherwood, Oregon

1.0 INTRODUCTION

On behalf of the City of Sherwood (City), Amec Foster Wheeler Environment & Infrastructure, Inc. (Amec Foster Wheeler) has prepared this Analysis of Brownfield Cleanup Alternatives (ABCA) for the Former Frontier Leather Property located at 1210 SW Oregon Street in Sherwood, Oregon. The City was awarded a United States Environmental Protection Agency (EPA) Site-Specific Brownfields Assessment Grant in 2014 to conduct assessment and cleanup planning for Tax Lots 600 and 602, collectively referred to as the Former Frontier Leather Property and the Site. All grant work performed by the City and its contractors was performed in accordance with the Cooperative Agreement (BF-00J93201) executed by the United States Environmental Protection Agency (EPA) and the City.

2.0 PROJECT BACKGROUND

This section provides a summary of the Site history, a site description, the proposed development plan, a summary of previous investigations, and the project objectives.

2.1 SITE LOCATION AND DESCRIPTION

The Site is located in Washington County, in Township 2 South, Range 1 West of the Willamette Meridian at the southwest corner of Section 29 (Figure 1). The Site consists of two vacant tax lots (Tax Lots 600 and 602) covering approximately 24 acres located in an industrially-zoned area of Sherwood, Oregon along SW Oregon Street (Figure 2). The Site is surrounded by industrially zoned land on the west, north, and east. A railroad right-of-way borders the Site on the north. A residential neighborhood is located south of the Site, across SW Oregon Street. The Site contains 17.36 acres of wetland areas (Amec Foster Wheeler, 2016a; Amec Foster Wheeler 2017) and is identified as part of the Rock Creek Unit of the Tualatin River National Wildlife Refuge. Rock Creek crosses the northeastern most tip of Tax Lot 600. Washington County currently owns the property as a result of property tax foreclosure.

Current Site features from historical operations include one small shed, two former sedimentation lagoons and their associated bermed perimeters, two shallow depressions from historical aeration ponds used to treat tanning wastes before they were discharged to the bermed sedimentation lagoons, an access road that enters the property from the west, extending to the east between the two aeration ponds, a surficial drainage ditch that runs parallel to the railroad tracks along the northern property boundary, and seven monitoring wells (installed during the Oregon Department of Environmental Quality [DEQ's] Remedial Investigation [RI] in 2003). Prior investigations also identified a hide-split landfill along the western edge of Tax Lot 600.

2.2 SITE HISTORY

The two tax lots that comprise the Site were historically part of a large tannery operation that existed from the late 1940s through the early 1990s and covered approximately 33 acres on six tax lots. The portion of the Site being evaluated for cleanup under this grant consists of two tax lots (600 and 602) used for landfilling of hide-splits (the non-valued part of the hide) and for processing various tannery wastes. These historical uses impacted soil, sediment, and shallow groundwater from a variety of contaminants associated with the tanning process and waste treatment.

2.3 ASSESSMENT SUMMARY

The Oregon Department of Environmental Quality conducted a Remedial Investigation (RI) of Tax Lot 600 in 2003 and 2004 (GeoEngineers, 2004). Groundwater monitoring was conducted at the Site by DEQ between 2005 and 2007 (DEQ, 2015b). Amec Foster Wheeler conducted a Supplemental Remedial Investigation (Amec Foster Wheeler, 2016b) of Tax Lot 602 in 2015. The scope and findings of the investigations are summarized below, with additional details presented in the project Quality Assurance Project Plan & Sampling and Analysis Plan (QAPP-SAP) (Amec Foster Wheeler, 2015). Additional information for each is also available in the relevant DEQ environmental cleanup file. The DEQ Environmental Cleanup Site Information Database (ECSI) file number for the sedimentation lagoon portion of the Former Frontier Leather Property is #2638.

Additional information pertaining to the nature of potential impacts at the Site are included in a Staff Report prepared by DEQ for the Ken Foster Farms Site (DEQ, 2015a), which is located approximately 0.5 miles south of the Site. The Ken Foster Farms Site is related because it also received tannery wastes generated at the Former Frontier Leather Tannery property. The DEQ file number for the Ken Foster Farms Site is #2516.

2.3.1 Remedial Investigation, GeoEngineers, 2004

The RI was conducted in 2003 and 2004 to evaluate potential impacts on Tax Lot 400 and Tax Lot 600 from historical tannery operations. Tax Lot 400 is not part of the current Site, while Tax Lot 600 is and contains the sedimentation lagoons and wetland areas extending east to Rock Creek. Tax

Lot 602 was not included in the RI completed in 2004, because DEQ was not able to secure access to conduct the investigation at that time.

The RI evaluated the vertical and horizontal extent of hide-splits, and the potential impacts in soil, sediment, groundwater, and surface water. The field investigation included the completion of 24 test pits, 63 hand auger borings, and installation of 7 monitoring wells, which resulted in the sampling and analysis of more than 150 soil samples, 9 sediment samples, 23 groundwater samples, 19 surface water samples from upland seeps, and 8 samples of surface water from Rock Creek.

2.3.2 Groundwater and Surface Water Assessment, DEQ, 2005-2007

After the RI was completed, DEQ collected and analyzed groundwater from four monitoring wells and surface water from five locations, between 2005 and 2007. Groundwater samples were analyzed for dissolved chromium and manganese. Surface water samples were analyzed for total chromium and manganese. Results from the sampling were consistent with results from samples collected in 2003 and 2004.

2.3.3 Supplemental Remedial Investigation – Amec Foster Wheeler, 2015

The Site investigation to support the Supplemental RI was conducted in November 2015 to assess the nature and extent of contamination on Tax Lot 602. The investigation included a geophysical survey to map the extent of the hide-split landfill on Tax Lot 602. A subsurface investigation was conducted and was comprised of 24 subsurface borings installed to a maximum depth of 20 feet below ground surface (bgs). Seven borings were installed within the northern aeration pond footprint; four borings were installed within the southern aeration pond footprint; and the remaining borings were spatially distributed throughout Tax Lot 602. Groundwater samples were collected from five borings.

2.3.4 Wetland Delineation – Amec Foster Wheeler, 2017

A wetland delineation was conducted in May 2016 and March 2017 to determine the extent of wetland areas at the Site (Amec Foster Wheeler, 2016; Amec Foster Wheeler 2017). Approximately 17.36 acres were identified as wetland, in one of the following categories:

1. Palustrine emergent wetland habitat/waterway (Rock Creek and the 100-year floodplain)
2. Palustrine emergent wetland (Rock Creek floodplain outside the 100-year boundary, portions of the sedimentation lagoon interiors, within the aeration ponds, and on the terrace above south sedimentation lagoon)
3. Palustrian forested habitat (forested portion of the sedimentation lagoon interiors)

4. Palustrine forested habitat/waterway (forested area of stormwater drainage along railroad at the northern property boundary)
5. Open water/stormwater ditch (stormwater drainage under SW Oregon Street near the southeastern corner of the Site)

The Oregon Department of State Lands (DSL) concurred with the wetland delineation in May 2017 (DSL, 2017). Areas of the Site delineated as wetland are illustrated on Figure 2.

2.4 SUBSURFACE CONDITIONS

The descriptions provided in this section are based on regional geologic and hydrogeologic reference documents, logs of the subsurface conditions observed during field activities from the assessment conducted in November 2015 and the previous RI conducted in 2003-2004, and logs of surrounding wells which were identified during the beneficial water use determination.

2.4.1 Soils & Geology

The Site is located within the Tualatin Valley. Fine alluvium from channels and floodplains of the Tualatin River overlies the Missoula Flood deposits (~65 to 80 feet thick), which consist of heterogeneous layers of silts, sands and/or gravels (The Oregon Department of Geology and Mineral Industries [DOGAMI], 2012). The entire area is underlain by the basalts of the Columbia River Basalt Group, which erupted 14 to 16 million years ago, from fissure volcanoes near the border of Idaho. Bedrock is exposed at Bull Mountain, north of the site, and Pleasant Hill, south of the site (DOGAMI, 2012).

The National Resources Conservation Service maps the site soils as Quatama loam, Aloha silt loam, and Cove clay. The Quatama loam soil series is characterized by moderately well drained loam and clay loam, and a depth to water from 2 to 3 feet bgs. The Aloha silt loam soil series is mapped in the southwest portion of the site and characterized by somewhat poorly drained silt loam from 0 to 65 inches, and a depth to water from 1.5 to 2 feet bgs. The Cove clay soil series is mapped in the east portion of the site, near Rock Creek, and is characterized by poorly drained clay, and a depth to water from 0 to 1 foot bgs.

2.4.2 Groundwater & Hydrogeology

Based on local topography and the location relative to the Rock Creek, groundwater flow appears to be northeast. Well logs on file with the Oregon Water Resources Department (OWRD) indicate a shallow groundwater layer with significant seasonal variation from 2 to 30 feet bgs and a deeper aquifer 75 to 200 feet bgs. This is consistent with the findings of the previous RI which indicates depths to water ranging from approximately 1.5 feet bgs to greater than 15 feet bgs.

3.0 NATURE AND EXTENT OF CONTAMINATION

The investigations completed to date have defined the nature and extent of potential impacts in soil, groundwater, sediment, and surface water from historical operations that treated and disposed of tannery wastes on Site. The areas of contamination associated with site-related activities were defined based on the 2004 RI (GeoEngineers, 2004) and 2016 Supplemental RI (Amec Foster Wheeler, 2016b) to be within the following historical Site features: a) the footprint of the hide-split landfill, b) within the two aeration ponds, c) within the two sedimentation lagoons, d) downgradient of the breaches in the berms of each sediment lagoon, and e) in one small segment of Rock Creek downgradient of the breach in the north sedimentation lagoon. The nature and extent of contamination associated with these features is presented by media in the remainder of this section.

3.1 HIDE-SPLIT LANDFILL

A test pit investigation was conducted in 2004 and a geophysical investigation was conducted in 2015 to identify the extent of the hide-split landfill on Tax Lot 600 and Tax Lot 602, respectively. Hide splits were encountered up to 10 bgs in test pits, but the thickness was noted to decrease along the edges of the landfill and adjacent to roadways.

A limited amount of soil was encountered within the hide-split landfill so most soil sampling was focused on the surface soils (upper 3 feet) and soils immediately below encountered hides. Twenty-nine samples were collected from the test pits to characterize soil within the hide-split landfill area. All 29 samples were analyzed for the ten project-specific metals. Three samples were also analyzed for hexavalent chromium, semivolatile organic compound (SVOCs), organochlorine insecticide (OCIs), and polychlorinated biphenyls (PCBs).

Arsenic, cadmium, copper, manganese, nickel, and zinc were detected at concentrations that are largely consistent with naturally occurring background levels for the Portland area (DEQ, 2013). Antimony, chromium, lead, and mercury were each detected at concentrations greater than background levels, and are likely associated with the hide-splits. Chromium concentrations were the highest, with a maximum concentration of 21,000 milligrams per kilogram (mg/kg) detected in TP-3 at 4 feet bgs. No SVOCs, OCIs, or PCBs were detected.

3.2 SOIL IMPACT

Approximately 128 soil exploration locations (direct push borings, test pits, and hand auger borings) were completed at the Site during various investigations. Samples from those explorations were tested for metals, including hexavalent chromium. Select samples were also tested for SVOCs, PCBs, and OCls and leachable metals.

Arsenic, copper, lead, nickel, and zinc were found primarily at background levels, except at a few locations each associated with hide-splits. Antimony, cadmium, chromium, manganese, and mercury were detected at concentrations greater than background levels.

Four OCls (4,4'-DDD; 4,4'-DDE; 4,4'-DDT; and chlordane) were detected in seven samples collected from the shallow railroad drainage ditch, the sedimentation lagoons, and in the wetland area adjacent to Rock Creek. OCls were not found in the hide-split landfill, and thus are not considered to be site-related. As stated in the RI report, detected OCls are believed to be representative of regional soil conditions (GeoEngineers, 2004). One SVOC (phenol) was detected in 1 of 13 samples. Phenol was detected at concentrations just above the detection limit in a sample collected within the footprint of the hide-split landfill. No other SVOCs were detected. No PCBs were detected.

3.3 GROUNDWATER IMPACT

Water level measurements and groundwater samples were collected from the seven monitoring wells (MW-1 through MW-7) installed between June 2003 and March 2004. The depth to groundwater is shallow and varies from just a few feet bgs (MW-1) to greater than 15 feet bgs (MW-4). Water levels at MW-3 and MW-5 appear very deep, but these wells are completed on the lagoon berms and thus their surface elevation is artificially high as compared to surrounding ground surface elevations. In general, groundwater elevations follow topography, and groundwater flows northeast toward Rock Creek. The groundwater gradient is approximately 0.04 feet per foot across the Site.

Groundwater samples were collected during seven events. Three events occurred during the RI in 2003 and 2004, and included testing of groundwater samples from monitoring wells and two hand auger borings for ten project-specific dissolved metals. In addition, selected groundwater samples from one of the RI groundwater sampling events were also analyzed for volatile organic compounds (VOCs), SVOCs, PCBs, OCls, chloride, nitrate, nitrite, and sulfate. Three events occurred after the RI in 2005, 2006, and 2007, and included testing of groundwater samples from monitoring wells for

Total and or dissolved metals were detected above laboratory reporting limits at least once, except for mercury which wasn't detected any sample. Dissolved metals detected infrequently were antimony, arsenic, cadmium, and zinc. Chromium and manganese were detected the most frequently and at the highest concentrations.

In addition to metals, three VOCs (1,2-dichlorobenzene; 1,4-dichlorobenzene; and chlorobenzene) and one OCI (lindane) were detected in one monitoring well (MW-4). Detected concentrations were low at 10 micrograms per liter (µg/L) or less. No other VOCs or OCIs were detected in groundwater. No SVOCs (other than 1,2-dichlorobenzene, as mentioned above) or PCBs were detected. Chloride, nitrate, and sulfate were each detected, while nitrate was not.

3.4 SURFACE WATER IMPACT

Surface water samples were collected from a wide range of locations, including: seven upland seeps, two locations within the northern sedimentation lagoon, two locations within the southern sedimentation lagoon, four locations from standing water in the wetland area adjacent to Rock Creek and four locations within Rock Creek (one upstream location and three downstream locations). Sampling events occurred between June 2003 and March 2004. In all, 27 surface water samples were collected from the Site. All samples were analyzed for 7 of the 10 project-specific dissolved metals (antimony, cadmium, chromium, copper, manganese, and zinc. Selected surface water samples were analyzed for dissolved arsenic, lead, nickel and hexavalent chromium. Two surface water samples (one from the railroad ditch and one from Rock Creek) were also analyzed for SVOCs, OCIs, and PCBs.

Chromium and manganese were the mostly commonly detected metals. No SVOCs, OCIs, or PCBs were detected.

3.5 SEDIMENT IMPACT

Nine samples were collected from Rock Creek in the upper 12 inches of sediment. All nine samples were analyzed for a suite of ten project-specific metals. Six samples were also analyzed for hexavalent chromium, SVOCs, OCIs, and PCBs.

All metals, except for chromium and manganese, were detected at concentrations consistent with naturally occurring background levels. Chromium and manganese were each detected in one sample at a concentration greater than its background level. The samples were located near the railroad drainage ditch, which appears to have been a historical transport pathway to Rock Creek. These samples are also located downgradient of the breach in the north sedimentation lagoon.

Two OCIs (4,4'-DDD and 4,4'-DDE) were detected in 4 of 6 samples, but are interpreted to be representative of regional OCI levels since no on-site source was identified in upland media. No SVOCs or PCBs were detected in sediment samples.

3.6 NATURE & EXTENT SUMMARY

Metals were widely detected in all media as summarized below:

- Soil – Metals concentrations are the highest within the hide-split landfill, within the sedimentation lagoons, and downstream of the breaches in each lagoon berm. All metals were found at concentrations greater than naturally occurring levels in at least a few samples, but arsenic, copper, lead, nickel, and zinc were found primarily at background levels, except at a few locations associated with hide-splits. Chromium concentrations were the highest of the metals most commonly exceeding background levels, with two greatest concentrations occurring within the footprint of the hide-split land fill (21,000 mg/kg in TP-3 at 4 feet bgs and 32,300 mg/kg in DP-15 at 5 feet bgs).
- Sediment – Metals were found at concentrations consistent with naturally occurring background levels, with the exception of chromium and manganese which were each detected in one sample near the railroad drainage ditch and downgradient of the breach in the north sedimentation lagoon at concentrations above the background level. The railroad drainage ditch appears to have been a historical transport pathway to Rock Creek.
- Groundwater and surface water – All metals but mercury were detected in groundwater or surface water at least once, with chromium and manganese being the mostly frequently detected in both media.

Other analytes from the VOC, SVOC, OCI, and PCB compound classes were largely not detected in the media where they were analyzed. Detections of 1,2-dichlorobenzene; 1,4-dichlorobenzene; chlorobenzene, and phenol were limited to one or two samples and all concentrations were low. Detections of 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, chlordane are believed to be representative of regional conditions (GeoEngineers, 2004). PCBs were not detected in soil, sediment, surface water, or groundwater.

4.0 CONCEPTUAL SITE MODEL

The Conceptual Site Model (CSM) describes the potentially complete exposure pathways through which receptors can come into contact with site-related contamination. The CSM is developed through a review of land and water use records to determine the reasonably likely current and future site uses. The CSM describes the potential for migration away from source areas to other media where receptor exposures could occur.

4.1 LAND USE ZONING

The Site is located in an area of industrially zoned land and is zoned for light industrial use according to the City of Sherwood Plan and Zone Map accessed in August 2017. The Site is partially fenced, but access is not controlled nor monitored. The City is considering use of the upland portion of the Site to relocate the City's public works facility out of its downtown core. This future land use would be consistent with the current and reasonably likely future zoning.

The Site is also part of the Rock Creek Unit of the Tualatin River National Wildlife Refuge, and the lower elevation portions of the Site may not be suitable for industrial development. The City envisions preserving those portions of the Site that are not suitable for development to provide open space or overlook access to the Tualatin River National Wildlife Refuge, and thus protecting Rock Creek as a Goal 5 resource. This is consistent with the Site's location within the Tualatin River National Wildlife Refuge and the City's Parks and Recreation Master Plan (City of Sherwood, 2006). It also would provide improved access to the natural undeveloped areas for residential developments located south of the Site.

Based on current zoning and potential future use, the potential human receptors at the Site are a current trespasser, and future occupational/industrial workers, future construction and excavation workers, and future recreational users. Future occupational/industrial workers are not anticipated to use the lower elevation areas of the Site where industrial development would not occur. Future construction and excavation workers could be exposed across the entirety of the Site during remediation and redevelopment activities. Future recreational users could potentially be exposed across the lower elevation portion of the Site if trails or other park uses are incorporated into future uses.

4.2 BENEFICIAL WATER USE

No drinking water wells are located at the Site. There is no known use of shallow groundwater (above the first layer of basalt) for domestic purposes within 1 mile of the Site. The closest wells to the Site are two industrial wells, both of which are completed on the opposite side of Rock Creek from the Site, and at depths below the first layer of basalt. Shallow groundwater does discharge to wetland areas and to Rock Creek at the Site.

There is a surface water point of diversion for irrigation and livestock use associated with the Site, but there is no evidence of recent use. Therefore, the reasonably likely future beneficial water uses at the Site are determined to include irrigation, livestock, and to support wildlife and aquatic habitat.

4.3 EXPOSURE PATHWAYS

Based on the land use and beneficial water use identified for the Site, potentially complete exposure pathways for human receptors include:

- Direct contact with surface soil by occupational workers, construction and excavation workers, and trespasser/recreational users.
- Direct contact with subsurface soil by construction and excavation workers.
- Direct contact with sediment by trespassers/recreational users.
- Direct contact with groundwater in excavations by construction and excavation workers.

The results of the Level 1 ecological risk evaluation identified that a variety of aquatic and terrestrial species could be exposed to site-related contamination through ingestion, inhalation, dermal contact and root contact with surface soils and shallow groundwater, as well as from exposure to sediment and surface water within Rock Creek.

5.0 RISK ASSESSMENT SUMMARY

5.1 HUMAN HEALTH RISK

A human health risk assessment (HHRA) was conducted using all available sampling results to evaluate potential human health risks from exposure to analytes in soil and groundwater for the complete exposure pathways defined by the human health CSM. The HHRA evaluated three exposure units (EUs): 1) Upland EU soils (all receptors), 2) Wetland EU soils (all receptors except occupational workers), and 3) Groundwater EU, Site-wide, (construction worker and excavation worker only). All metals results for soil and groundwater were conservatively evaluated to ensure all potential constituents of potential concern (COPCs) were identified for further evaluation. The COPCs identified for each EU were:

- Upland EU soils – Arsenic, copper, lead, and hexavalent chromium.
- Wetland EU soils – Arsenic.
- Groundwater EU (site-wide) – None.

Of the COPCs evaluated, unacceptable human health risks were identified for only two constituents: 1) arsenic and 2) lead. The effected receptors include the occupational worker exposed to arsenic in the upper 5 feet of soil in the Upland EU, and the excavation worker exposed to lead in the upper 5 feet of soil, and down to 15 feet, in the Upland EU. In both cases, the predicted health risks were driven by a single elevated detection of arsenic or lead that was found within the footprint of the hide-split landfill. In addition, arsenic was detected in two samples at concentrations just above background and the screening level for a recreational user/trespasser. All other detections of arsenic in the wetland exposure unit are consistent with background levels of arsenic at concentrations less than background (DEQ, 2013). No unacceptable human health risks were identified for copper or hexavalent chromium.

The HHRA concluded that unacceptable risk to human health is isolated to direct contact with contaminant concentrations associated with the hide-split landfill only.

5.2 Ecological Risk Assessment Summary

An Ecological Risk Assessment (ERA) was prepared for Tax Lots 400 and 600 in 2004 and presented in the 2004 RI. The ERA evaluated exposure from soil, sediment, groundwater, and surface water in Rock Creek for metals, VOCs, SVOCs, OCls, and PCBs. The 2004 ERA included evaluation of threatened & endangered (T&E) species, based on the T&E listings at that time, but no T&E species are known to be at the Site today, and thus the results for T&E species are no longer relevant.

VOCs, SVOCs, PCBs, and OCls were not retained as constituents of potential ecological concern (CPECs) based on their limited detection or lack of detection, and in the case of OCls because they are not site-related. Metals concentrations in groundwater and surface water were found below levels of concern. Metals in soil and sediment were found at levels of concern as summarized below:

- Soil – antimony, chromium, lead, manganese, and mercury
- Sediment – antimony, cadmium, chromium, copper, manganese, and zinc

Additional evaluation of potential ecological risks from chromium in soil was conducted by evaluating the American Robin consuming worms as the representative specie using all habitat types at the Site. The site-specific risk-based concentration developed for non-T&E species was 280 mg/kg. Based on this concentration, unacceptable risks were identified in portions of the north sedimentation lagoon, the majority of the south sedimentation lagoon, areas downstream of the breaches in each sedimentation lagoon, areas of the Rock Creek floodplain downgradient of the lagoon breaches, and the hide-split landfill area. Elevated concentration of other metals of concern were largely found to be co-located with elevated chromium concentrations, with only a few isolated locations as exceptions.

Ecological hot spots for chromium based on a 10-fold multiplier of the risk-based concentration, were identified in a small portion of the northern sedimentation lagoon, the southern sedimentation lagoon, outside of the breach in the south sedimentation lagoon, one area within the Rock Creek floodplain, and the entire area of the hide-split landfill. The ERA identified that concentrations of the metals remaining after soil removal should be reevaluated to determine if remaining concentrations pose an unacceptable risk to ecological receptors.

The ERA prepared in 2004 was not updated during the Supplemental RI in 2015 because no new data were generated in areas of ecological exposure and the assumptions and approach used to evaluate potential ecological risks in 2004 were still considered valid.

6.0 SUMMARY OF ISSUES IDENTIFIED BY THE RI

The RIs completed in 2003-2004 and 2015 identified the following issues for which environmental cleanup is required to address unacceptable risks:

1. Chromium concentrations greater than the site-specific risk-based concentration of 280 mg/kg for ecological receptors are widespread in soil and in sediment within the sedimentation lagoons, localized in sediment downstream of the railroad ditch and breach in the northern sedimentation lagoon, and assumed to be present throughout the hide-split landfill.
2. Other metals of potential concern found at concentrations in soil and sediment greater than background levels (antimony, manganese, and mercury) are generally co-located with the areas of highest chromium concentrations.

Human health risks were identified only for the occupational worker exposed to arsenic in the upper 5 feet of soil in the Upland EU, and the excavation worker exposed to lead in the upper 5 feet of soil, and down to 15 feet, in the Upland EU. In both cases, the predicted health risks were driven by a single elevated detection of arsenic or lead that was found within the footprint of the hide-split landfill and that will be addressed by the remedy that addresses the risks to ecological receptors from the hide-splits. No unacceptable human health risks were identified for other metals, though the data set for hexavalent chromium is small and one detection was very close to the site-specific risk-based concentration for one sample within the hide-split landfill. Potential risks from hexavalent chromium will be addressed by the remedy that addresses the risk to ecological receptors from the hide-splits.

7.0 REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) are written statements that guide how cleanup alternatives are developed because they define what requires remediation using the outcome of the RI. Four RAOs were developed to support cleanup alternative development for this Site. The first two RAOs were developed during the 2004 Focused Feasibility Study prepared for Tax Lot 600 by GeoEngineers on behalf of DEQ and are still relevant to the Site. The third and fourth RAOs were developed by Amec Foster Wheeler to address the additional issues identified on Tax Lot 602, and focus the City's resources on the areas of greatest contamination.

1. RAO #1 – Prevent ecological receptors from exposure to soil or sediments containing chromium, or other metals, at concentrations in excess of appropriate cleanup levels determined to be protective of sensitive Site receptors.
2. RAO #2 – Prevent migration of soil or sediments in stormwater or surface water runoff that could result in an adverse effect to the beneficial water uses of Rock Creek for aquatic life.
3. RAO #3 – Source control of materials in historical features that are not being addressed by RAO #1 or RAO #2 (i.e. the two aeration ponds, hides on the ground surface outside the footprint of the hide-split landfill).
4. RAO #4 - Remediate soil or sediment hot spots of contamination to the extent feasible.

The proposed cleanup levels are presented in the next section.

8.0 SITE-SPECIFIC CLEANUP LEVEL

Prior assessments proposed use of a site-specific cleanup level for chromium that was developed for the American Robin as a representative but sensitive receptor using all habitat types at the Site. DEQ was consulted to determine if the previously established value of 280 mg/kg would still be considered appropriate for use in identifying areas of the site requiring remediation. DEQ approved use of 280 mg/kg for defining areas of soil remediation, but not for sediment (DEQ, 2017). Instead, DEQ recommended use of the probable effect concentration (PEC) for chromium of 111 mg/kg established by MacDonald et al in a paper titled *Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems* (2000) as the proposed cleanup level. The PEC, as described by McDonald, et al., is the concentration above which adverse effects are expected to occur more often than not in ecological receptors.

A large portion of the chromium concentrations in Site soils, including within the hide-split landfill, and sediment exceed the proposed cleanup levels of 111 mg/kg and 280 mg/kg, leading to a significant volume of soil and sediment requiring remediation that would translate into a significant cost. Therefore, hot spot concentrations were developed for soil and sediment for use in evaluating remedial alternatives so that a smaller volume of soil could be considered. The calculation of hot spot levels for ecological receptors is based on a 10-fold multiplier of the acceptable risk level, which sets the proposed cleanup levels at 1,110 mg/kg and 2,800 mg/kg. DEQ has the ability to approve remedial actions requiring treatment of hot spots to the extent treatment is feasible, as specified in Oregon Administrative Rules (OAR) 340-122-090(4), which says that the treatment requirement for hot spots is subject to the remedy selection balancing factors and criteria listed in OAR 340-122-090(4) and specifies that a higher threshold be applied in evaluating the reasonableness of costs for treating hot spots of contamination.

Conducting a cleanup of soil and sediment with concentrations above hot spot levels meets the requirements of OAR 340-122-090(4) because it is a) considered to be protective of present and future ecological receptors, b) is based on balancing of remedy selection factors which includes consideration of reasonableness of cost and that the costs of the remedy are proportionate to the benefits created through risk reduction or management, and c) recognizes the preference for treatment of hot spots. Therefore, the hot spot concentrations were used as the Site cleanup goals.

No areas of soil contamination outside the footprint of the hide-split landfill in the upland portion of the Site exceeded the hot spot level of 2,800 mg/kg, and therefore no soil remediation areas separate from the hide-split landfill were identified. Multiple areas of sediment contamination in the wetland portion of the Site did exceed the hot spot level of 1,110 mg/kg as illustrated on Figure 2. Remediation of these areas is evaluated in ABCA presented in the next section.

9.0 ANALYSIS OF BROWNFIELD CLEANUP ALTERNATIVES

The purpose of this ABCA is to define and evaluate cleanup alternatives that meet or exceed the RAOs identified in Section 7. This can be accomplished by either decreasing contaminant concentrations to levels that are protective of human health and the environment or breaking the exposure route between the potential receptor and the chemical. The ABCA contains the following elements:

1. Considerations for developing sustainable cleanup alternatives;
2. Discussion of major assumptions;
3. Description of proposed remedial action alternatives; and,
4. Recommendation of the preferred alternative.

This ABCA presents seven cleanup alternatives and evaluates each according to balancing factors that assess protectiveness, effectiveness, long-term reliability, implementability, implementation risk, sustainability, climate change concerns, and cost. The balancing factors are defined below (as summarized from DEQ's environmental cleanup rules presented in OAR 340-122-0090 and EPA Brownfield guidance):

- Protectiveness – Considers the present and future public health, safety, and welfare, and the environment. RAOs must achieve the standards of protectiveness stipulated in OAR 340-122-0040.
- Effectiveness – Measures the performance of the technology in achieving protectiveness up to the time when RAOs are achieved and remedy implementation is complete.
- Long-Term Reliability – A remedy's long-term reliability is based on the reliability of treatment technology to remain protective and, if using engineering or institutional controls, on its reliability in managing residual risks. Long-term reliability also is influenced by uncertainties associated with potential long-term risk management.
- Implementability – Measures whether it is easy or difficult to implement a remedy considering practical, technical, or legal difficulties that may be associated with construction and implementation, including scheduling delays. Implementability also depends on the ability to measure the effectiveness of the remedy and its consistency with regulatory requirements.
- Implementation risk – Implementation risk evaluates the risk posed by the remedy during implementation (including construction and operation), based on potential impacts to the community, workers, and the environment. Implementation risk also considers the time needed to implement the remedy and the impact to the environment from use of fossil.
- Sustainability – Elements of the remedial alternatives that increase or decrease sustainability, such as fuel consumption and emissions from truck traffic, provide an additional ranking factor that can be used in the comparative analysis for remedy selection.
- Climate change concerns – The impact of reasonably foreseeable changing climate conditions on the remedial alternatives is ranked if there are site-specific risk factors associated with the remedy.
- Reasonableness of cost – A remedy's reasonableness of cost is based on the following, as appropriate:
  - Cost of remedial action, including capital cost, and annual operation and maintenance (O&M) cost;
  - The degree to which the costs are proportionate to the benefits to human health and the environment created by risk reduction;

- The degree of sensitivity and uncertainty of the costs; and
- Any other information relevant to cost reasonableness.

The cleanup alternatives were developed within the context of redevelopment of the Site as the future location for the City's public works facility and possibly with open space and/or park space to provide access to the Tualatin River National Wildlife Refuge. Re-locating the public works facilities to the Site puts out-of-use industrial land back into productive service for the community while moving the facility away from the downtown core where public works activities conflict with desired downtown development. The seven cleanup alternatives are:

- Alternative 1 – No Action,
- Alternative 2 – Removal and Disposal of Contaminated Sediments and Hide Splits,
- Alternative 3 – Placement of Contaminated Sediments and Hide Splits Within High-Density Polyethylene (HDPE)-Lined On-Site Containment Cell,
- Alternative 4 – Placement of Contaminated Sediments and Hide Splits Within Chemically Stabilized On-Site Containment Cell,
- Alternative 5 – Placement of Contaminated Sediments Within Chemically Stabilized On-Site Containment Cell; Removal and Disposal of Hide Splits,
- Alternative 6 – Placement of Contaminated Sediments Within Chemically Stabilized On-Site Containment Cell; Hide-Split Landfill Managed in Place,
- Alternative 7 – Removal and Disposal of Contaminated Sediments; Hide-Split Landfill Managed In-Place.

9.1 SUSTAINABILITY CONSIDERATIONS

Sustainability has been considered in the design and selection of a cleanup plan for the Site so that the sustainable elements of each alternative are accounted for in the ranking of each alternative and in the comparative analysis. Sustainability considerations included in the evaluation are:

- Materials management and waste reduction – Disposal alternatives for contaminated soil, sediment, and waste animal hides have been evaluated and onsite containment options have been considered to limit the amount of material transported to a landfill. Also, berm material surrounding the sedimentation lagoons will be considered for reuse for soil cover. After the berms are removed this could increase the amount of wetland area at the Site further promoting project sustainability through enhancements to the wetland environment.
- Greenhouse gas emissions and fuel consumption – Estimates for off-Site trucking for material disposal for each cleanup alternative were calculated and are presented in Appendix A.

- Trucking contractors hired to transport material to and from the Site will be encouraged to use diesel fuel blended with 10% biofuel.
- The number of miles driven for off-Site transportation to a landfill will be considered when evaluating the sustainability of each alternative.

9.1.1 Changing Climate Considerations

As part of the ABCA, the resilience of proposed remedial alternatives will be evaluated in regards to reasonably foreseeable changing climate conditions and associated site-specific risk factors. This includes the increased potential for flooding from extreme weather events and a higher wet-season water table.

9.1.2 Green Infrastructure

Climate change impacts along with land use changes can affect the amount of stormwater runoff that needs to be managed by stormwater infrastructure. Green infrastructure reduces the burden of storm events on local stormwater infrastructure. It uses landscape features to store, infiltrate and evaporate stormwater to reduce the amount of water entering sewers, reducing the discharge of pollutants into water bodies. Green infrastructure can also provide a number of important environmental and socio-economic benefits to communities, including preserving and restoring natural landscape features such as forests, floodplains and wetlands, and reducing the amount of land covered by impermeable surfaces.

9.1.3 Site Specific Weather Conditions

Due to the site's configuration and location, current and forecasted climate changes could impact the long-term reliability of certain remedial alternatives. For example, rises in the water table and increased flooding at the Site could compromise an engineered cap and expose underlying contamination.

9.2 MAJOR ASSUMPTIONS

The ABCA evaluates six remedial alternatives (excluding Alternative 1 which is "no action") within the context of the following five major assumptions:

1. Remediation Areas Defined using Hot Spot Cleanup Levels – All six remedial alternatives have remediation areas for soil and sediment defined based on the hot spot cleanup levels of 2,800 mg/kg and 1,110 mg/kg, respectively. Remediation to a lower and more stringent standard will increase the cost of all six alternatives.
2. Wastes are Classified as Non-Hazardous – Two alternatives include off-site disposal as part of the remedy, and assume contaminated materials are non-hazardous, based

assessment data. The costs for remediation for these two alternatives would increase if some or all of the contaminated materials must be handled as hazardous waste.

3. An On-Site Containment Cell Can be Constructed in a Wetland – Four of the six remedial alternatives rely on construction of an on-site containment cell in a wetland area (in the south sedimentation lagoon), where the water table is above the ground surface during the wet season. These four alternatives assume that major reconstruction of the sedimentation lagoon would not be required (other than addition of an engineered floor and cap) and that the regulatory agencies governing environmental cleanup and wetland area will approve this approach. Additional planning and engineering design beyond that presented in this ABCA will be required if the selected alternative includes construction of an on-site containment cell.
4. Preservation of Upland Area for Redevelopment – Construction of an engineered on-Site containment cell in the upland portion of the Site was not evaluated to preserve the upland portion of the Site for future redevelopment. Managing the hides in place where they currently exist, however, is evaluated in two alternatives to provide a simplified evaluation of an upland management strategy.
5. Wetland Mitigation – Five of the six remedial alternatives will impact wetland areas, including elimination of 3.9 acres of wetland in the south sedimentation lagoon. Loss of wetlands will require mitigation, so the ABCA incorporates a simplified assessment of the requirements for mitigation to capture estimated costs for this element of a cleanup. The simplified assessment assumes that the City will pay into a wetland bank for two alternatives (increases remedy cost) and assumes the City would be willing to open and manage a wetland mitigation bank at the Site for three alternatives (decreases remedy cost). However, there could be a variety of other solutions that will meet mitigation requirements, so additional planning and negotiations with key regulatory agencies will be required to design a final wetland mitigation plan that integrates with the selected remedy.

The cost estimates presented in the ABCA are planning-level engineering cost estimates with a precision of +50% / -30%. They do not account for site preparation costs associated with redevelopment, which could include a geotechnical suitability analysis. They also don't account for potential long-term monitoring and maintenance costs for the on-Site containment cell and/or wetlands, nor do they account for the cost to open and manage a wetland bank. Additional work will be needed for remedial planning and design to refine the selected remedy to take the outcome of the ABCA from planning level information to detailed design and construction level documents.

Other assumptions made in the development of remedial alternatives and costs are listed below:

- Backfill material for Site excavations can be taken from the berms surrounding the north and south sedimentation lagoons. The removed berms would be graded and restored as wetland habitat. It is assumed that adequate general fill materials are available on the Site for various excavation and fill activities. The berm material is estimated to be 13,000 cubic yards (estimated area of the berms [58,400 square feet] multiplied by an average height of six feet).
- The thickness of the hide-split landfill is estimated with an average based on data collected during the hide-split landfill assessment. The actual thickness of the landfill could be larger or smaller.
- Residential use will not occur.
- All costs are presented as 2017 dollars, with no discounting.

9.3 Alternative 1 – No Action

9.3.1 Alternative 1 Description

Alternative 1 is the baseline against which all other alternatives are compared. Under this alternative, contaminated sediments and the hide-split landfill would be left in place in their current configuration.

9.3.2 Alternative 1 Evaluation

Protectiveness: Alternative 1 is not protective of current or future receptors at the Site.

Effectiveness: Alternative 1 has low effectiveness since there is no action implemented and thus no protection to ecological receptors is provided.

Long-term Reliability: Alternative 1 has low long-term reliability because it does not remove contamination or eliminate ecological exposure pathways.

Implementability: This alternative is easy to implement because no action is required.

Implementation Risk: There is low implementation risk associated with this alternative because no activities would be conducted.

Sustainability: Alternative 1 is moderately sustainable. No greenhouse gas emissions would be produced by this alternative however the Site would remain impacted by metals.

Reasonableness of Cost: There is no cost to implement this alternative.

Climate Change Concerns: No Site-specific risk factors were identified under this alternative with respect to climate change considerations.

9.4 Alternative 2 – Removal and Disposal of Contaminated Sediments and Hides

9.4.1 Alternative 2 Description

Contaminated sediments above the hot spot cleanup level would be excavated and transported off-Site for disposal. Sampling data results indicate that sediments are not anticipated to be a Resource Conservation and Recovery Act (RCRA) hazardous waste. Correspondence with DEQ indicates that hides are not considered a RCRA hazardous waste. Therefore, the contaminated materials can be disposed at a Subtitle D (non-hazardous) waste landfill.

Approximately 9,300 cubic yards of contaminated sediments from the north and south sedimentation lagoons and several areas of shallow sediments outside the lagoons in the Rock Creek floodplain would be excavated and transported to the Waste Management landfill in Hillsboro, Oregon.

Approximately 25,300 cubic yards of hide splits from the hide-split landfill and co-mingled soil would be excavated from the upland portion of the Site and transported to the Waste Management landfill in McMinnville, Oregon.

Excavation areas would be backfilled with suitable fill taken from the berms of the existing sedimentation lagoons or imported from a local source and compacted back to the existing grade.

Excavated areas inside the north and south sedimentation lagoons and the excavation areas in the Rock Creek floodplain are located within designated wetland areas and would require restoration measures. Under this alternative, it is estimated that 3.9 acres of wetland credits would be sold into a wetland mitigation bank by the City after remedial action. This includes wetland enhancement of the north and south sedimentation lagoons, and wetland conversion of the sedimentation lagoon berm areas.

9.4.2 Alternative 2 Evaluation

Protectiveness: Alternative 2 is highly protective because it eliminates the most-contaminated material from the Site.

Effectiveness: Alternative 2 eliminates the potential for direct contact with the most contaminated materials (sediment and hide splits) by removing the material from the Site. It also reduces a long-term potential secondary source of contamination from stormwater runoff. Therefore, this alternative is highly effective.

Long-term Reliability: Alternative 2 permanently removes the most contaminated material identified at the Site, and therefore is highly reliable over the long-term. Although the material would not be destroyed, it would be placed into a permitted solid waste landfill designed for controlled long-term storage. Compacted soils used to fill the excavations should be suitable for long-term use. Restored wetland areas would require long-term monitoring and maintenance to assure viability.

Implementability: Alternative 2 would require readily available equipment, materials, and services and would consist of unrestricted excavation, loading, and shipment of impacted sediment by covered dump truck to the landfill. Excavations would be backfilled and compacted with clean, suitable fill. Restored wetland areas would require a site-specific design, construction oversight, monitoring, and maintenance. This alternative is considered easy to implement.

Implementation Risk: Alternative 2 would have a high implementation risk due to the location, size, and depth of the excavations, as well as from the length of time required to complete the work (13 weeks) and the number of miles traveled for off-site disposal. Subcontractors hired to conduct the contaminated material removal would be current with Occupational Safety and Health Administration (OSHA) 40-Hour Hazardous Waste Operations and Emergency Response (HAZWOPER) training and all work would be performed under a site-specific Health and Safety Plan (HASP). This alterative includes additional risks of further exposure to surrounding residents, drivers, and landfill workers due to transportation and off-site disposal. The exposure risk due to transportation, road accidents, and landfill placement are moderate to high due to the estimated number of trips (1,728) required to execute this alternative.

Sustainability: Transport of all sediments described under Alternative 2 would consume the largest amount of fuel of any of the alternatives and is therefore has a higher carbon footprint. The estimated fuel usage (9,624 gallons of diesel) and associated emissions of carbon dioxide (98,261 kilograms) and methane gas (442 grams) would be considerable (refer to calculation provided in Appendix A). Additional fuel may be expended for an unknown quantity of backfill material that may need to be brought in, thus increasing the carbon emissions. In contrast, this alternative would allow for the greatest area of wetland reconstruction, thereby contributing to clean air and water initiatives in accordance with the Clean Water Act. Alternative 2 therefore is considered to be slightly to moderately sustainable.

Reasonableness of Cost: The cost estimate to implement Alternative 2 is the second highest of the evaluated alternatives at approximately $2.49 million (M) and is primarily based on 1) the volume of excavated material; 2) transport and disposal of excavated material, and 3) selling of wetland credit to a wetland bank which reduces the total cost of this alternative. Tasks associated with this alternative are expected to be eligible for funding under an EPA multi-purpose brownfield cleanup grant.

Climate Change Concerns: No Site-specific risk factors were identified for the Site under this alternative. This alternative would allow for the greatest amount of wetland reconstruction and would also contribute to enhanced flood control along Rock Creek.

9.5 Alternative 3 – Placement of Contaminated Sediments and Hides Within HDPE-Lined On-Site Containment Cell

9.5.1 Alternative 3 Description

Under this alternative, sediments above the hot spot cleanup level and the hide-split landfill would be excavated and placed into an engineered containment cell constructed within the south sedimentation lagoon. The south sedimentation lagoon is selected because it contains more contaminated sediments than the northern sedimentation lagoon.

Approximately 6,500 cubic yards of contaminated sediments from the south sedimentation lagoon would be excavated and temporarily stored on-site, before constructing an engineered containment cell with a HDPE liner placed across the bottom of the excavated area inside the lagoon. Once constructed, sediments would be placed into the south sedimentation lagoon containment cell over the new HDPE liner.

Approximately 2,600 cubic yards of contaminated sediments from the north sedimentation lagoon, 200 cubic yards of contaminated sediment within the Rock Creek floodplain, and approximately 25,300 cubic yards of hide splits from the hide-split landfill would be excavated and placed into the south sedimentation lagoon containment cell.

Once filled, the containment cell would be capped with a HDPE cover, which would be sealed with the underlying liner, and then covered with approximately 3,600 cubic yards of sand and organic soil fill. To prevent erosion, the cap would be graded to direct stormwater away from the containment cell and vegetative cover would be planted on the cap. Excavation areas would be backfilled and compacted with suitable fill taken from the berms of the existing sedimentation lagoons or imported from a local source.

Because contaminated material would be contained on the Site, institutional and engineering controls would be used to mitigate residual risk. An institutional control in the form of an Easement and Equitable Servitude (EES), or deed restriction, may be required. Long-term operation and maintenance in the form of routine inspection to document conditions would also be required. Repairs would be need to be implemented when issues are identified during inspections.

Excavated areas inside the north and south sedimentation lagoons and the excavation areas in the Rock Creek floodplain are located within designated wetland areas and would require restoration measures. Under this alternative, it is estimated that 1.2 acres of wetland credits would be purchased from a wetland mitigation bank after remedial action. This includes filling of the south sedimentation lagoon with the containment cell, wetland enhancement of the north sedimentation lagoon, and wetland conversion of the sedimentation lagoon berm areas.

9.5.2 Alterative 3 Evaluation

Protectiveness: Alternative 3 is highly protective because it breaks the exposure pathway for current and future receptors at the Site by placing the most contaminated material within an engineered HDPE-lined containment cell.

Effectiveness: Alternative 3 eliminates the potential for direct contact with the most contaminated materials (sediment and hide splits) and it reduces a potential secondary source of stormwater runoff. Residual risk of excavated contaminated material would be managed by the engineered containment cell with protective cap and HDPE bottom liner. This alternative is considered highly effective.

Long-term Reliability: Alternative 3 relocates contaminated material on the Site from an uncontrolled condition into an engineered containment cell, designed for long-term reliability. Compacted, suitable fill used to backfill the excavations should be suitable for long-term use. Restored or created wetland areas would require long-term monitoring and maintenance to assure viability. The bottom of the containment cell would be constructed at the base of the sedimentation lagoon. Based on groundwater elevation data, the sedimentation lagoon is expected to be regularly inundated with three feet of water during the wet season (a minimum of six months each year). Hydrostatic pressure could be placed on the HDPE liner potentially causing liner failure. Hides will decompose over time and could contribute to settlement in the containment cell. Hides could also contribute to generation of methane gas. Testing for methane gas generation in the existing hide-split landfills should be conducted to determine if this is a significant issue. The long-term reliability of this alternative is considered low.

Implementability: Alternative 3 is the most difficult alternative to implement because of the need to create a temporary sediment pile somewhere on Site before installing the HDPE liner. This alternative would require readily available equipment, materials, and services. Excavation of contaminated materials and placement into the on-Site containment cell is straightforward. Likewise, backfilling and compaction of clean, suitable fill in the cavities will entail basic construction activities. Construction of the on-Site containment cell would require engineering design and field oversight, and is expected to take twelve weeks to implement in the field. Permitting of the containment cell and long-term periodic inspections of the containment cell and cap would be required. Filling a wetland would require permitting. Restored and created wetland areas would require a site-specific design, construction oversight, monitoring, and maintenance. The implementability of this alternative is considered relatively difficult.

Implementation Risk: Alternative 3 would have a moderate implementation risk due to the length of time (12 weeks) to complete excavation activities and onsite construction of the containment cell. Obtaining a permit to fill a wetland could take six months to a year. Subcontractors hired to conduct the contaminated material removal would need to be current with OSHA 40-Hour HAZWOPER training. Work would be performed under a site-specific HASP.

Sustainability: Alternative 3 would have a relatively low carbon foot print as all the contaminated materials would remain onsite. It is anticipated that fuel usage from off-site trucking would be zero for this alternative. A large amount of resources would be required in the form of a plastic liner for the top and the bottom of the containment cell, so the overall sustainability of this alternative is considered moderate.

Reasonableness of Cost: The cost estimate to implement Alternative 3 would be approximately $1.78M and is primarily based on 1) volume of material excavated and graded, 2) containment cell construction, and 3) Site restoration, including purchase of wetland credits from wetland bank. Tasks associated with this alternative are expected to be eligible for funding under an EPA multi-purpose brownfield cleanup grant.

Climate Change Concerns: The construction of a containment cell located within the Rock Creek floodplain has the potential to be impacted by flood damage and therefore erosion. These risks are considered low, however, because the cell will be located an estimated 10 feet above and 375 feet away from Rock Creek. The climate change concerns for this alternative are considered moderate because of the presence of an on-site containment cell in the floodplain.

9.6 ALTERNATIVE 4 – PLACEMENT OF CONTAMINATED SEDIMENTS AND HIDES WITHIN CHEMICALLY STABILIZED ON-SITE CONTAINMENT CELL

9.6.1 Alterative 4 Description

Under this alternative, sediments above the hot spot cleanup level and the hide-split landfill would be excavated and placed into an engineered containment cell constructed within the south sedimentation lagoon. Before material placement, the base of the engineered containment cell would be amended with a blended phosphate-based material or other chemical mixture to fixate the metals to reduce their leachability and mobilization to groundwater.

Sediment in the bottom of the south sedimentation lagoon would be mixed with a suitable chemical admixture to stabilize metals of concern that may potentially migrate downward through the containment cell inside the lagoon and into groundwater. The estimated costs included in this ABCA are based on a single application of solid phosphate blend amendment to establish a competent base layer approximately 18 inches thick. Treatability testing would be required before remedy implementation to determine the most appropriate chemical admixture for stabilizing metals by creating insoluble compounds, creating a preference for metals compounds to sorb to sediment particles, or through encapsulation, as well as for creating a sufficiently strong base to support the weight of contaminated materials placed in the containment cell.

Approximately 2,600 cubic yards of contaminated sediments from the north sedimentation lagoon, 200 cubic yards of contaminated sediment from the Rock Creek floodplain, and 25,300 cubic yards of hide splits from the hide-split landfill would be excavated and placed into the south sedimentation lagoon containment cell above the amended floor.

Once filled, the containment cell would be capped with a HDPE liner and covered with approximately 3,600 cubic yards of sand and organic soil fill as a cap. To prevent erosion, the cap would be graded to direct stormwater away from the containment cell and a vegetative cover would be planted on the cap. Excavation areas would be backfilled and compacted with suitable fill taken from the berms of the existing sedimentation lagoons or imported from a local source.

Because contaminated material would be contained on the Site, institutional and engineering controls would be used to mitigate residual risk. An institutional control in the form of an EES, or deed restriction, may be required. Long-term O&M in the form of routine inspection to document condition would also be required. Repairs would be need to be implemented when issues are identified during inspections.

Excavated areas inside the north and south sedimentation lagoons and the excavation areas in the Rock Creek floodplain are located within designated wetland areas and would require restoration measures. Under this alternative, it is estimated that 1.2 acres of wetland credits would be purchased from a wetland mitigation bank after remedial action. This includes filling of the south sedimentation lagoon with the containment cell, wetland enhancement of the north sedimentation lagoon, and wetland conversion of the sedimentation lagoon berm areas.

9.6.2 Alterative 4 Evaluation

Protectiveness: Alternative 4 is moderately protective because it breaks the exposure pathway for current and future receptors at the Site by placing the most contaminated material at the Site within a containment cell. However, leaching of Site contaminants could occur if the chemically stabilized floor is not installed properly, uniformly, or in inadequate quantity, or if the groundwater table rises significantly during the annual wet season and changes the hydraulic gradient within the containment cell.

Effectiveness: Alternative 4 eliminates the potential for direct contact with the most contaminated materials at the Site (sediment and hide splits) and reduces a potential secondary source of stormwater and shallow groundwater contamination. Residual risk of excavated contaminated material would be managed by the designed containment cell with protective cap and stabilized floor. The effectiveness of Alternative 4 is considered high.

Long-term Reliability: Alternative 4 relocates the most contaminated material on the Site from an uncontrolled condition into an engineered containment cell, designed for long-term reliability. Permitting of the containment cell and long-term periodic inspections of the containment cell and cap would be required. Compacted, clean fill used to backfill the excavations should be suitable for long-term use. Restored or created wetland areas would require long-term monitoring and maintenance to assure viability. The potential for failure of the engineered elements is considered low because a treatability study would have been conducted to determine the most suitable chemical admixture to stabilize the containment cell floor. The bottom of the containment cell would be constructed at the bottom of the sedimentation lagoon. Based on groundwater elevation data, the sedimentation lagoon is expected to be regularly inundated with three feet of water during the wet season. Regular groundwater flushing of the containment cell could create migratory pathways for contained contaminants and will require long-term monitoring. Hides will decompose over time and could contribute to settlement in the containment cell. Hides could also contribute to generation of methane gas. Testing for methane gas generation in the existing hide-split landfills should be conducted to determine if this is a significant issue. The overall long-term reliability for this alternative is considered moderate.

Implementability: Alternative 4 is easy to implement and would require readily available equipment, materials, and services. Excavation of contaminated materials and its placement into the on-site containment cell is not complicated. Likewise, backfilling and compaction of clean, suitable fill in the cavities will entail basic construction activities. Construction of the onsite containment cell would require engineering design and field oversight and is expected to take ten weeks to implement in the field. Filling a wetland would require permitting. Restored and created wetland areas would require a site-specific design, construction oversight, monitoring, and maintenance.

Implementation Risk: Alternative 4 would have moderate implementation risk due to the length of time (ten weeks) required to complete excavation activities and onsite construction of the containment cell. Obtaining a permitting to fill a wetland could require up to one year. Subcontractors hired to conduct the contaminated material removal would need to be current with OSHA 40-Hour HAZWOPER training. Work would be performed under a site-specific HASP. The exposure risk is contained on the site in a limited area and the risk of an accident from off Site disposal would not be present because all materials would be contained on Site.

Sustainability: Alternative 4 would have a relatively low carbon foot print because all the contaminated materials would remain on-site. It is anticipated that fuel usage for off-Site trucking would be zero for this alternative, and fewer resources would be required in the form of plastic because only the top of the containment cell would have an HDPE liner. The sustainability of this alternative is considered high.

Reasonableness of Cost: The cost estimate to implement Alternative 4 would be approximately $1.6M and is largely based on 1) volume of excavated material, 2) containment cell construction, and 3) Site restoration, including purchase of wetland credits from wetland bank. Tasks associated with this alternative are expected to be eligible for funding under an EPA multi-purpose brownfield cleanup grant.

Climate Change Concerns: The construction of a containment cell located nearby the Rock Creek lowland areas has the potential to be impacted by flood damage and therefore erosion. However, these risks are considered low as the cell will be located an estimated 10 feet above and 375 away from Rock Creek. The climate change concerns for this alternative are considered moderate because of the presence of an on-site containment cell in the floodplain.

9.7 Alternative 5 – Placement of Contaminated Sediments Within On-Site Phosphate-Amended Containment Cell; Removal and Disposal of Hides

9.7.1 Alterative 5 Description

Under this alternative, sediments above the hot spot cleanup level would be excavated and placed into an engineered containment cell constructed within the south sedimentation lagoon. The hide-split landfill would be excavated and transported for off-site for disposal. Sampling results indicate the hide splits are not a RCRA hazardous waste; therefore, they can be disposed at a Subtitle D (non-hazardous) waste landfill.

Sediment in the bottom of the south sedimentation lagoon would be mixed with a suitable chemical admixture to stabilize metals of concern that may potentially migrate downward through the containment cell inside the lagoon and into groundwater. The estimated costs included in this ABCA are based on a single application of solid phosphate blend amendment to establish a competent base layer approximately 18 inches thick. Treatability testing would be required before remedy implementation to determine the most appropriate chemical admixture for stabilizing metals by creating insoluble compounds, creating a preference for metals compounds to sorb to sediment particles, or through encapsulation, as well as for creating a sufficiently strong base to support the weight of contaminated materials placed in the containment cell.

Approximately 2,600 cubic yards of contaminated sediments from the north sedimentation lagoon and 200 cubic yards of contaminated sediment from the Rock Creek floodplain would be excavated and placed into the south sedimentation lagoon containment cell above the phosphate-amended floor.

Approximately 25,300 cubic yards of hide splits from the hide-split landfill and comingled soil would be excavated from the upland portion of the Site and transported to the Waste Management landfill in McMinnville, Oregon.

Once filled, the containment cell would be capped with a HDPE liner and covered with approximately 3,600 cubic yards of sand and organic soil fill as a cap. To prevent erosion, the cap would be graded to direct stormwater away from the containment cell and a vegetative cover would be planted on the cap. Excavation areas would be backfilled and compacted with suitable fill taken from the berms of the existing sedimentation lagoons or imported from a local source.

Because contaminated sediment would be contained on the Site, institutional and engineering controls would be used to mitigate residual risk. An institutional control in the form of an EES, or deed restriction, may be required. Long-term operation & maintenance in the form of routine inspection to document condition would also be required. Repairs would be need to be implemented when issues are identified during inspections.

Excavated areas inside the north and south sedimentation lagoons and the excavation areas in the Rock Creek floodplain are located within designated wetland areas and would require restoration measures. Under this alternative, it is estimated that 1.3 acres of wetland credits would be sold into a wetland mitigation bank after remedial action. This includes filling of a portion of the south sedimentation lagoon with the containment cell, wetland enhancement of the north sedimentation lagoon and a portion of the south sedimentation lagoon, and wetland conversion of the sedimentation lagoon berm areas.

9.7.2 Alterative 5 Evaluation

Protectiveness: Alternative 5 is moderately protective because it breaks the exposure pathway for current and future receptors at the Site by placing the most contaminated material at the Site within a containment cell. Some leaching of Site contaminants could, however, occur if the chemically stabilized floor is not installed properly, uniformly, or in inadequate quantity; or if the groundwater table rises significantly during the annual wet season and changes the hydraulic gradient within the containment cell.

Effectiveness: Alternative 5 eliminates the potential for direct contact with the most contaminated materials (sediment and hide splits) on the Site and reduces a potential secondary source of stormwater runoff. Residual risk of excavated contaminated sediment would be managed by the designed containment cell with protective cap and stabilized floor. The effectiveness of this alternative is considered high.

Long-term Reliability: Alternative 5 relocates the most-contaminated material from an uncontrolled access condition and places it into either an on-Site containment cell (contaminated sediment) or off-Site landfill (hide splits). Both locations are designed for long-term reliability. Permitting of the containment cell and long-term periodic inspections of the containment cell and cap would be required. Compacted, suitable fill used to backfill the excavations should be suitable for long-term use. The potential for failure of the engineered elements is considered low because a treatability study would have been conducted to determine the most suitable chemical admixture to stabilize the containment cell floor. Restored or created wetland areas would require long-term monitoring and maintenance to assure viability. The bottom of the containment cell would be constructed at the bottom of the sedimentation lagoon. Based on groundwater elevation data, the sedimentation lagoon is expected to be regularly inundated with three feet of water during the wet season. Regular groundwater flushing of the containment cell could create migratory pathways for contained contaminants and will require long-term monitoring. Hides will decompose over time and could contribute to settlement in the containment cell. Hides could also contribute to generation of methane gas. Testing for methane gas generation in the existing hide-split landfills should be conducted to determine if this is a significant issue. Overall, the long-term reliability of this alternative is considered moderate.

Implementability: Alternative 5 is easy to implement and would require readily available equipment, materials, and services. Excavation of contaminated materials and placement into the on-Site containment cell is straightforward, as is excavation and transportation of hide-splits for off-Site disposal. Likewise, the backfilling and compaction of clean, suitable fill in the cavities will entail basic construction activities. Construction of the on-Site containment cell would require engineering design and field oversight and is expected to take nine weeks to implement in the field. Filling a wetland would require permitting. Restored and created wetland areas would require a site-specific design, construction oversight, monitoring and maintenance. Obtaining a permitting to fill a wetland could take six to twelve months.

Implementation Risk: Alternative 5 would have a moderate implementation risk due to the length of time (nine weeks) to complete excavation activities and onsite construction of the containment cell, combined with the additional risks from off-site trucking. This alterative includes additional risks of further exposure to surrounding residents, drivers, and landfill workers due to transportation and off-site disposal. The exposure risk due to transportation, road accidents, and landfill placement are moderate to high due to the estimated number of trips (1,728) required to execute this alternative.

Sustainability: Alternative 5 would have a high carbon foot print as only 36% of the contaminated materials would remain on-Site. It is anticipated that approximately 7,871 gallons of diesel fuel would be used for trucking the hide splits to the landfill. The associated emissions of carbon dioxide (80,836 kilograms) and methane gas (361 grams) are considered moderate. The overall sustainability of this alternative is considered moderate.

Reasonableness of Cost: The cost estimate to implement Alternative 5 would be approximately $2.53M and is largely based on 1) volume of excavated material, 2) containment cell construction, 3) source and volume of clean fill, and 4) restoration, including selling of wetland credits by the City to a wetland bank which reduces the total cost of this alternative. Tasks associated with this alternative are expected to be eligible for funding under an EPA multi-purpose brownfield cleanup grant.

Climate Change Concerns: The construction of a containment cell located nearby the Rock Creek lowland areas has the potential to be impacted by flood damage and therefore erosion. However, these risks are considered low as the cell will be located an estimated 10 feet above and 375 feet away from Rock Creek. The climate change concerns for this alternative are considered moderate because of the presence of an on-site containment cell in the floodplain.

9.8 Alternative 6 – Placement of Contaminated Sediments Within Phosphate-Amended Containment Cell; Hide-Split Landfill Managed In Place

9.8.1 Alterative 6 Description

This alternative was included in the ABCA because managing the hide-split landfill in place was previously evaluated in the 2004 Focused Feasibility Study and this evaluation provides a current assessment of the benefits and drawbacks to leaving the hides in place. Under this alternative, contaminated sediments above the hot spot cleanup level would be excavated and placed into an engineered containment cell constructed within the south sedimentation lagoon. Hide splits in the upland areas would be covered with suitable fill and managed in-place.

Sediment in the bottom of the south sedimentation lagoon would be mixed with a suitable chemical admixture to stabilize metals of concern that may potentially migrate downward through the containment cell inside the former lagoon and into groundwater. The estimated costs included in this ABCA are based on a single application of solid phosphate blend amendment to establish a competent base layer that is approximately 18 inches thick. Treatability testing would be required before remedy implementation to determine the most appropriate chemical admixture for stabilizing metals by creating insoluble compounds, creating a preference for metals compounds to sorb to sediment particles, or through encapsulation; as well as for creating a sufficiently strong base to support the weight of contaminated materials placed in the containment cell.

Approximately 2,600 cubic yards of contaminated sediments from the north sedimentation lagoon and 200 cubic yards of contaminated sediment from the Rock Creek floodplain would be excavated and placed into the south sedimentation lagoon containment cell above the chemically stabilized floor.

Once filled, the containment cell would be capped with a HDPE liner and covered with approximately 3,600 cubic yards of sand and organic soil fill. To prevent erosion, the cap would be graded to direct stormwater away from the containment cell and a vegetative cover would be planted on the cap. Excavation areas would be backfilled and compacted with suitable fill taken from the berms of the existing sedimentation lagoons or imported from a local source.

The surface of the hide-split landfill would be graded so that when covered it would approximate the desired grade for planned development. The hide-split landfill would be covered with a minimum of three feet of suitable soil cover taken from the berms of the existing sedimentation lagoons, or imported from a local source, and managed in-place.

Because contaminated sediment and hide splits would be contained on the Site, institutional and engineering controls would be used to mitigate residual risk. An institutional control in the form of an EES, or deed restriction, may be required. Long-term operation & maintenance in the form of routine inspection to document condition would also be required. Repairs would be need to be implemented when issues are identified during inspections.

Excavated areas inside the north and south sedimentation lagoons and the excavation areas in the Rock Creek floodplain are located within designated wetland areas and would require restoration measures. Under this alternative, it is estimated that 1.3 acres of wetland credits would be sold into a wetland mitigation bank after remedial action. This includes filling of a portion of the south sedimentation lagoon with the containment cell, wetland enhancement of the north sedimentation lagoon and a portion of the south sedimentation lagoon, and wetland conversion of the sedimentation lagoon berm areas.

9.8.2 Alterative 6 Evaluation

Protectiveness: Alternative 6 is moderately protective because it breaks the exposure pathway for current and future receptors at the Site by placing the most contaminated material within a containment cell. Some leaching of Site contaminants could, however, occur if the chemically stabilized floor is not installed properly, uniformly, or in inadequate quantity; or if the groundwater table rises significantly during the annual wet season and changes the hydraulic gradient within the containment cell. In addition, managing the hide-split landfill in place allows for potential exposure to future receptors if erosion occurs or if future excavation is required. The overall protectiveness of this alternative is considered moderate.

Effectiveness: Alternative 6 eliminates the potential for direct contact with the most contaminated materials (sediment and hide splits) managed on the Site and reduces a potential secondary source of stormwater runoff. Residual risk of excavated contaminated sediment would be managed by the engineered containment cell with protective cap and stabilized floor. Soil cover would mitigate in-place the direct exposure risk posed by the hide-split landfill. The overall effectiveness of this alternative is considered high.

Long-term Reliability: Alternative 6 relocates the most contaminated sediment from an uncontrolled condition by placing it into an on-site containment cell. The hide-split landfill would be capped with soil to eliminate the direct exposure pathway. Both relocating the contaminated sediment and capping the hide-split landfill in-place would provide relative long-term reliability. Permitting of the containment cell and long-term periodic inspections of the containment cell and cap would be required. The potential for failure of the engineered elements is considered low because a treatability study would have been conducted to determine the most suitable chemical admixture to stabilize the containment cell floor. Compacted, suitable fill used to backfill the excavations should be suitable for long-term use. Restored or created wetland areas would require long-term monitoring and maintenance to assure viability. The likelihood of having to mitigate or remove the hides from this location in the future is moderate to high because hides are located in an area considered developable. The bottom of the containment cell would be constructed at the bottom of the sedimentation lagoon. Based on groundwater elevation data, the sedimentation lagoon is expected to be regularly inundated with three feet of water during the wet season. Regular groundwater flushing of the containment cell could create migratory pathways for contained contaminants and will require long-term monitoring. The containment cell in this alternative would be considerably smaller than the containment cell in Alternative 4 and would therefore be less impacted by inundation. Hides will decompose over time and could contribute to settlement in the containment cell. Hides could also contribute to generation of methane gas. Testing for methane gas generation in the existing hide-split landfills should be conducted to determine if this is a significant issue. The overall long-term reliability of this alternative is considered low to moderate.

Implementability: Alternative 6 is considered relatively easy to implement. Excavation of contaminated materials and placing into an on-site containment cell (sediment) or capping with clean soil (hide splits) is not complicated. Likewise, the backfilling and compaction of clean, suitable fill in the cavities will entail basic construction activities. Construction of the on-Site containment cell would require engineering design and field oversight and is expected to take eight weeks to implement in the field. Filling a wetland would require permitting. Restored and created wetland areas would require a site-specific design, construction oversight, monitoring and maintenance. The placement of hide splits on the upland portion of the Site may restrict future redevelopment activities.

Implementation Risk: Alternative 6 would have a low implementation risk due to straightforward excavation activities and onsite construction of the containment cell that are anticipated to take less than ten weeks to complete. Subcontractors hired to conduct contaminated material removal would need to be current with OSHA 40-Hour HAZWOPER training. Work would be performed under a site-specific HASP.

Sustainability: Alternative 6 would have a small carbon foot print because all of the contaminated materials would remain on-Site. It is anticipated that fuel usage from trucking would be zero for this alternative. Capping the hides in place is a poor use of usable upland property and could degrade the value and future uses of the Site. Therefore, this alternative is considered to have low sustainability.

Reasonableness of Cost: The cost estimate to implement Alternative 6 would be approximately $1.6M and is largely based on 1) volume of excavated sediment, 2) containment cell construction, 3) covering the hide-split landfill, and 4) restoration, including purchase of wetland credits from wetland bank. Tasks associated with this alternative are expected to be eligible for funding under an EPA multi-purpose brownfield cleanup grant.

Climate Change Concerns: The construction of a containment cell located nearby the Rock Creek lowland areas has the potential to be impacted by flood damage and therefore erosion. However, these risks are considered low because the cell will be located an estimated 10 feet above and 375 feet away from Rock Creek. The climate change concerns for this alternative are considered moderate because of the presence of an on-site containment cell in the floodplain.

9.9 ALTERNATIVE 7 – REMOVAL AND DISPOSAL OF CONTAMINATED SEDIMENTS; HIDE-SPLIT LANDFILL MANAGED IN-PLACE

9.9.1 Alterative 7 Description

This alternative was included in the ABCA because managing the hide-split landfill in place was previously evaluated in the 2004 Focused Feasibility Study and this evaluation provides a current assessment of the benefits and drawbacks to leaving the hides in place. Under this alternative, contaminated sediments above the hot spot cleanup level would be excavated and transported off-Site for disposal. Sampling results indicate that sediments are not anticipated to be a RCRA hazardous waste. Therefore, they can be disposed at a Subtitle D (non-hazardous) waste landfill. Hide splits in the upland areas would be covered with clean, suitable fill and managed in-place.

Approximately 2,600 cubic yards of contaminated sediments from the north sedimentation lagoon, approximately 6,500 cubic yards from south sedimentation lagoon, and approximately 200 cubic yards from the Rock Creek floodplain would be excavated and transported the Waste Management landfills in Hillsboro, Oregon.

The surface of the hide-split landfill would be graded so that when covered it would match the necessary grade for desired development. The hide-split landfill would be covered with a minimum of three feet of suitable soil cover taken from the berms of the existing sedimentation lagoons or imported from a local source and managed in-place.

Because contaminated hide splits would be contained on the Site, institutional and engineering controls would be used to mitigate residual risk. An institutional control in the form of an EES, or deed restriction, may be required. Long-term operation & maintenance in the form of routine inspection to document condition would also be required. Repairs would be need to be implemented when issues are identified during inspections.

Excavated areas inside the north and south sedimentation lagoons and the excavation areas in the Rock Creek floodplain are located within designated wetland areas and would require restoration measures. Under this alternative, it is estimated that 3.9 acres of wetland credits would be sold into a wetland mitigation bank by the City after remedial action. This includes wetland enhancement of the north and south sedimentation lagoons, and wetland conversion of the sedimentation lagoon berm areas.

9.9.2 Alterative 7 Evaluation

Protectiveness: Alternative 7 is moderately protective because it breaks the exposure pathway for current and future receptors at the Site by removing or managing in place the most-contaminated material at the Site. In addition, managing the hide-split landfill in place allows for potential exposure to future receptors if erosion occurs or if future excavation is required in the landfill. The overall protectiveness of this alternative is considered moderate.

Effectiveness: Alternative 7 eliminates the potential for direct contact with the most-contaminated materials (sediment and hide splits) located on the Site and reduces a potential secondary source of stormwater runoff. Residual risk from the contaminated sediment would be eliminated by removing it from the Site and placing it into a permitted landfill. Clean soil cover would mitigate in-place the direct exposure risk posed by the hide splits. The overall effectiveness of this alternative is considered high.

Long-term Reliability: Alternative 7 permanently removes the most-contaminated sediment identified at the Site. The hide-split landfill would be capped with soil to eliminate the direct exposure pathway to associated contamination. Both removing the contaminated material and capping the hide-split landfill in-place would provide relative long-term reliability. The likelihood of having to mitigate or remove the hides from this location in the future is moderate to high because hides are located in an area considered developable. Minor permitting and long-term periodic inspection and reporting would be required for the capped area. Compacted, clean fill used to backfill the excavations or should be suitable for long-term use. Hides will decompose over time and could contribute to settlement in the containment cell. Hides could also contribute to generation of methane gas. Testing for methane gas generation in the existing hide-split landfills should be conducted to determine if this is a significant issue. The overall long-term reliability of this alternative is considered moderate.

Implementability: Alternative 7 is easy to implement. Excavation of contaminated materials and transporting off-site or placing clean fill over the existing hide-split landfill area is not complicated. Likewise, the backfilling and compaction of clean, suitable fill in the cavities will entail basic construction activities. Capping the hide splits would require an implementation plan and field oversight and is estimated to take nine weeks to implement. Restored and created wetland areas would require a site-specific design, construction oversight, monitoring and maintenance. The placement of hide splits on the upland portion of the Site may restrict future redevelopment activities. Restored or created wetland areas would require long-term monitoring and maintenance to assure viability.

Implementation Risk: Alternative 7 would have a low implementation risk because the straightforward excavation activities and onsite construction of the hide split capping area are anticipated to take less than ten weeks to complete. Subcontractors hired to conduct contaminated material removal would need to be current with OSHA 40-Hour HAZWOPER training. Work would be performed under a site-specific HASP. The exposure risk due to transportation, road accidents, and landfill placement is considered moderate due to the estimated number of trips (464) for this alternative. Overall, the implementation risk for this alternative is considered low.

Sustainability: Alternative 7 would have a moderate carbon footprint as approximately 64% of the contaminated materials would remain on-Site. It is anticipated that approximately 1,753 gallons of diesel fuel would be used for trucking contaminated sediment to the landfill. The associated emissions of carbon dioxide (18,002 kilograms) and methane gas (80 grams) are considered moderate for this alternative. This alternative would allow for the greatest area of wetland conversion thereby contributing to clean air and water initiatives in accordance with the Clean Water Act. Capping the hides in place is a poor use of usable upland property and could degrade the value and future uses of the site. The overall sustainability of this alternative is considered moderate.

Reasonableness of Cost: The cost estimate to implement Alternative 7 would be approximately $1,37M and is largely based on 1) volume of excavated material, 2) covering the hide-split landfill, and 4) restoration, including selling of wetland credits by the City to a wetland bank which reduces the total cost of this alternative. Tasks associated with this alternative are expected to be eligible for funding under an EPA multi-purpose brownfield cleanup grant. If portions of the Site were converted to wetlands the resultant area could offset the proposed upland development in the wetlands area of could be sold into a mitigation bank for a profit.

Climate Change Concerns: Major risk factors have not been identified under this alternative as the hide split capping areas would be located on the upland portion of the Site. This alternative would allow for the greatest amount of wetland reconstruction and would also contribute to enhanced flood control along Rock Creek.

9.10 SELECTION OF PREFERRED REMEDIAL ALTERNATIVE

The seven remedial alternatives were evaluated using the balancing factors required by DEQ, as well as evaluating sustainability and climate change concerns as required by the Brownfield program. Table 1 summarizes cleanup alternatives compared to the evaluation criteria. Table 2 summarizes the major redevelopment costs for each alternative.

Alternatives 2 and 7 ranked the highest, followed by Alternatives 4 and 5 which were closely ranked.

When cost is considered, alternatives 4 and 7 are the lowest, at $1.37M and $1.6M, respectively (Table 2 – Summary of Costs). However, the lowest cost alternative (Alternative 7) leaves hides in place in the upland portion of the Site, which is not a desired attribute for putting the property back in productive use. Therefore, the Alternative 4 – *Placement of Contaminated Soils and Hides in Chemically Stabilized On-Site Containment Cell* - is selected as the most appropriate cleanup action for the Site. The primary components of Alternative 4 are depicted on Figure 3, including proposed excavation areas and the proposed location of the chemically-stabilized containment cell.

10.0 CONCLUSIONS

This ABCA has summarized the assessment activities conducted to date, the issues identified by the assessment, the remedial action objectives designed to address these issues, the proposed cleanup levels, and an evaluation of seven remedial alternatives using DEQ's balance factors and considering sustainability and climate change concerns. Alternative 4 (Placement of Contaminated Sediments and Hides Within Phosphate-Amended Containment Cell) was selected as the proposed remedial alternative based on balancing factors demonstrating overall benefits for the estimated costs. This alternative was selected within the context of five major assumptions that cover the proposed cleanup levels, disposing of wastes as nonhazardous, construction of the on-Site containment cell in a wetland (i.e. south sedimentation lagoon), preserving the upland area for redevelopment, and using wetland banking as a mitigation strategy. Additional remedial design work and planning work, in consultation with the City, will be needed to take the outcome of the ABCA from planning level information to detailed design and construction level documents, in consultation with the City, so that future redevelopment meets City needs.

We appreciate the opportunity to be of service to the City of Sherwood on this project. If you have any questions or comments regarding this report, please contact the undersigned at (503) 639-3400.

Amec Foster Wheeler
Environment & Infrastructure, Inc.

DRAFT

Michelle Peterson, RG
Project Manager

Reviewed By:

DRAFT

Russ Bunker, RG
Associate Geologist

GT/CE/MLP/ay

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LIMITATIONS

This report was prepared exclusively for the City of Sherwood by Amec Foster Wheeler Environment & Infrastructure, Inc. The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in Amec Foster Wheeler services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This Analysis of Brownfield Cleanup Alternatives is intended to be used by the City of Sherwood for the Former Frontier Leather Property located at 1210 SW Oregon Street in Sherwood, Oregon only, subject to the terms and conditions of its contract with Amec Foster Wheeler. Any other use of, or reliance on, this report by any third party is at that party's sole risk.

The findings contained herein are relevant to the dates of the Amec Foster Wheeler Site visit and should not be relied upon to represent conditions at later dates. In the event that changes in the nature, usage, or layout of the property or nearby properties are made, the conclusions and recommendations contained in this report may not be valid. If additional information becomes available, it should be provided to Amec Foster Wheeler so the original conclusions and recommendations can be modified as necessary.

TABLES

TABLE 1
Summary of Cleanup Alternatives Compared to Evaluation Criteria
Former Frontier Leather Tannery Property
Sherwood, Oregon

Alternative No. and Title	Protectiveness		Effectiveness		Long-term Reliability		Implementability		Implementation Risk			Sustainability		Climate Change Concerns		Rank (higher score = more desirable)	Cost
	Scoring None Low Moderate High	0 1 2 3	Scoring None Low Moderate High	0 1 2 3	Scoring None Low Moderate High	0 1 2 3	Scoring NA Difficult Moderate Easy	 1 2 3	Scoring None High Moderate Low	0 1 2 3	No. of Weeks	Scoring NA Low Moderate High	 1 2 3	Scoring None Low Moderate High	4 3 2 1		
Alternative 1 No Action	None	0	None	0	None	0	Easy	3	None	0	0	Moderate	2	None	4	9	$0
Alternative 2 Removal and Disposal of Contaminated Soils and Hide	High	3	High	3	High	3	Easy	3	High	1	13	Moderate	2	None	4	19	$2,490,000
Alternative 3 Placement of Contaminated Soils and Hides in (HDPE)-Lined On-Site Containment Cell	High	3	High	3	Low	1	Difficult	1	Moderate	2	12	Moderate	2	Moderate	2	14	$1,780,000
Alternative 4 Placement of Contaminated Soils and Hides in Chemically Stabilized On-Site Containment Cell	Moderate	2	High	3	Moderate	2	Easy	3	Moderate	2	10	High	3	Moderate	2	17	$1,600,000
Alternative 5 Placement of Contaminated Soils in Chemically-Stabilized On-Site Containment Cell; Removal and Disposal of Hides	Moderate	2	High	3	Moderate	2	Easy	3	Moderate	2	9	Moderate	2	Moderate	2	16	$2,540,000
Alternative 6 Placement of Contaminated Soils in Chemically-Stabilized On-Site Containment Cell; Hides Managed In Place	Moderate	2	High	3	Low to Moderate	2	Easy	3	Low	3	8	Low	1	Moderate	2	16	$1,590,000
Alterative 7 Removal and Disposal of Contaminated Soils; Hides Managed In-Place	Moderate	2	High	3	Moderate	2	Easy	3	Moderate	2	9	High	3	None	4	19	$1,370,000

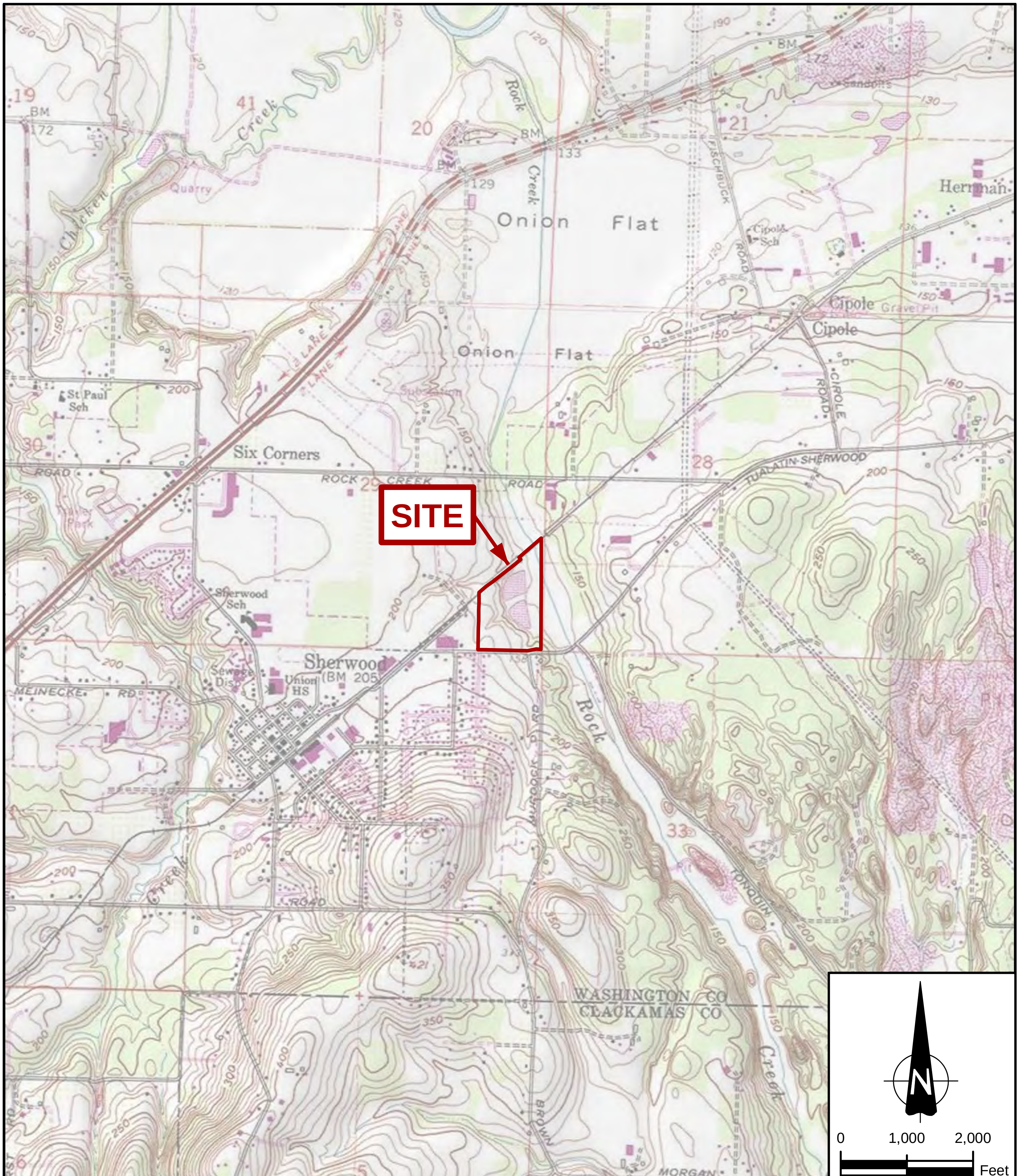
Notes:
No. of weeks - total weeks estimated for construction
Green highlight identifies the remedial alternatives with the highest rank
Yellow highlight identifies the alternatives of similar score below the highest ranked alternatives

TABLE 2
Summary of Key Costs for Each Remedial Alternative
Former Frontier Leather Tannery Property
Sherwood, Oregon

Major Redevelopment Elements	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6	Alternative 7
	No Action	Removal and Disposal of Contaminated Soils and Hide	Placement of Contaminated Soils and Hides in (HDPE)-Lined On-Site Containment Cell	Placement of Contaminated Soils and Hides in Chemically-Stabilized On-Site Containment Cell	Placement of Contaminated Soils in Chemically-Stabilized On-Site Containment Cell; Removal and Disposal of Hides	Placement of Contaminated Soils in Chemically-Stabilized On-Site Containment Cell; Hides Managed In Place	Removal and Disposal of Contaminated Soils; Hides Managed In-Place
Consultant Fees (Labor and Expenses)	$ -	$ 304,000	$ 296,000	$ 272,000	$ 264,000	$ 248,000	$ 259,000
Contractor Fees	$ -	$ 2,180,000	$ 1,482,000	$ 1,327,000	$ 2,269,000	$ 1,333,000	$ 1,110,000
Excavation/Grading	$ -	$ 501,000	$ 501,000	$ 501,000	$ 501,000	$ 341,000	$ 341,000
Transport/Disposal	$ -	$ 1,767,000	$ -	$ -	$ 1,218,000	$ -	$ 550,000
Site Prep	$ -	$ 87,000	$ 83,000	$ 75,000	$ 71,000	$ 67,000	$ 71,000
Liner/Phosphate Installation	$ -	$ -	$ 319,000	$ 193,000	$ 193,000	$ 193,000	$ -
Wetland Mitigation	$ -	$ (600,000)	$ 189,000	$ 189,000	$ (206,000)	$ -	$ (600,000)
Cap Cover/Backfill/Restoration	$ -	$ 142,000	$ 198,000	$ 198,000	$ 198,000	$ 765,000	$ 605,000
Contractor Markup	$ -	$ 285,000	$ 194,000	$ 174,000	$ 296,000	$ 174,000	$ 145,000
Total	$ -	$ 2,490,000	$ 1,780,000	$ 1,600,000	$ 2,540,000	$ 1,590,000	$ 1,370,000

Notes:
Negative wetland mitigation costs indicate a credit for wetland mitigation banking. Require restoration and sale of wetland credits.

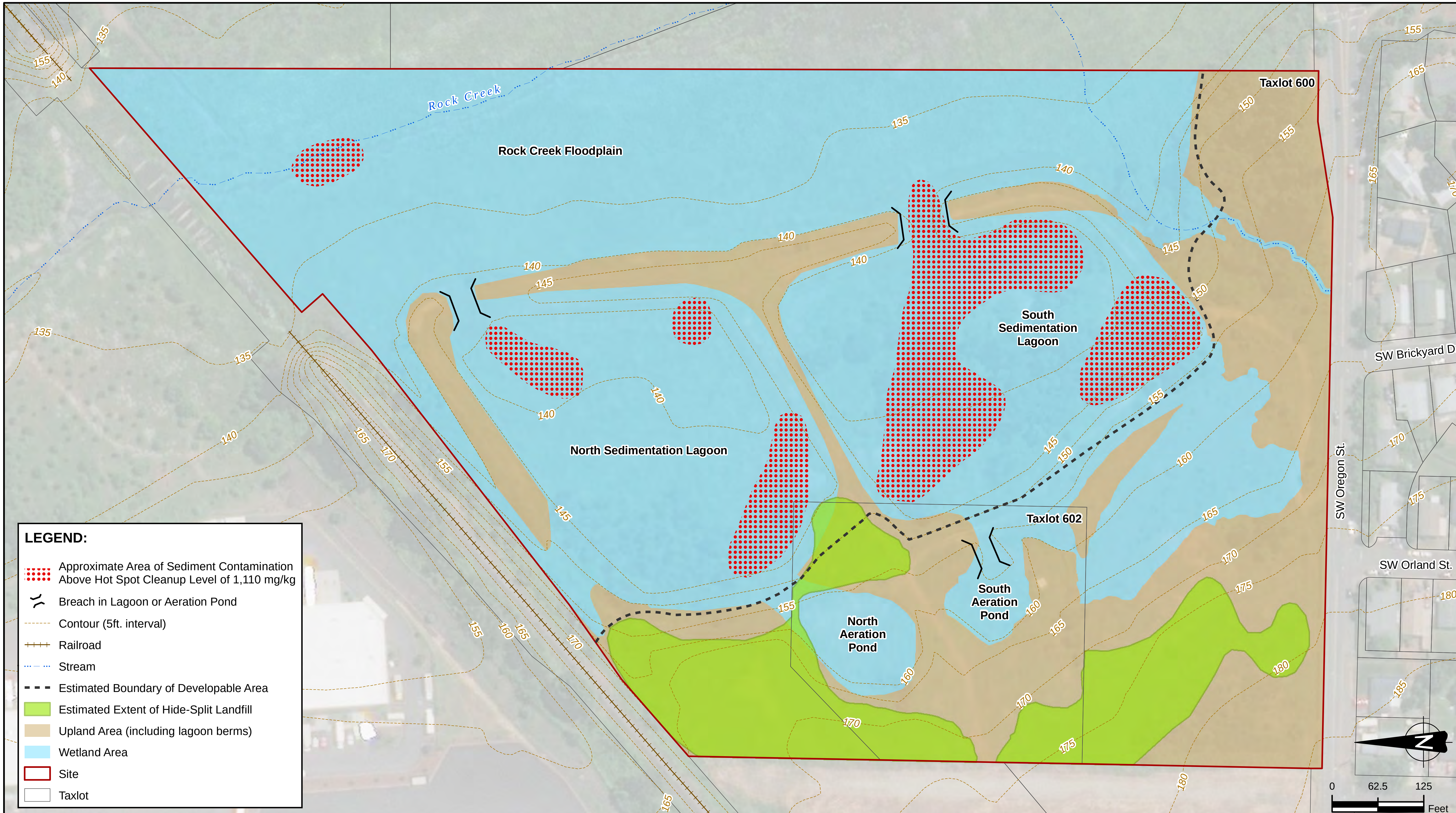
FIGURES



CITY OF SHERWOOD		FORMER FRONTIER LEATHER PROPERTY SHERWOOD, OREGON	DATE JULY 2017
			SCALE 1 " = 2,000 '
Amec Foster Wheeler Environment & Infrastructure, Inc. 7376 S.W. Durham Road Portland, OR 97224	amec foster wheeler	SITE LOCATION MAP	PROJECT NO. 5-61M-130820-03
			FIGURE 1

DRAWN BY: SD CHECKED BY: EH

K:\13000\13000\13082\DWG_ABCA\Figure 1 - Site Location Map.mxd - stephane.descombes - 7/25/2017 - 10:33:31 AM



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CITY OF SHERWOOD

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Environment & Infrastructure, Inc.
7376 S.W. Durham Road
Portland, OR 97224

amec foster wheeler

FORMER FRONTIER LEATHER PROPERTY
SHERWOOD, OREGON

CLEANUP PLANNING MAP

DATE	AUGUST 2017
SCALE	1 " = 125 '
PROJECT NO.	5-61M-130820-03
FIGURE	2

DRAWN BY: SD CHECKED BY: EH

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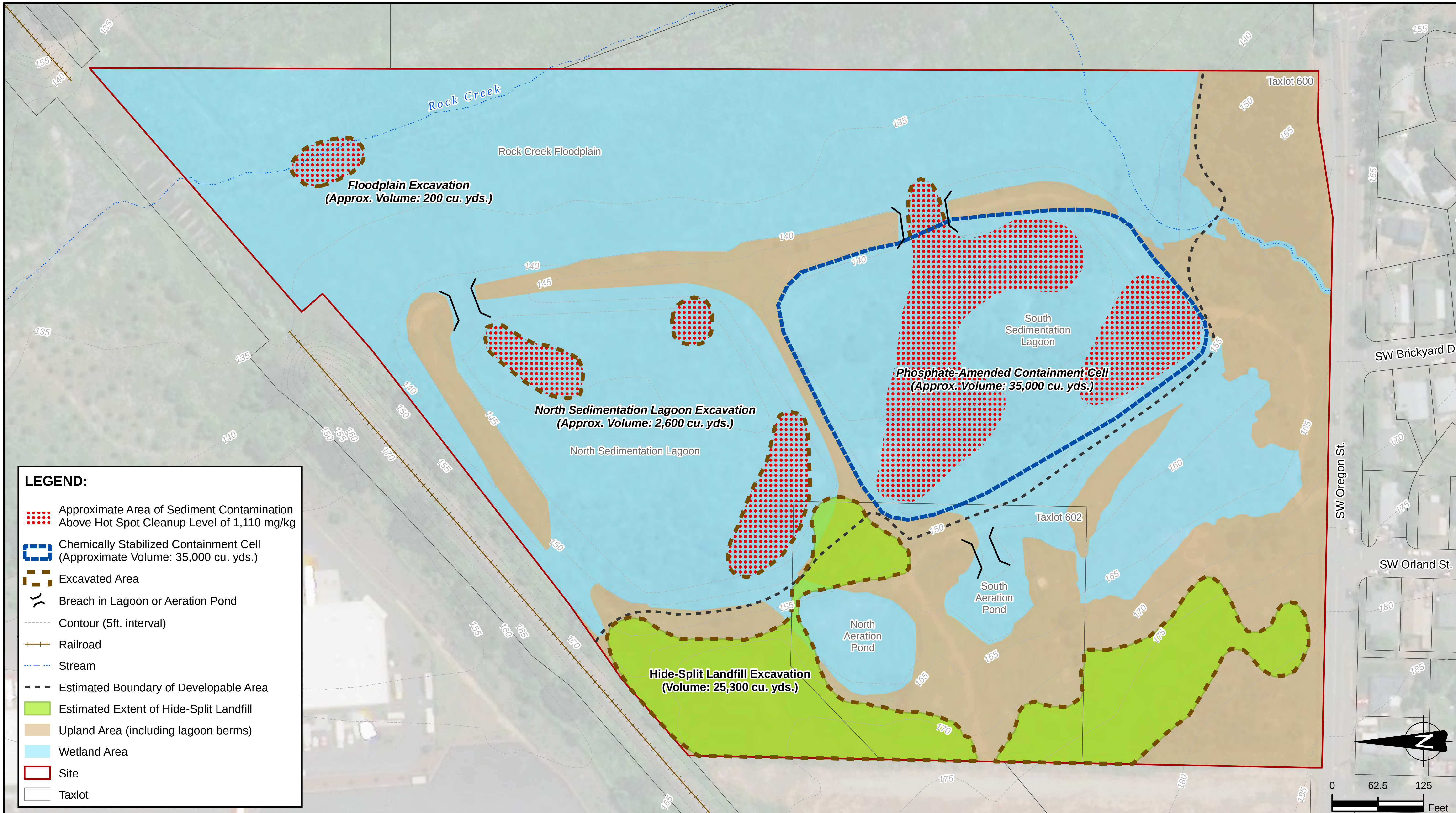

NOTE: Containment cell would be capped with 3 feet of suitable fill.

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Amec Foster Wheeler
Environment & Infrastructure, Inc.
7376 S.W. Durham Road
Portland, OR 97224

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FORMER FRONTIER LEATHER PROPERTY
SHERWOOD, OREGON

SELECTED REMEDIAL ALTERNATIVE MAP

DATE	AUGUST 2017
SCALE	1 " = 125 '
PROJECT NO.	5-61M-130820-03
FIGURE	3

DRAWN BY: SD CHECKED BY: EH

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APPENDIX A

Greenhouse Gas Emissions Calculations for Remedial Alternatives

Appendix A-1
Greenhouse Gas Emissions Calculations for Remedial Alternatives

Alternative Number	Alternative Description	Material Transported from Site (CY)	Estimated Number of Truck Trips [1]	Estimated Miles per Round Trip [2]	Estimated Total Mileage	Estimated MPG [3]	Estimated Total Fuel Consumption (gallons)	Estimated CO_2-Equivalent Emissions (kilograms) [4]	Estimated CO_2-Equivalent Emissions (pounds)	Estimated Methane Emissions (grams) [4]
1	No Action	-	-	-	-	-	-	-	-	-
2	Removal and Disposal of Contaminated Soils and Hide Splits	34,555	1,728	56 or 34	86,616	9	9,624	98,261	216,666	442
3	Placement of Contaminated Soils and Hide Splits Within High-Density Polyethylene (HDPE)-Lined Containment Cell	-	-	-	-	-	-	-	-	-
4	Placement of Contaminated Soils and Hide Splits Within Phosphate-Amended Containment Cell	-	-	-	-	-	-	-	-	-
5	Placement of Contaminated Soils Within On-Site Phosphate-Amended Containment Cell and Removal and Disposal of Hide Splits	25,286	1,265	56	70,840	9	7,871	80,836	178,244	361
6	Placement of Contaminated Soils Within Phosphate-Amended Containment Cell and Hide Split Landfill Managed In Place	-	-	-	-	-	-	-	-	-
7	Removal and Disposal of Contaminated Soils and Hide Split Landfill Managed In-Place	9,269	464	34	15,776	9	1,753	18,002	39,695	80

Notes:

[1] Assume 20 cubic yards per truck; number of trucks rounded up.

[2] Mileage assumes one round-trip per truck from Sherwood to landfills.

[3] Source: Oak Ridge National Laboratory (http://cta.ornl.gov/vtmarketreport/pdf/chapter3_heavy_trucks.pdf)

[4] Source: EPA Center for Corporate Climate Leadership Simplified GHG Emissions Calculator (SGEC) Version 3.2 January 2017

CY = Cubic Yards

CO2 = Carbon dioxide

MPG = miles per gallon

Roundtrip mileage to Riverbend Landfill (McMinnville) is 56 miles.

Roundtrip mileage to Hillsboro Landfill is 34 miles.