Draft Final
Focused Feasibility Study
Kaiser Trentwood Facility
West Discharge Ravine
Spokane Valley, Washington

Prepared for
Kaiser Aluminum Washington, LLC

July 19, 2012
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Prepared by
Hart Crowser, Inc.

DRAFT

William B. Abercrombie
Principal

DRAFT

Chris Poulsen, PE
Senior Associate

1700 Westlake Avenue North, Suite 200
Seattle, Washington 98109-6212
Fax 206.328.5581
Tel 206.324.9530

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1.0 INTRODUCTION

This report presents the results of the Focused Feasibility Study (FFS) conducted on behalf of Kaiser Aluminum Washington, LLC (Kaiser) at its Trentwood Facility (Facility) located at East 15000 Euclid Avenue in Spokane Valley, Washington. Specifically, this FFS addresses impacts in the smear zone soil at the former West Discharge Ravine (WDR) identified on Figure 1.

A site-wide feasibility study (FS) for the Kaiser Facility (Hart Crowser 2011) was conducted pursuant to the requirements outlined in Task IX of Exhibit B to Agreed Order No. DE 2692 between Kaiser and the Washington State Department of Ecology (Ecology), dated August 16, 2005. The Agreed Order requires Kaiser to complete an FS that develops cleanup levels, develops remedial alternatives, and evaluates the remedial alternatives based on the criteria in WAC 173-340-360.

This FFS document builds upon the information and analysis presented in the site-wide FS and previous documents, specifically the Draft Final Feasibility Study Technical Memorandum (FSTM) (Hart Crowser 2010), Draft Final Soil Remedial Investigation (RI) (Hart Crowser 2009), and Draft Final Remedial Investigation Addendum (RI Addendum) (Hart Crowser 2012).

The FSTM identified potential remediation technologies that may be applicable to each constituent of concern (COC) present in soil and groundwater at the Facility and identified technologies and process options that were judged implementable and reliable for each of the COCs.

The primary purpose of the site-wide FS was to:

- Conduct a final screening of the technologies judged to be implementable and reliable by the FSTM. This final screening included a cost screening when appropriate.

- Evaluate the technology-based remedial alternatives based on the criteria in WAC 173-340-360 to identify the most appropriate technology-based alternatives for each individual COC or mixture of COCs in the environmental segments (media) present at the Facility. Facility media were divided into four environmental segments: near-surface soil, deep vadose zone soil, the petroleum hydrocarbon plumes and associated smear zone soil, and the Remelt/Hot Line PCB plume and associated smear zone soil.

- Assemble the most appropriate technology-based remedial alternatives for each environmental segment, to identify the appropriate area-based remedial alternative(s) for each operating area of the Facility such as the Oil House area, Wastewater Treatment area, etc.

The FS said the following about the WDR:

"The former West Discharge Ravine (WDR) is located north and northwest of the wastewater lagoon and started near the sanitary wastewater treatment plant. The WDR trends south and west toward the Spokane River. This ravine was used to convey process water to the Spokane River from the northern end of the mill prior to construction of the first industrial wastewater treatment (IWT) plant in 1973."

And:

"The WDR contains an estimated 6 pounds of PCBs in near-surface soil... The uneven surfaces in these areas will require that a multi-layer cap be installed in locations designated for capping. The segment of the WDR west of the perimeter road has steep side walls that prohibit further excavation in this area. This area is currently undergoing additional investigation to evaluate its potential impacts on underlying groundwater. Addendums to the RI and this FS will be provided once the investigation is complete. Pending the results of this ongoing investigation, the WDR area may receive a multi-layer cap."

Supplemental Remedial Investigation

A supplemental remedial investigation and associated addendum to the site-wide RI Report was completed. The purpose of the investigation was to determine the nature and extent of polychlorinated biphenyl (PCB)-impacted soil beneath the WDR to determine whether it may be a potential source of PCBs in groundwater.

Specific tasks conducted by Hart Crowser included:

- Advancing three soil borings to the bottom of the WDR using sonic drilling methods for collection of subsurface soil samples;

- Drilling and installing two monitoring wells to evaluate the water quality immediately north of the WDR;
- Collecting continuous soil samples from the borings for lithological logging;
- Collecting discrete soil samples from the borings for chemical analysis to characterize WDR soil for PCBs, total petroleum hydrocarbons (TPH), and polycyclic aromatic hydrocarbons (PAHs);
- Collecting groundwater from the monitoring wells for chemical analysis and characterization; and
- Interpreting analytical results from the investigation to determine potential sources of PCBs to groundwater near the WDR.

Specific results and discussion can be found in the RI Addendum (Hart Crowser 2012). The general conclusions drawn in the RI addendum were that:

"Data obtained during the additional soil and groundwater investigation at the WDR supports the assertion that: 1) concentrations of PCBs in soil at the WDR are of sufficient concentration to serve as a potential source to groundwater, and; 2) sustained groundwater flow/gradient reversal creates a sufficient transport mechanism to cause groundwater from below the WDR to be transported north and east during periods of observed groundwater flow reversals. However, the investigation did not definitively show that PCBs in the WDR area are responsible for intermittent and low-concentration PCB detections in those wells near the river."

1.1 Purpose

The primary purpose of this FFS is to:

- Conduct a final evaluation of technologies judged to be implementable and reliable for use at the WDR. This final evaluation includes consideration of cost when appropriate.
- Evaluate the technology-based remedial alternatives based on the criteria in WAC 173-340-360 to identify the most appropriate technology-based alternatives for PCBs in the smear zone soil present at the WDR.

1.2 Report Organization

Primary report sections consist of the following:

- **1.0 Introduction.** Discusses the general background and identifies the purpose and scope of the FFS and describes the structure of the FFS report.
- **2.0 Development of Remedial Alternatives.** Describes cleanup standards, the area of concern, and selecting the remedial alternatives for the FFS.
- **3.0 Description of Remedial Alternatives.** Describes the remedial alternatives for the WDR.
- **4.0 Evaluation of Remedial Alternatives.** Evaluates technology-based remedial alternatives for the WDR.
- **5.0 Comparative Analysis of Remedial Alternatives.** Compares remedial alternatives and selects the preferred alternative for the WDR.
- **6.0 Preferred Alternative.** Identifies the preferred alternative for use at the WDR site.
- **7.0 References.** Lists references cited in the report.

Supporting information and data tables are presented in appendices:

- **Appendix A.** Presents detailed cost estimates for implementing Alternatives E2 and E3 in the WDR.
- **Appendix B.** This appendix identifies and discusses potential applicable or relevant and appropriate requirements (ARARs) to be used to assess and implement remedial actions at the WDR. The potential ARARs focus on federal or state statutes, regulations, criteria, and guidelines. The specific types of potential ARARs evaluated include contaminant-, location-, and action-specific ARARs.

1.3 Limitations

Work for this project was performed, and this report prepared, in accordance with generally accepted professional practices for the nature and conditions of the work completed in the same or similar localities, at the time the work was performed. It is intended for the exclusive use of Kaiser Aluminum Washington, LLC, for specific application to the referenced property. This report is not meant to represent a legal opinion. No other warranty, express or implied, is made.

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2.0 DEVELOPMENT OF REMEDIATION ALTERNATIVES FOR WDR SOIL

This section, based on the criteria in WAC 173-340-360, evaluates remedial technologies that were judged to be the most applicable to PCBs in WDR smear zone soil. Section 2 is organized as follows:

- Section 2.1 – Developing Cleanup Standards;
- Section 2.2 – Defining the Area of Concern; and
- Section 2.3 – Screening Remedial Technologies.

To help evaluate the alternatives, estimated costs were prepared for WDR soil where appropriate. These costs are summarized for each alternative in their respective descriptions in Section 3. Cost estimate summary tables and backup calculations for each alternative are provided in Appendix A. Table A-1 in Appendix A compares the net present value (NPV) costs for the alternatives. These estimated costs are used in Sections 4 and 5 as part of the process for evaluating each technology-based remedial alternative, and selecting the most appropriate alternative.

Because the soil matrix at the WDR consists mostly of gravel and cobbles (Hart Crowser 2012), any estimate of PCB mass based on analytical concentrations would need to account for these soil types. The gravel and cobble portion of the soil sample was either not sent to or not analyzed by the laboratory, since cobbles would not fit in the sample jar and gravel would have to be pulverized in the laboratory before analysis. Therefore, the concentration of COCs reported by the laboratory is an overestimate of the actual *in situ* COC mass in soil at the WDR.

Nonetheless, the laboratory values were reported in the RI Addendum (Hart Crowser 2012) without accounting for the gravel and cobbles, since they represent a conservative estimate of the actual concentration of PCBs at the WDR, and contribute to a conservative approach to estimating risks to human health and the environment posed by PCBs. Data indicate that as much as 43 percent of WDR soil is greater than 2 inches in diameter (i.e., cobble size). Grain size distribution data from the WDR indicate that an average of 80 percent of the material is retained on a No. 4 sieve (0.187 inch). This fraction is considered gravel and cobbles (Hart Crowser 2012).

2.1 Developing Cleanup Standards for the WDR

Preliminary Cleanup Levels (PCULs) were developed by Ecology during the site-wide RI/FS process and presented in the agency's report titled "*Kaiser Trentwood Site, Draft Cleanup Standards*" (Ecology 2010). In establishing cleanup standards for the Kaiser Facility, Ecology generally used MTCA Method B risk-based equations and chemical- and site-specific data to calculate values for each indicator chemical in both groundwater and soil. However, for PCBs in particular, the calculated cleanup level is lower than the lowest available and agency-approved laboratory detection limits. Therefore, adjustment "up" to the method detection limit (MDL) is provided for in WAC 173-340-707. The following is a comparison of the calculated PCB cleanup levels under MTCA Method B and the MDL:

- Groundwater (for protection of surface water): 64 pg/L
- Method 8082 MDL modified for ultra-low level detection for groundwater: 4500 pg/L
- Unsaturated Soil (for protection of surface water): 3.97E-04 mg/kg
- Saturated Soil (for protection of surface water): 1.99E-05 mg/kg
- Method 8082 MDL for soil: 0.01 mg/kg

Other analytical methods for PCBs with lower detection limits exist, namely EPA proposed Method 1668. However, this method has not been promulgated or otherwise approved for compliance under the requirements of WAC 173-340-830.

2.2 Defining the Area of Concern

The source of PCBs in the WDR is associated with past wastewater discharge. The 2007 West Discharge Ravine Interim Action removed approximately 2,500 cubic yards of PCB-impacted material. Though field-screening results collected during excavation indicated PCBs were still present above cleanup levels, further excavation was not possible due to side slope stability (Hart Crowser 2008).

Over 90 base-of-excavation verification samples were collected along the length of the WDR in a grid-based sampling scheme. Only a few samples collected are below the cleanup level (Hart Crowser 2008). Following excavation, the ravine was backfilled with clean fill at depths up to 11 feet. The area of concern (AOC) for near-surface soil in the WDR area, defined in the FSTM, was 4,900 square feet (Hart Crowser 2010).

As discussed above, additional investigations to evaluate the potential impacts of the WDR soil on underlying groundwater were conducted concurrently with the FS. The additional investigation looked at PCB concentration with depth along the WDR. Total PCBs, as determined by EPA Method 8082, were detected above the reporting limit in three soil samples from the WDR-3 boring, with depths ranging from 6 to 21 feet below ground surface (elevation 1932 to 1917 feet, 1988 North American Vertical Datum [NAVD88][1]). Total concentrations from the WDR-3 boring ranged from 8.8 to 7,200 µg/kg. PCBs were not detected at concentrations above the reporting limits in samples collected below 21 feet in WDR-3 and from all soil samples analyzed from borings WDR-1 and WDR-2 (Hart Crowser 2012).

The area of concern (AOC) for this FFS is defined as the portion of the WDR with detectable concentrations of PCBs in smear zone soil that is in contact with groundwater for at least a portion of the year. The seasonal high groundwater elevation observed in monitoring wells in the area is 1936 feet. Soil samples from the base of the 2007 interim action excavation indicate that west of the former diversion structure, PCB concentrations exceeding screening levels were left in place below the elevation of the seasonal high groundwater. The AOC for this FFS extends from boring WDR-2 west to approximately elevation 1930 (Figure 2). The width of the AOC is approximately 25 feet and corresponds to the base of the ravine that would have been subject to wastewater discharge flows during the years the WDR was used. The AOC extends vertically to elevation 1917, according to sample analytical results from boring WDR-3. The AOC does not include the clean fill that was used to backfill the excavation (see Figure 3). The AOC contains approximately 1,200 cubic yards of impacted material below 1000 cubic yards of clean fill placed following the 2007 interim action in the WDR.

2.3 Screening Remedial Technologies

The site-wide FS identified institutional controls, monitoring, and monitored natural attenuation (MNA) and a flexible multi-layer cover for the portion of the WDR that is west of the road, and institutional controls, monitoring, MNA and excavation/disposal for the portion of the WDR that is east of the road (refer to Figure 6-13 of the FS). The site-wide FS only addressed near-surface soil because smear zone soil data for PCBs in the WDR was not available when the site-wide FS was prepared. Smear zone soil data in the WDR was collected as part of the

[1] All elevations are NAVD88 unless indicated otherwise.

RI Addendum for the WDR (Hart Crowser 2012). As discussed above, PCBs are present at concentrations exceeding proposed CULs in smear zone soil in the vicinity of sampling location WDR-3 at depths from approximately 10 to 21 feet below ground surface (bgs) (refer to Section 2.2).

The following technologies were identified as having the potential for remediating PCBs in smear zone soil and were evaluated in Section 4.4.2.3 of the FSTM (Hart Crowser 2010).

In Situ Bio/Chemical Treatment

In situ bioremediation (enhanced bioremediation) and *in situ* chemical treatment were accepted as implementable for the treatment of smear zone soil that contain PCBs co-located with SVOCs (e.g., Oil House area, Wastewater Treatment area). These *in situ* processes were rejected based upon implementability concerns at locations where PCBs alone were present (as is the case in the WDR after the interim action) due to the relatively low concentration of PCBs and the depth (up to 78 feet bgs in areas of Remelt) of the smear zone (refer to FSTM Tables 3-5, 4-13c, and 4-14c).

In Situ Stabilization/Solidification

In situ stabilization and solidification processes were rejected as remedial alternatives for PCBs alone in smear zone soil due to the depth of the smear zone soil (i.e., in the area), concerns about the potential for unacceptable groundwater flow impacts resulting from the application of the reagents, concerns about the proper application (location, dosing) of reagents, and the potential impacts downgradient if the reagents migrated from their application site (refer to FSTM Tables 3-13b and 4-13a).

Excavation and Off-Site Disposal of Smear Zone Soil

Section 4.1 of the FSTM states "*excavation-based technologies (with on- or off-site treatment of excavated soils) are not considered potential remediation technologies for smear zone soils since it is judged inappropriate to consider excavation as a means of access to soils that are found in the smear zone (typically 55 to 88 feet bgs).*" These smear zone depths represent conditions in the Remelt area PCB smear zone soils.

Applicability of Technologies at the WDR

In contrast to the smear zone soil present in the plant area, PCB-contaminated soil in the WDR AOC is located at a maximum depth of approximately 13 to 28 feet bgs (refer to Section 2.2). *In situ* solidification and stabilization technologies and *in situ* chemical oxidation technologies have been successfully applied to soil at depths of 10 to 30 feet below ground surface. Thus, these technologies could be implemented at the WDR. Concerns about groundwater flow impacts, application, and potential downgradient impacts will be addressed in Section 4 of this FFS.

Additionally, these depths are judged to be within the range of traditional surface excavation technologies that use augers, trench boxes and/or related equipment. Thus, excavation and off-site disposal of soil is judged a potentially applicable technology for the remediation of smear zone soil in the WDR AOC.

The technologies and process options judged to be potentially applicable to the WDR smear zone soil AOC include:

- Institutional controls;
- Monitoring;
- Monitored natural attenuation;
- Soil excavation and off-site disposal;
- *In situ* solidification and stabilization; and
- *In situ* chemical oxidation.

These technologies and process options are assembled into potential remedial alternatives in Section 3 of this FFS.

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3.0 DESCRIPTION OF REMEDIAL ALTERNATIVES FOR WDR SOIL

The technology-based remedial alternatives judged to be potentially applicable for the smear zone AOC in the WDR are discussed in this section as follows:

- Section 3.1 – Alternative E1: Institutional Controls, Monitoring, and Monitored Natural Attenuation;
- Section 3.2 – Alternative E2: Institutional Controls, Monitoring, Monitored Natural Attenuation, and Soil Excavation with Off-Site Disposal;
- Section 3.3 – Alternative E3: Institutional Controls, Monitoring, Monitored Natural Attenuation, and *In Situ* Solidification and Stabilization; and
- Section 3.4 – Alternative E4: Institutional Controls, Monitoring, Monitored Natural Attenuation, and *In Situ* Chemical Oxidation.

3.1 Alternative E1: Institutional Controls, Monitoring, and Monitored Natural Attenuation

Alternative E1, which consists of institutional controls, monitoring, and monitored natural attenuation (MNA), is common to each of the alternatives that were developed and evaluated in the site-wide FS and will be similarly considered a part of the individual alternatives developed and evaluated in this FFS. These common elements are described in the FS as Alternative A1 (Hart Crowser 2011).

Institutional controls include physical measures such as fences and controlled access to the WDR, best management practices (BMPs) such as SPCC Plans and operating practices designed to prevent spills and leaks of chemicals and lubricants, and administrative measures that include a restrictive covenant. An extensive groundwater monitoring plan at the Facility has been in place for many years. Monitoring wells MW-27S and MW-28S (installed in 2011 as part of the supplemental RI) are now included in the monitoring program. This plan contains a wide range of protection and performance monitoring for groundwater at the Facility in general and specifically for groundwater near the WDR, and is included as an element of Alternatives E2 through E4 to allow for an empirical evaluation of whether soil concentrations are protective of the soil to groundwater and groundwater to surface water pathways.

Costs for the baseline institutional controls, monitoring, and MNA are included in the preferred alternative (presented in the site-wide FS) and, therefore, are not included in the incremental costs presented for Alternatives E2 and E3. Additional institutional controls, monitoring, and monitored natural attenuation needs, recommendations, and costs, if applicable, are presented within the Alternative E2 through E4 descriptions below.

3.2 Alternative E2: Institutional Controls, Monitoring, Monitored Natural Attenuation, and Contaminated Soil Excavation with Off-Site Disposal

Alternative E2 adds the additional protection of contaminated smear zone soil removal and off-site disposal to Alternative E1. An interim removal action was completed in 2007, which removed the upper 10 to 12 feet of soil in the footprint of the AOC. During the interim removal action, shoring was not used. Therefore, the volume of soil removed was limited by the geotechnical stability of the excavation side walls. Alternative E2 assumes that alternative excavation techniques such as auger excavation, and/or a shoring system will be required to safely excavate AOC soil. A discussion of alternative excavation and shoring technologies is discussed below.

3.2.1 Description of Alternative E2

The soil AOC is defined in Section 2.2. The existing surface elevation of the WDR within the AOC varies from approximately 1,930 feet NAVD88 near the river to approximately 1,945 feet NAVD88 on the northeast/uppermost end. Alternative E2 will remove soil within the footprint of the AOC down to an elevation of approximately 1,917 feet NAVD88 (Figures 4 and 5). After the interim removal action, the upper 10 to 12 feet of the WDR were backfilled with clean soil. Clean overburden soil will be excavated and stockpiled for reuse as backfill material before excavating smear zone soil.

Following excavation of the smear zone soil, the excavated material will be transported to an on-site screening plant. Material smaller than 2 inches in diameter will be screened, stockpiled as necessary to characterize the soil, and transported off-site for proper disposal. It is expected that the excavated soil will require disposal at a Subtitle D (non-hazardous) landfill. The nearest Subtitle D landfill to the Kaiser Facility that will accept PCBs at the low concentrations expected in the excavated soil is located in Roosevelt, Washington. Material larger than 2 inches will be stockpiled for reuse at the Kaiser Facility. The excavation would then be backfilled to existing grades using clean imported fill material, similar in soil type to that removed from the AOC.

Alternative Excavation Techniques and Constraints

As an alternative to traditional excavation using a track-mounted excavator or other heavy bulk excavation equipment, technologies such as vacuum excavation or auger excavation are methods that generally could be employed to excavate small columns of soil, potentially eliminating the need for shoring. Both of these principles would involve the repetitive advancing of a cylindrical borehole in an overlapping grid pattern, eventually removing a large volume of material, one cylinder at a time. Given the soil conditions at the WDR, vacuum excavation would not be effective at removing the larger gravel and cobbles.

The use of an auger to excavate soil may be feasible. Auger rigs have been used to install monitoring wells at the site, albeit these have been relatively small-diameter borings. Despite potential feasibility, the use of auger excavation would be technically impractical. The limited production rates, potential inability to keep the hole/excavation open, and the potential for auger refusal by large boulders rules out further consideration of auger excavation. Furthermore, these same technical impracticabilities point to the need to use shoring rather than alternative excavation techniques, in general.

Shoring Techniques and Constraints

Shoring is the construction practice of supporting excavation or trench side walls from collapse while construction activities progress within the excavation. Typical or common methods of shoring include:

Sheet Piles. Corrugated steel sheets are driven around the perimeter of an excavation before digging. Once the perimeter wall is established, the inside material is excavated. Sheet piling is typically driven using a large crane-mounted vibratory hammer. Soil conditions at the WDR (i.e., large cobbles and boulders), combined with limited access for a crane, make use of sheet piling impractical.

Drilled Shaft/Secant Pile Wall. This involves creating a perimeter wall of touching/overlapping concrete columns. Columns are created by pressure grouting or auger casting. Once a perimeter wall is constructed, the inner material can be excavated. Similar soil type and access constraints as discussed for sheet piling limit the effectiveness of these types of shoring.

Trench Box. The most common type of shoring is a trench box, a prefabricated steel or aluminum box that is lowered into the excavation to prevent from cave-ins. Typical trench boxes have steel sides supported by cross members with varying widths to accommodate different size excavations or trenches.

A variation of the trench box, which is typically installed after an excavation is open to prevent cave-ins, is the slide-rail system. The slide-rail system consists of two reinforced steel side panels, steel beam spreaders to support the panels, and slotted spreader posts that allow the side panels and spreader beams to slide up and down within the excavation. The slide-rail panels are constructed with cutting edges, which enables the system to be advanced with the excavation so that the side walls are continuously supported. The systems can typically be modified for excavation widths up to 30 feet and depths up to 32 feet. Installation does not require special equipment, such as a crane, and the top-down installation allows any large cobbles or boulders to be removed as the excavation progresses. However, large cobbles or boulders near the edges of the excavation still pose an implementation risk. In the event that cobbles or boulders ravel into the space between the box and the excavation, considerable over-excavation at the leading edge of the system to remove raveled material may be required, or in the worst case, the slide-rail system may become lodged in the excavation. Given the observed soil conditions during the previous interim removal action, the use of the proposed shoring system is expected to be feasible; however, soil conditions may change with depth, which may increase the aforementioned risk.

After weighing all the risks and benefits of the available technologies, Alternative E2 consists of excavation and off-site disposal using a slide-rail type shoring system.

3.2.2 Monitoring Requirements for Alternative E2

Compliance monitoring will be implemented in accordance with WAC 173-340-410 and will include:

- **Protection Monitoring** to confirm that human health and the environment are adequately protected during the construction period of the cleanup action;

- **Performance Monitoring** to confirm that the cleanup action has attained cleanup levels and/or other performance standards; and

- **Confirmational Monitoring** to confirm the long-term effectiveness of the cleanup action once performance standards have been obtained.

The objective of compliance monitoring is to confirm that cleanup levels have been achieved, and to confirm the long-term effectiveness of cleanup actions at the WDR. Remedy performance criteria, quality assurance (QA) activities, documentation requirements, and potential corrective actions are planned to be developed during the design phase preparation of project plans and specifications.

Monitoring requirements for Alternative E2 are expected to be similar to those presented in Table 2-6 of the site-wide FS. Specifically, the existing surfaces post excavation (floor and sidewalls) will be sampled and samples analyzed for total PCBs by EPA Method 8082 for comparison to the draft site-specific cleanup levels developed by Ecology (Ecology 2010) and based on this methods MDL. In addition, a number of duplicate samples will be analyzed for PCB congeners by EPA Method 1668 for investigative and documentary purposes. The frequency of sampling will be similar to the previous excavation interim action at the WDR and will be detailed in the forthcoming Interim Action Work Plan.

Monitoring During Excavation

A written Construction Quality Assurance Plan (CQAP) will be prepared by the contractor conducting the work. The CQAP will include monitoring to verify the quality of construction materials and the construction practices used in their placement, with the ultimate goal of confirming that the final construction work meets or exceeds the design criteria and specifications.

Health and safety monitoring during excavation will be required to address the short-term risks associated with excavating soil contaminated with PCBs. A HASP will be required to define the potential hazards associated with the work to be performed and to define procedures necessary to maintain worker safety.

Monitoring after Excavation

Ideally, monitoring wells would be installed downgradient of the AOC to monitor the efficacy of any remedial action. However, installation of monitoring wells between the WDR AOC and the river is not possible given the proximity to the river. Monitoring wells MW-27S and MW-28S were installed on the north side of the ravine directly adjacent to the WDR as part of the supplemental RI. These wells will continue to be monitored as part of the site-wide groundwater monitoring program.

3.2.3 Alternative E2 Estimated Cost

Assuming an operating period of 3 years and a discount rate of 7 percent, the incremental net present value (NPV) cost of Alternative E2, is approximately $487,000 (Appendix A, Table A-1). Backup for the summary in Table A-1 is presented in Tables A-3 through A-6. Baseline institutional control, monitoring, and MNA costs are accounted for under the preferred alternative presented in the site-wide FS.

3.3 Alternative E3: Institutional Controls, Monitoring, Monitored Natural Attenuation, and In Situ Solidification and Stabilization

Alternative E3 adds the protectiveness of *in situ* solidification and stabilization (ISS) to Alternative E1. ISS, in general, consists of mixing contaminated soil with solidifying reagents such as Portland cement, kiln dust, or pozzolans and stabilizing reagents such as organophilic clay, granular activated carbon, and zero-valent iron. The solidifying and stabilizing reagents create an impermeable or low-permeability soil monolith to treat and/or absorb contaminants of concern, immobilizing them within the monolith, thereby reducing risk to the environment posed by the contaminants. Specifically, given the coarse soil properties and relatively low PCB concentrations at the WDR, the primary remedial objective of Alternative E3 is to physically encapsulate the smear zone soil in a low-permeability soil matrix, eliminating contact between groundwater and PCBs in the AOC.

3.3.1 Description of Alternative E3

Alternative E3 would apply ISS technology to the smear zone soil, as defined in Section 2.2, to immobilize PCBs and reduce or eliminate potential risk to groundwater and, subsequently, the river (Figures 6 and 7). Solidification and stabilization are generic names applied to a wide range of discrete technologies that are closely related, in that both use chemical and/or physical processes to reduce potential adverse impacts on the environment from the disposal of radioactive, hazardous, and mixed wastes (EPA 1999). In developing the alternative, several factors were taken into consideration and are discussed below.

Mixing Technologies and Constraints

ISS involves mixing the solidifying and stabilizing reagents, *in situ*, with the contaminated soil. The three most common mixing approaches are: (1) soil mixing using a continuous flight auger; (2) excavator bucket or Lang tool mixing; and (3) pressure grouting.

The first two technologies involve physically displacing contaminated soil and mixing in the reagents. Because of the soil conditions (i.e., large amounts of cobbles and boulders) and depth at the WDR, these mixing techniques are technically impracticable.

Pressure grouting is a well-tested application developed to stabilize soil for geotechnical and structural augmentation. The process involves advancing a fairly small augered injection head to the desired depth and injecting a Portland cement-based or other grout into the formation. The volume of grout and the injection pressure is monitored to dictate when enough grout has been injected. The injection head is raised as the volume of grout and pressure has reached the desired level, creating a continuously stabilized/solidified column up to the surface. The process is then repeated in an overlapping grid pattern to create a secant-type wall or in a two dimensional grid pattern (rows and columns) to create a monolith.

Pressure grouting would be readily implementable at the WDR. Equipment access would not be a significant issue. A batch plant to produce the grout could be established upland from the ravine and piped down to the injection location. Smaller, all-terrain type rigs are available, which can be used at the WDR.

Furthermore, the sequencing of injections at the WDR to avoid potential displacement of contaminants is of the utmost importance. Figure 6 denotes the sequencing order of injections. The first application of injections will be to contain the smear zone nearest to the river. The second application will include two columns of injections to bound the north and south edges of the AOC, and a third row to bound the eastern end. The last application will involve filling the interior of the AOC with solidifying/stabilizing admixture. It is assumed that sufficient time will be allowed to lapse (more than 48 hours) to allow the cement to cure between each application. The column height of the injections will range from elevation 1,917 feet (NAVD88) up to 2 feet below existing grade (refer to Figure 7). Following injections, the upper two feet of soil will be excavated and replaced with imported material of similar content/gradation as native and the area will be restored to natural conditions.

Solidification/Stabilization Reagent Selection and Constraints

Reagents used in ISS are selected because they provide cementitious (solidification) properties, or because they provide absorptive properties. The most widely used cementitious reagent is Portland cement. Other common reagents include fly ash, blast furnace slag, silica fume, cement kiln dust, various forms of lime, and lime kiln dust.

Most organic compounds are not sorbed or otherwise bound to typical cementitious reagents, but instead are physically entrapped by the setting cement in a low-permeability monolith. Furthermore, high concentrations of organic contaminants can interfere with cement-based setting processes. To further increase the effectiveness of ISS in the presence of organics, absorptive media can be added to the reagent mixture. Typical absorptive media include bentonite and organophilic clays, granular activated carbon, phosphates, rubber particulates, and chemical gellants (ITRC 2011).

Typically, a treatability study is conducted to test different reagent concentrations and mixtures to optimize the effectiveness of the ISS. However, the physically challenging setting at the WDR, coupled with the very low fines content of the WDR soil, would make treatability testing impractical. In order to obtain a sample for laboratory testing, hundreds of cubic yards of clean overburden soil would need to be removed to get to the underlying smear zone soil. Once the clean overburden is removed, a sample of the smear zone soil could be collected. As discussed previously, the soil matrix consists of primarily coarse gravel and cobbles. Treatability testing would most likely involve the screening out and stabilization/solidification of the finer-grained particles, thereby calling into question the applicability of the treatability testing to the *in situ* conditions.

Given the low concentration of PCBs in the WDR smear zone soil, relative to other ISS projects, it is assumed that the use of Portland cement would address the remedial action objectives at the WDR. Typical Portland cement concentrations range from 5 to 30 percent of the total soil unit weight. Because the primary objective of Alternative E3 is to create a solid, low-permeability soil monolith, it is assumed that the Portland cement content would be optimized by the injection grout contractor to maximize strength and minimize permeability while maintaining a flowable grout mixture that can be efficiently injected.

3.3.2 Monitoring Requirements of Alternative E3

Compliance monitoring will be implemented in accordance with WAC 173-340-410 and will include:

- **Protection Monitoring** to confirm that human health and the environment are adequately protected during the construction period of the cleanup action;

- **Performance Monitoring** to confirm that the cleanup action has attained cleanup levels and/or other performance standards; and

- **Confirmational Monitoring** to confirm the long-term effectiveness of the cleanup action once performance standards have been obtained.

The objective of compliance monitoring is to confirm that cleanup levels have been achieved and to confirm the long-term effectiveness of cleanup actions at the WDR. Remedy performance criteria, quality assurance (QA) activities, documentation requirements, and potential corrective actions are planned to be developed during the design phase preparation of project plans and specifications.

Monitoring During ISS

A written Construction Quality Assurance Plan (CQAP) will be prepared by the contractor conducting the work. The CQAP will include monitoring to verify the quality of construction materials and the construction practices used in their placement, with the ultimate goal of confirming that the final construction work meets or exceeds the design criteria and specifications. Because Alternative E3 involves injecting material in such close proximity to the river, constant monitoring at the river during construction will be in place. At a minimum, visual and pH monitoring will be a key component to the CQAP and performance guidelines will be detailed in the project specifications.

Health and safety monitoring during excavation will be required to address the short-term risks associated with excavating soil contaminated with PCBs. A HASP will be required to define the potential hazards associated with the work to be performed and to define procedures necessary to maintain worker safety.

Monitoring after ISS

Ideally, monitoring wells would be installed downgradient of the AOC to monitor the efficacy of any remedial action. However, installation of monitoring wells between the WDR AOC and the river is not possible given the proximity to the river. Monitoring wells MW-27S and MW-28S were installed on the north side of the ravine directly adjacent to the WDR as part of the supplemental RI. These wells will continue to be monitored as part of the site-wide groundwater monitoring program.

3.3.3 Alternative E3 Costs

Assuming an operating period of 3 years and a discount rate of 7 percent, the incremental net present value (NPV) cost of Alternative E2, is approximately $334,000 (Appendix A, Table A-2). Backup for the summary in Table A-2 is presented in Tables A-4 through A-6. Baseline institutional control, monitoring, and MNA costs are accounted for under the preferred alternative presented in the site-wide FS.

3.4 Alternative E4: Institutional Controls, Monitoring, Monitored Natural Attenuation, and In Situ Chemical Oxidation

The purpose of Alternative E4 is to chemically oxidize PCBs *in situ*. During *in situ* chemical oxidation, chemical oxidants that destroy the PCBs are introduced to the soil column. Hydrogen peroxide (H_20_2), potassium permanganate ($KMn0_4$), ozone (O_3), and persulfate ($S_2O_8{}^{2-}$) are the four most commonly used oxidants in this treatment process (EPA 2006). Another common field application, Fenton's Reagent, uses hydrogen peroxide and an iron catalyst to create hydroxyl free radicals.

Successful *in situ* chemical oxidation requires contact between the oxidant and the PCBs. Oxidants have varying persistence in the subsurface ranging from a few months (permanganate) to hours (ozone) (EPA 2006). Once injected, oxidants typically react quickly with contaminants and other natural chemical oxidant demand and are generally unstable, which limits the effective radius of influence of the oxidant from the injection well.

PCBs have been shown to be somewhat reactive under certain types of oxidant combinations including peroxide and iron (Fenton's Reagent) and ozone and peroxide (ITRC 2005). PCBs have shown to be recalcitrant to ozone alone, persulfate, and permanganate (ITRC 2005). The very low PCB concentrations in the WDR make *in situ* chemical oxidation even more challenging.

The common oxidants (except for ozone) would be delivered into the subsurface in a liquid form. The proximity of the Spokane River to the AOC increases the risk that these aqueous amendments will reach the river unreacted. Oxidants may also react with metals in the subsurface and oxidize them to their highest oxidative state. This may increase the toxicity and mobility of the metals (arsenic, iron, manganese).

As a result of the cumulative impact of the technical concerns and potential health and safety risks, *in situ* chemical oxidation was judged not to be an implementable or reliable alternative for the treatment of smear zone soil for the WDR.

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4.0 EVALUATION OF REMEDIAL ALTERNATIVES

Ecology has identified criteria to evaluate remedial technologies and alternatives (WAC 173-340-360). These evaluation criteria are listed below and are described in detail in Section 2.2.1 of the site-wide FS (Hart Crowser 2011). The criteria are applied to Alternatives E1 through E3 in Sections 4.1 through 4.3, respectively. A comparative analysis of alternatives is conducted in Section 5.0 to identify the most appropriate remedial alternative. The comparative analysis assesses the relative capability of each alternative to meet threshold requirements, to use permanent solutions to the maximum extent practicable, and to achieve a reasonable restoration time frame.

WAC 173-340-360(2) dictates the minimum requirements for cleanup actions:

- Threshold requirements:
  - Protect human health and the environment;
  - Comply with MTCA cleanup standards;
  - Comply with applicable state and federal laws; and
  - Provide for compliance monitoring.

- Other requirements:
  - Use permanent solutions to the maximum extent practicable to be determined in accordance with WAC 173-340-360(3)(f) for the following criteria:
    - Protectiveness;
    - Permanence;
    - Cost;
    - Effectiveness over the long term;
    - Management of short-term risks;
    - Technical and administrative implementability; and
    - Consideration of public concerns.
  - Provide for a reasonable restoration time frame to be determined in accordance with the factors listed in WAC 173-340-360(4)(b).

Compliance Monitoring requirements are defined in WAC 173-340-410 and WAC 173-340-720 through WAC 173-340-760. The long-term compliance monitoring associated with Alternative E1 is also a part of Alternatives E2 and E3. As a result, compliance monitoring incorporated as part of each alternative is not included as an evaluation criterion in this section.

Public acceptance was not used as a criterion to distinguish among the remediation alternatives evaluated in this FFS. Public concerns will ultimately be considered during the public comment period for this FFS. Selection of the preferred remediation alternative may be revised based on the results of the public review process. This criterion is not further addressed in this report.

The evaluations provided in Sections 4.1 to 4.3 assume that the former WDR will be remediated in its current condition, without the installation of the flexible cover discussed in Section 6 of the site-wide FS.

4.1 Evaluation of Remedial Alternative E1: Institutional Controls, Monitoring, and Monitored Natural Attenuation

Alternative E1 uses the institutional controls, monitoring, and MNA actions described in Section 3.1. The institutional controls include physical measures such as fences and controlled access to the WDR, BMPs such as operating practices designed to prevent spills and leaks of chemicals and lubricants and SPCC Plans, and administrative measures such as a restrictive covenant. An extensive groundwater monitoring plan at the Facility has been in place for many years. This plan contains a wide range of protection and performance monitoring for groundwater at the Facility, and is included as an element of Alternatives E2 and E3 to allow for evaluation of whether soil concentrations are protective of the soil to groundwater and groundwater to surface water pathways.

Alternative E1 does not employ any active remedial measures to reduce the toxicity, mobility, or volume of the PCBs that are present in smear zone soil at the WDR. The capability of Alternative E1 to meet the cleanup requirements established by MTCA is summarized below.

4.1.1 Threshold Requirements

Protect Human Health and the Environment

Physical and administrative controls and BMPs are used to reduce the potential for worker exposure to PCBs. The human direct contact and ingestion pathways to Facility workers and visitors are mitigated because the PCBs in the smear zone soil are overlain with clean fill. The PCBs in the smear zone soil are in contact with groundwater, allowing the transport of PCBs from soil to groundwater, which can potentially migrate to the Spokane River.

This alternative will not actively work to reduce the concentration of the PCBs in smear zone soil at the WDR, other than through natural attenuation processes. An assessment of natural attenuation in groundwater at the Facility is provided in Appendix F of the site-wide FS (Hart Crowser 2011). This assessment indicates that PCBs in groundwater may be amenable to bioremediation under both anaerobic and aerobic conditions. This natural attenuation is expected to be concentrated in locations near the source areas of the PCBs.

Although the natural attenuation processes that are occurring at the Facility may reduce the concentration of PCBs in Alternative E1, it will take a long time to attain cleanup requirements, and reduction in risk to human health and the environment is not expected to occur within a reasonable period of time. Therefore, Alternative E1 is not considered protective of human health and the environment.

Comply with MTCA Cleanup Standards

Alternative E1 relies on source control measures and natural attenuation to reduce the concentration of PCBs to PCULs over a long time. Alternative E1 will not result in compliance with MTCA cleanup requirements, or with applicable or relevant and appropriate requirements (ARARs) promulgated by state and federal law for a long time.

Comply with Applicable State and Federal Laws

Contaminant-specific ARARs were included in the development of cleanup levels, and compliance with these ARARs is discussed above. No location-specific and action-specific ARARs were identified for Alternative E1.

Summary of the Threshold Requirements

Alternative E1 is not considered to meet threshold requirements within a reasonable time frame. The other minimum requirements as described in WAC 173-340-360(2)(b) were evaluated for comparative purposes in Table 1 and discussed below.

4.1.2 Other Requirements

Use of Permanent Solutions to the Maximum Extent Practicable

Protectiveness. Alternative E1 will not actively reduce the concentration of the PCBs in at the WDR to meet the cleanup levels, other than by natural attenuation processes. While some natural attenuation of PCBs may be occurring, this process will not result in a significant reduction in risk to human health and the environment in a reasonable time frame. Alternative E1 does not alleviate the soil to groundwater pathway. Thus, Alternative E1 will not meet existing MTCA cleanup standards or ARARs promulgated by state and federal laws within a reasonable time frame.

Permanence. The BMPs in place at the Facility will reduce the release of hazardous substances to the environment. Facility access controls will reduce the opportunity for visitors at the Facility to come in contact with the PCBs. Existing clean fill also prevent direct contact with PCBs in smear zone soil.

While the natural attenuation processes may reduce PCBs over time, Alternative E1 will not actively reduce the toxicity, mobility, or volume of PCBs present in smear zone soil at the WDR. Natural attenuation will require a long time to attain cleanup levels.

Cost. The cost to implement the monitoring, institutional controls, and MNA elements that are part of Alternative E1 are considered to be included in the costs for the preferred alternative presented in Table 6-7 in the site-wide FS (Hart Crowser 2011).

Effectiveness over the Long Term. This alternative will not reduce the concentration of PCBs currently present in smear zone soil to concentrations below cleanup levels in a reasonable restoration time frame. The overall risk to human health and the environment will not be significantly reduced by this alternative.

Management of Short-Term Risks. This alternative uses existing procedures to implement institutional controls, BMPs, and groundwater monitoring, and does not create any new or additional risk to human health and the environment.

Technical and Administrative Implementability. The actions associated with the implementation of Alternative E1 are already in place at the Kaiser Facility. While there is indication that the natural attenuation of PCBs is occurring (refer to Appendix F of the site-wide FS), evidence to support this assertion is still being evaluated.

Restoration Time Frame

The factors used to determine whether an alternative provides for a reasonable restoration time frame are summarized in Section 2.2.1.2 of the site-wide FS

(Hart Crowser 2011). One of the factors to consider is the potential risk posed by the impacted area to human health and the environment (WAC 173-340-360[4][b][i]). The soil to groundwater exposure pathway remains under this Alternative. Although the natural attenuation processes are occurring, it will take a long time to meet cleanup requirements. A reduction in risk to human health and the environment is not expected to occur within a reasonable time frame and, thus, the restoration time frame for Alternative E1 by itself is judged to be excessive because of the lack of risk reduction when compared to other viable alternatives.

4.2 Evaluation of Remedial Alternative E2: Institutional Controls, Monitoring, Monitored Natural Attenuation, and Contaminated Soil Excavation with Off-Site Disposal

Alternative E2 adds excavation and off-site disposal to Alternative E1. The purpose of Alternative E2 is to remove PCB-impacted smear zone soil to eliminate the potential for the PCBs to migrate to groundwater. The estimated contaminated soil excavation volume is 1,200 CY.

4.2.1 Threshold Requirements

Protect Human Health and the Environment

Alternative E2 includes the institutional controls, monitoring, and MNA provided by Alternative E1. Approximately 1,200 CY of smear zone soil will be excavated and mechanically screened on site to remove cobbles. Available soil data for the WDR smear zone indicates the impacted soil would not be designated as State Dangerous Waste (Chapter 173-303 WAC). The cobble-free excavated soil (approximately 1,000 CY, assuming 70 percent of soil volume is smaller than 2 inches) will be analyzed and transported to a Subtitle D (non-hazardous) landfill. The landfills being considered are lined, monitored, and permitted to accept this soil.

Alternative E2 permanently reduces the toxicity, mobility, and volume of PCBs present in smear zone soil accessible to excavation at the WDR. The soil to groundwater pathway is mitigated under Alternative E2.

Comply with MTCA Cleanup Standards

Alternative E2 will remove PCBs in smear zone soil and is expected to meet the PCULs for saturated soil based on the Method 8082 MDL. The PCULs developed for saturated soil were based on the requirements of MTCA and contaminant-specific state and federal ARARs. The draft site-specific soil cleanup level for saturated soils established by Ecology and based on the Method 8082 MDL exceeds the calculated risk-based concentration that is determined to be protective of groundwater based on MTCA procedures. The draft site-specific soil cleanup levels have been adjusted upward to comply with MTCA requirements when cleanup levels are below MDLs using agency-approved analytical methods.

Comply with Applicable State and Federal Laws

Contaminant-specific ARARs were included in the development of PCULs, and compliance with these ARARs is discussed above. The identified action-specific ARARs for Alternative E2 consist of requirements associated with implementation of the alternative (see Appendix B). Meeting the substantive requirements of grading permits, for example, would be required for excavation work, and the management of excavated contaminated soil would be governed by state waste regulations. Location-specific ARARs consist of potential restrictions related to construction near the shoreline of the Spokane River. These ARARS are judged to be attainable and do not significantly affect the alternative selection process.

Summary of the Threshold Requirements

Alternative E2 is judged to meet the threshold requirements for smear zone soil at the WDR as established by WAC 173-340-360(2).

4.2.2 Other Requirements

Use of Permanent Solutions to the Maximum Extent Practicable

Protectiveness. As discussed above, the excavation and off-site disposal of the PCB-impacted material from the smear zone soil AOC is protective of human health and the environment because the PCBs are removed and the soil to groundwater pathway is eliminated.

Permanence. There is a medium degree of permanence with this Alternative because it will significantly reduce the volume and quantity PCBs in smear zone soil in the WDR but will not destroy them. A permitted lined landfill provides more protection for human health and the environment than leaving the soil on site. There is high certainty that the alternative will be successful but it relies on PCB disposal in a lined, monitored facility rather than PCB destruction.

Cost. The NPV of the incremental costs implementing Alternative E2 over 3 years is estimated (-35 to +50 percent) to be $487,000. The assumptions used to prepare this estimate are described in Section 3.2 and listed in the cost tables contained in Appendix A (refer to Table A-1). The cost of implementing monitoring, institutional controls, and MNA are already accounted for under the preferred alternative in the site-wide FS (Hart Crowser 2011).

Effectiveness over the Long Term. Alternative E2 will remove PCBs in smear zone soil in the AOC within a relatively short (one year) time period. As mentioned above, approximately 1,200 CY of smear zone soil will be excavated and mechanically screened to remove gravel and cobbles on site. The cobble-free excavated soil (approximately 1000 CY, assuming 70 percent of soil volume is smaller than 2 inches) will be analyzed and transported to a Subtitle D landfill. These landfills are lined, monitored, and permitted, and risks to the environment and human health are controlled. There is a high degree of certainty that this alternative will be successful and minimal residual risk will remain after the excavation and disposal activities.

Management of Short-Term Risks. Short-term risks associated with the excavation, screening, transport, and off-site treatment processes include worker exposure to contaminants during excavation and mechanical screening. The HASP will be implemented during construction activities to protect on-site workers. Additional human health and environmental risks are associated with the transport of the material from the Facility to the landfill for disposal. Transport containers will be covered and take the appropriate measures to reduce risk to the communities that they travel through. Only properly licensed material haulers will be used. The material greater than 2 inches in diameter will remain on site and is assumed to pose little risk to human health and the environment, since the contamination is in the finer grained material.

Technical and Administrative Implementability. Excavation and disposal activities are conventional activities and can be easily implemented. These activities have been performed at the Kaiser Facility before without using any shoring.

However, slide rail systems, as with any type of excavation, present some implementation risk. The primary concern with using a top-down shoring system is the ability to lower and then raise the system during or after excavation. The ease of lowering and raising the system is a function of the stability of the excavated soils. If soil ravels into the space between the trench box and the excavation, considerable overexcavation at the leading edge of the system may be required to remove raveled soil, or in the worst case, the system may become lodged in the excavation. Given the observed soil conditions during the previous interim removal action, the use of the proposed shoring system is judged to be reasonable, but soil conditions may change with depth, which may increase this risk.

Restoration Time Frame

Excavation and off-site disposal is expected to reduce the mass of PCBs in a short time frame (less than 1 year). The practicability of achieving a shorter restoration time frame is addressed in the comparative analysis of remedial alternatives in Section 5.1.3, which concludes that the restoration time frame for Alternative E2 is considered to be reasonable, as defined by WAC 173-340-360(4). Thus, Alternative E2 is judged to provide a reasonable restoration time frame. However, containment of PCB-impacted soil in a regulated landfill would require long-term monitoring at the landfill.

4.3 Evaluation of Remedial Alternative E3: Institutional Controls, Monitoring, Monitored Natural Attenuation, and In Situ Solidification and Stabilization

Alternative E3 adds ISS to Alternative E1. The purpose of Alternative E3 is to solidify and immobilize the PCBs by pressure grouting cement into the subsurface to minimize the potential for the PCBs to migrate to groundwater.

4.3.1 Threshold Requirements

Protect Human Health and the Environment

Alternative E3 includes the institutional controls, monitoring, and MNA provided by Alternative E1. Alternative E3 reduces the toxicity and mobility of the PCBs in the WDR by solidifying them in place. It is anticipated that the resulting matrix will prevent PCBs from leaching to groundwater at levels that would cause adverse effects to human health and the environment. Because of the soil matrix, it is not practicable to obtain samples representative of *in situ* soil conditions to conduct the appropriate treatability studies.

Comply with MTCA Cleanup Standards

Effective application of Alternative E3 is expected to comply with cleanup standards. However, it may be difficult to confirm that cleanup standards will be met without treatability studies and because it will be hard to collect downgradient confirmation groundwater samples. The uncertainty of being able to comply with the cleanup standard is higher for Alternative E3 than for Alternative E2.

Comply with Applicable State and Federal Laws

Contaminant-specific ARARs were included in the development of PCULs, and compliance with these ARARs is discussed above. The identified action-specific ARARs for Alternative E3 consist of requirements associated with implementation of the alternative (see Appendix B). Location-specific ARARs consist of potential restrictions related to construction near the shoreline of the Spokane River. These ARARS are judged to be attainable and do not significantly affect the alternative selection process.

4.3.2 Other Requirements

Use of Permanent Solutions to the Maximum Extent Practicable

Protectiveness. As discussed above, stabilizing the PCB-impacted material in the smear zone soil AOC is protective to human health and the environment because the PCBs are immobilized and the soil to groundwater pathway is reduced or eliminated. This alternative has some level of uncertainty in its degree of protectiveness because of the inability to conduct pre-construction treatability tests.

Permanence. Alternative E3 provides a permanent reduction in the toxicity and mobility of PCBs in the soil by solidifying them in place. Soil-cement is expected to be durable for a very long time if adequate amounts of cement are used and the material is properly cured.

Cost. The NPV of the incremental costs implementing Alternative E3 over 3 years is estimated (-35 to +50 percent) to be $334,000. The assumptions used to prepare this estimate are described in Section 3.3 above and listed in the cost tables contained in Appendix A (refer to Table A-2). The cost of implementing monitoring, institutional controls, and MNA are already accounted for under the preferred alternative in the site-wide FS (Hart Crowser 2011).

Effectiveness over the Long Term. Alternative E3 is considered a proven technology and to have a high relative degree of long-term effectiveness as described in 173-340-630(3)(e)(iv). However, there is an only a moderate degree of certainty that the smear zone soil will be completely solidified because of the gravel and cobble soil conditions at the WDR. It is also not practical to perform a treatability study on a representative sample to optimize treatment design. The proximity to the river also makes it difficult to conduct groundwater monitoring downgradient of the WDR to assess the effectiveness this alternative in eliminating the soil to groundwater pathway.

Management of Short-Term Risks. Short-term risks associated with worker exposure to contaminants during the stabilization process are minimal and will be mitigated by the implementation of a HASP. Other short-term risks include elevated pH levels in the surrounding groundwater while the concrete is curing. The pH of the river near the WDR will be measured to make sure that the pH is not being affected. Short-term risks may also include a temporary increase in PCBs in the groundwater if the cement displaces contaminants. However, implementation sequencing can be employed, as discussed, to minimize this risk.

Technical and Administrative Implementability. ISS is a demonstrated technology for treating contaminants in place and can be easily implemented. Because of the soil conditions, it is not practicable to complete treatability studies that would be required to optimize treatment design. The assumption of reagent composition and concentrations based on previous literature/study data would decrease the certainty of an effective implementation.

Restoration Time Frame

ISS is expected to immobilize PCBs in a short time frame (less than 1 year). The practicability of achieving a shorter restoration time frame is addressed in the comparative analysis of remedial alternatives in Section 5.1.3, which concludes that the restoration time frame for Alternative E2 is considered to be reasonable, as defined by WAC 173-340-360(4). Thus, Alternative E2 is judged to provide for a reasonable restoration time frame.

5.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Alternatives E1, E2, and E3 are evaluated individually in Sections 4.1 through 4.3 using the evaluation criteria that are established by Ecology (WAC 173-340-360). The comparative analysis presented in this section assesses the relative capability of the alternatives for the treatment of PCBs in the WDR smear zone soil to meet threshold requirements; to use permanent solutions to the maximum extent practicable; and to provide a reasonable restoration time frame. A disproportionate cost analysis is used to determine whether a cleanup action uses permanent solutions to the maximum practicable extent. The disproportionate cost analysis procedure is summarized in Section 2.3.1 of the site-wide FS (Hart Crowser 2011). The outcome of this comparative assessment of alternatives is summarized in Table 1.

5.1 Comparative Analysis of Alternatives Applicable to PCBs

5.1.1 Threshold Requirements

Protect Human Health and the Environment

As discussed above, Alternative E1 is not considered protective of human health and the environment within a reasonable time frame. Both Alternatives E2 and E3 are considered to be protective of human health and the environment since the contaminated soil would be excavated and removed from the site or solidified in place. Increased handling and transport of contaminated soil are required for Alternative E2 relative to other alternatives. There is additional uncertainty in the protectiveness of Alternative E3 because it is not practicable to obtain samples representative of *in situ* soil conditions to be able to conduct the appropriate treatability studies. Alternative E2 is judged to be equally protective as Alternative E3.

Comply with MTCA Cleanup Standards

The PCULs developed for the WDR were based on the requirements of MTCA and contaminant-specific state and federal ARARs. The implementation of Alternative E1 alone will not result in compliance with MTCA cleanup requirements, or with ARARs promulgated by state and federal law for a long time. Both Alternatives E2 and E3 are expected to comply with MTCA cleanup standards. However, it may be difficult to confirm that cleanup standards will be met under Alternative E3 without treatability studies and because it will be hard to collect downgradient confirmation groundwater samples.

Comply with Applicable State and Federal Laws

Contaminant-specific ARARs were included in the development of PCULs, and compliance with these ARARs is discussed above. The identified action-specific ARARs for Alternatives E1, E2, and E3 consist of requirements associated with implementation of the alternatives (see Appendix B). Location-specific ARARs consist of potential restrictions related to construction near the shoreline of the Spokane River. These ARARS are judged to be attainable and do not significantly affect the alternative selection process.

5.1.2 Disproportionate Cost Analysis

Alternatives E2 and E3 meet the threshold requirements established by MTCA. This disproportionate cost analysis assesses whether Alternative E2 or E3 uses permanent solutions to the maximum extent practicable and evaluates whether the costs are disproportionate to the benefits.

Protectiveness

Both Alternatives E2 and E3 are considered to be protective of human health and the environment since the contaminated soil would be excavated and removed from the site or solidified in place. Increased handling and transport of contaminated soil are required for Alternative E2 relative to other alternatives. There is additional uncertainty in the protectiveness of Alternative E3 because it is not practicable to obtain samples representative of *in situ* soil conditions to be able to conduct the appropriate treatability studies. Alternative E2 judged to be equally protective as Alternative E3.

Permanence

Alternative E2 removes PCBs from the site and disposes them in a lined, permitted landfill, which will require long-term monitoring and controls. Alternative E3 solidifies the PCBs in place in a near-permanent soil-cement monolith. Alternative E3 is judged to be more permanent than Alternative E2.

Cost

The incremental NPV cost of implementing Alternative E2 over 3 years is $487,000 (-35 to +50 percent). The incremental NPV cost of implementing Alternative E3 over 3 years is $334,000 (-35 to +50 percent).

Effectiveness over the Long Term

Immobilization or solidification is listed as having a higher degree of long-term effectiveness over off-site disposal in an engineered, lined, and monitored facility in WAC 173-340-360. However, for the site conditions at the WDR, excavation and off-site disposal has a higher degree of certainty that the remedy will be successful because of the difficulties in completing treatability studies for solidification and in monitoring the remedy after implementation to confirm effectiveness. Therefore, Alternative E2 is judged to have a greater effectiveness over the long term.

Management of Short-Term Risks

Alternative E2 poses a risk to human health and the environment because of the handling and transport of contaminated soil. However, these risks are easily mitigated by following a site-specific HASP. Alternative E3 poses a risk to the environment because of the proximity of the river to the AOC. The cement may cause an elevated pH and temporary increases in groundwater PCB concentrations may be observed if the cement displaces contaminants. Alternative E2 is judged to have more manageable short-term risks than Alternative E3.

Technical and Administrative Implementability

Alternative E2 uses conventional technologies that are similar to activities that have been previously performed at the WDR. Trench boxes are a common technology used when shoring is required during excavations; the implementation risks are described in Section 4.2. Although the technologies employed in Alternative E3 are demonstrated and have been used at many sites, it is not practicable to perform the usual treatability studies to optimize design. Comparing the implementability of the two alternatives, Alternative E2 is judged to be more implementable than Alternative E3.

Summary of Disproportionate Cost Analysis

Alternatives E2 and E3 both meet the threshold requirements established by WAC 173-340-360(2)(a). They each will provide physical and administrative controls and BMPs that will be used to reduce the potential for Facility worker and visitor exposure to PCBs and reduce the potential for PCBs in smear zone soil to migrate to groundwater.

Although Alternative E3 provides a greater degree of permanence, Alternative E2 provides greater certainty that the remedy will be successful for the specific site conditions of the AOC, including the proximity of the river and the high percentage of cobbles in site soil.

5.1.3 Restoration Time Frame

Remedial alternatives must provide for a reasonable restoration time frame per WAC 173-340-360(2)(b)(ii). A reduction in risk to human health and the environment is not expected to occur within a reasonable restoration time frame for Alternative E1. The construction activities for both Alternatives E2 and E3 are expected to be completed within a short time frame (less than 1 year).

6.0 PREFERRED ALTERNATIVE

Alternative E2 - Institutional Controls, Monitoring, Monitored Natural Attenuation, and Contaminated Soil Excavation with Off-Site Disposal, was selected as the preferred alternative to address the PCB contamination in the smear zone soil at the WDR. The ability of Alternative E2 to meet threshold requirements is discussed above in Section 4.2 and a comparison of the various alternatives based on threshold and other criteria is presented in Section 5.1. Alternative E2 has been judged to be protective of human health and the environment, compliant with MTCA cleanup standards, compliant with state and federal laws, to use permanent solutions to the maximum extent practicable, and to provide a reasonable restoration time frame. Public concerns will be considered during the public comment period for this FFS.

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Table 1 - Summary of Detailed Analysis of Alternatives Applicable to PCBs in the Smear Zone Soil at the West Discharge Ravine

	Criteria	Alternative E1 Institutional Controls, Monitoring, and MNA	Alternative E2 Alternative E1 Plus Excavation and Off-Site Disposal	Alternative E3 Alternative E1 Plus *In Situ* Solidification and Stabilization
Threshold Requirements	Overall Protection of Human Health and the Environment	The human direct contact and ingestion pathways to Facility workers and visitors is mitigated through implementation of institutional controls and because the PCBs in the smear zone soil are overlain with clean fill. Alternative E1 does not address the soil to groundwater pathway that could potentially transfer PCBs to receptors in the Spokane River. Because of the proximity of the river, any natural attenuation that may be occurring will not reduce the risk in a reasonable time frame. Based on this information, Alternative E1 is not considered protective of human health and the environment within a reasonable time frame.	Alternative E2 includes the institutional controls, monitoring, and MNA provided by Alternative E1. Alternative E2 permanently reduces the toxicity, mobility, and volume of PCBs present in smear zone soil accessible to excavation at the WDR. Excavated material will be disposed of at a permitted off-site landfill facility. The soil to groundwater pathway is mitigated by Alternative E2. Alternative E2 is equally protective as Alternative E3 but more protective than Alternative E1.	Alternative E3 includes the institutional controls, monitoring, and MNA provided by Alternative E1. Alternative E3 reduces the toxicity and mobility of the PCBs in the WDR by solidifying them in place. The soil to groundwater pathway is reduced by Alternative E3. Alternative E3 is judged to be equally protective as E2 and more protective than Alternative E1.
	Comply with Cleanup Standards	The concentration of PCBs in the WDR will remain above PCULs for a long time. The implementation of Alternative E1 will not result in compliance with MTCA cleanup standards within a reasonable time frame.	Since Alternative E2 would remove PCBs and contain them in an off-site landfill, this alternative directly meets the PCULs that have been established for PCBs at the Kaiser Facility.	Effective application of Alternative E3 is expected to comply with cleanup standards. However, it may be difficult to confirm that cleanup standards will be meet without treatability studies and because it will be hard to collect downgradient confirmation groundwater samples.
	Comply with Applicable State and Federal Law	Contaminant-specific ARARs were included in the development of PCULs, and compliance with these ARARs is discussed above. Location-specific and action-specific ARARs were not identified for Alternative E1 .	Contaminant-specific ARARs were included in the development of PCULs, and compliance with these ARARs is discussed above. The identified action-specific ARARs for Alternative E2 consist of requirements associated with implementation of the alternative (see Appendix B). Location-specific ARARs consist of potential restrictions related to construction near the shoreline of the Spokane River. These ARARS are judged to be attainable and do not significantly affect the alternative selection process.	Contaminant-specific ARARs were included in the development of PCULs, and compliance with these ARARs is discussed above. The identified action-specific ARARs for Alternative E3 consist of requirements associated with implementation of the alternative (see Appendix B). Location-specific ARARs consist of potential restrictions related to construction near the shoreline of the Spokane River. These ARARS are judged to be attainable and do not affect the alternative selection process.
	Provide for Compliance Monitoring	Alternative E1 provides for compliance monitoring as per WAC 173-340-410 and WAC 173-340-720 through WAC 173-340-760.	Alternative E2 provides for compliance monitoring as per WAC 173-340-410 and WAC 173-340-720 through WAC 173-340-760.	Alternative E3 provides for compliance monitoring as per WAC 173-340-410 and WAC 173-340-720 through WAC 173-340-760.
Disproportionate Cost Analysis	Protectiveness	See "Overall Protection of Human Health and the Environment" above.	See "Overall Protection of Human Health and the Environment" above.	See "Overall Protection of Human Health and the Environment" above.
	Permanence	Institutional controls and BMPs in place at Kaiser help to prevent the release of PCBs into the environment. Existing clean fill also prevents direct contact with PCBs in smear zone soil. Alternative E1 does not significantly reduce the toxicity, mobility, or volume of PCBs present in WDR. Less permanent than Alternatives E2 and E3.	Alternative E2 permanently reduces the mass of PCBs in smear zone soil at the WDR. A permitted lined landfill provides more protection for human health and the environment than leaving the soil on site. BMPs will reduce the release of hazardous substances to the environment. Provides a greater degree of permanence than Alternative E1 but is less permanent than Alternative E3.	Alternative E3 reduces the toxicity and mobility of PCBs in the soil by solidifying them in place. The process of stabilization is irreversible. Provides a greater degree of permanence than Alternatives E1 and E2.
	Effectiveness over the Long Term	The institutional controls, monitoring, and MNA employed by this alternative are currently in use at the Kaiser Facility. Does not reduce the concentration of PCBs in WDR to below PCULs. These soils will continue to pose potential risks to human health and the environment. Much less effective over the long term than Alternatives E2 and E3.	Alternative E2 removes PCBs from the WDR via excavation. There is a high degree of certainty that this alternative will be successful. The excavated soil would be disposed of in an off-site permitted lined landfill. There is minimal residual risk after the completion of the excavation and disposal activities. Alternatives E2 is judged to have more long-term effectiveness than Alternative E1 and E3.	Alternative E3 is considered to have a high relative degree of long term effectiveness as described in 173-340-630(3)(e)(iv). However, there is an only a moderate degree of certainty that the smear zone soil will be completely solidified because of the soil conditions at the WDR. It is also not practical to perform a treatability study on a representative sample to optimize treatment design. The proximity to the river makes it difficult to conduct monitoring downgradient to assess the effectiveness. Alternative E3 is judged to be more effective over the long term than Alternative E1 but less effective over the long term than Alternative E2.

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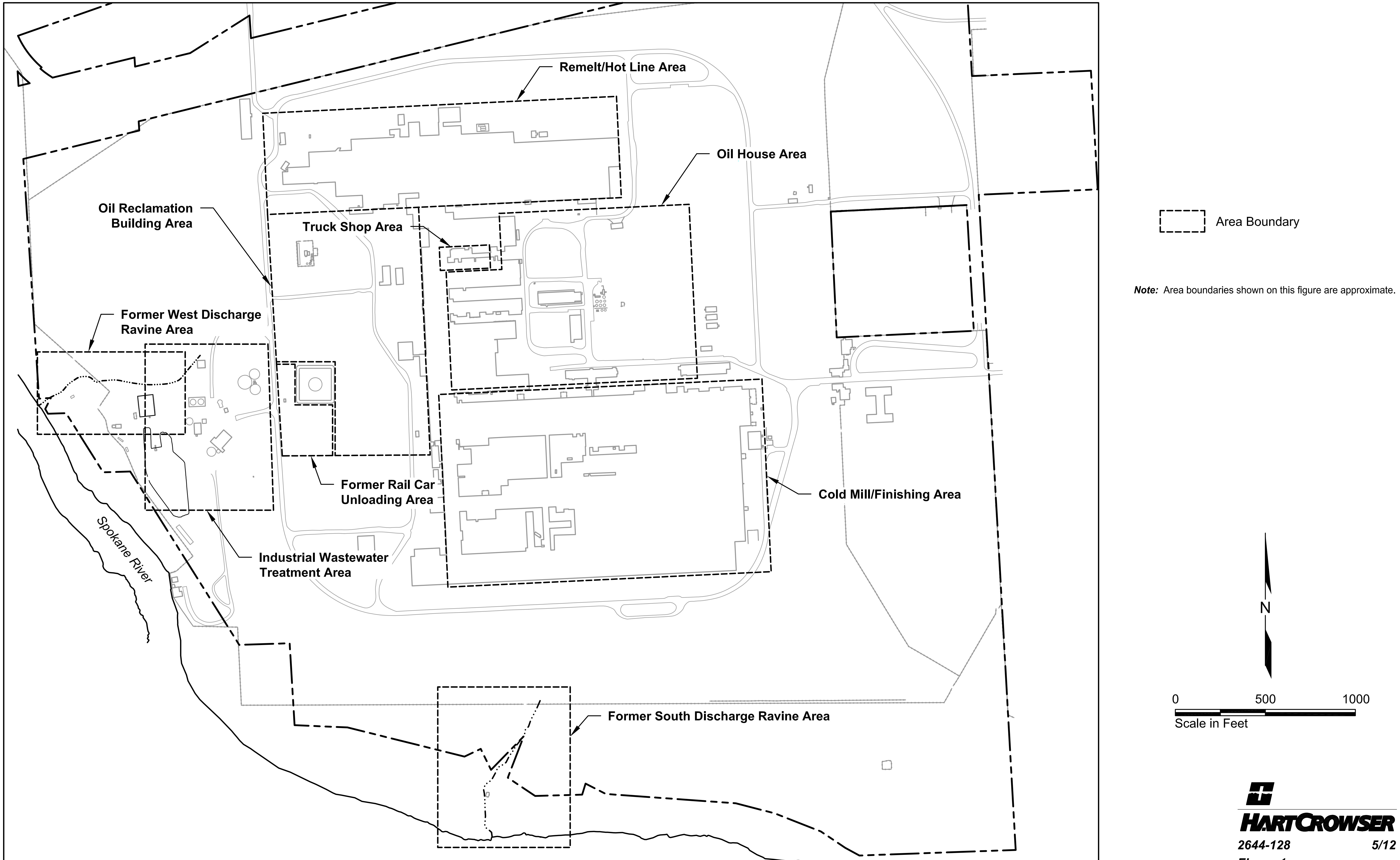
Table 1 - Summary of Detailed Analysis of Alternatives Applicable to PCBs in the Smear Zone Soil at the West Discharge Ravine

	Criteria	Alternative E1 Institutional Controls, Monitoring, and MNA	Alternative E2 Alternative E1 Plus Excavation and Off-Site Disposal	Alternative E3 Alternative E1 Plus *In Situ* Solidification and Stabilization
Disproportionate Cost Analysis	Management of Short-Term Risks	Alternative E1 uses existing procedures to implement institutional controls, BMPs, and groundwater monitoring, and does not create any new or additional risk to human health and the environment. Alternative E1 poses fewer short-term risks than Alternatives E2 and E3.	Short-term risks to construction workers during excavation and installation of the containment surfaces will be mitigated by adherence to the HASP. Alternative E2 results in additional short-term risks in the transportation of PCB-contaminated soil to an off-site landfill. Additional short-term risks are associated with handling the waste material at the landfill. These risks would be mitigated by adherence to the health and safety procedures that the transportation and landfill contractors would implement as part of their operations. Short-term risks for Alternative E2 are judged to be more manageable than for Alternative E3, but less manageable than those associated with Alternative E1.	Short-term risks associated with worker exposure to contaminants during the stabilization process are minimal and will be mitigated by the implementation of a HASP. Other short-term risks include elevated pH levels in the surrounding groundwater while the concrete is curing. The pH of the river near the WDR will be measured to make sure that the pH is not being affected. Short-term risks may also include a temporary increase in PCBs in the groundwater if the cement displaces contaminants. Short-term risks are judged to be less manageable for Alternative E3 than for Alternatives E1 and E2.
Disproportionate Cost Analysis	Technical and Administrative Implementability	Alternative E1 includes BMPs, groundwater monitoring, and institutional controls, which are already in place at the Kaiser Facility. While there is indication that the natural attenuation of PCBs is occurring (refer to Appendix F in the site-wide FS), evidence to support this assertion is being evaluated. Alternative E1 is more implementable than Alternatives E2 and E3.	Excavation and disposal activities are conventional activities and can be easily implemented. These activities have been performed at the Kaiser Facility previously without the use of trench boxes. Trench boxes are the most common type of shoring and are easily implemented. Large cobbles or boulders near the edges of the excavation still pose a risk. In the event that cobble or boulders ravel into the space between the box and the excavation, it may require either considerable overexcavation at the leading edge of the system to remove raveled material, or in the worst case, the slide-rail system may become lodged in the excavation. Given the observed soil conditions during the previous interim removal action, the use of the proposed shoring system is expected to be feasible. Alternative E2 is more implementable than Alternative E3, but less implementable than Alternative E1.	ISS is a demonstrated technology for treating contaminants in place and can be easily physically implemented. Because of the soil conditions, it is not practicable to complete treatability studies that would be required to optimize treatment design. Alternative E3 is less implementable than Alternatives E1 and E2.
Disproportionate Cost Analysis	Consideration of Public Concerns	This criterion will be addressed during the public comment period for the FFS.	This criterion will be addressed during the public comment period for the FFS.	This criterion will be addressed during the public comment period for the FFS.
Disproportionate Cost Analysis	Conceptual-Level Cost (NPV -35/+50 percent)	Already accounted for in site-wide FS (Hart Crowser 2011)	$487,000	$334,000
	Restoration Time Frame	Alternative E1 does not reduce the concentration of PCBs in smear zone soil to below PCULs and does not address the soil to groundwater pathway. The restoration time frame for Alternative E1 is judged unreasonable.	The excavation and transportation aspects of Alternative E2 are expected be completed in a short time frame (less than 1 year). This time frame is judged to be reasonable per the requirements in WAC 173-340-360(4). However, containment of PCB-impacted soil in a regulated landfill would require long-term monitoring at the landfill.	ISS is expected to immobilize PCBs in a short time frame (less than 1 year). This time frame is judged to be reasonable per the requirements in WAC 173-340-360(4).

Kaiser Facility Map



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2644-128 5/12

Figure 1

EAL 05/7/12 2644128-003.DWG

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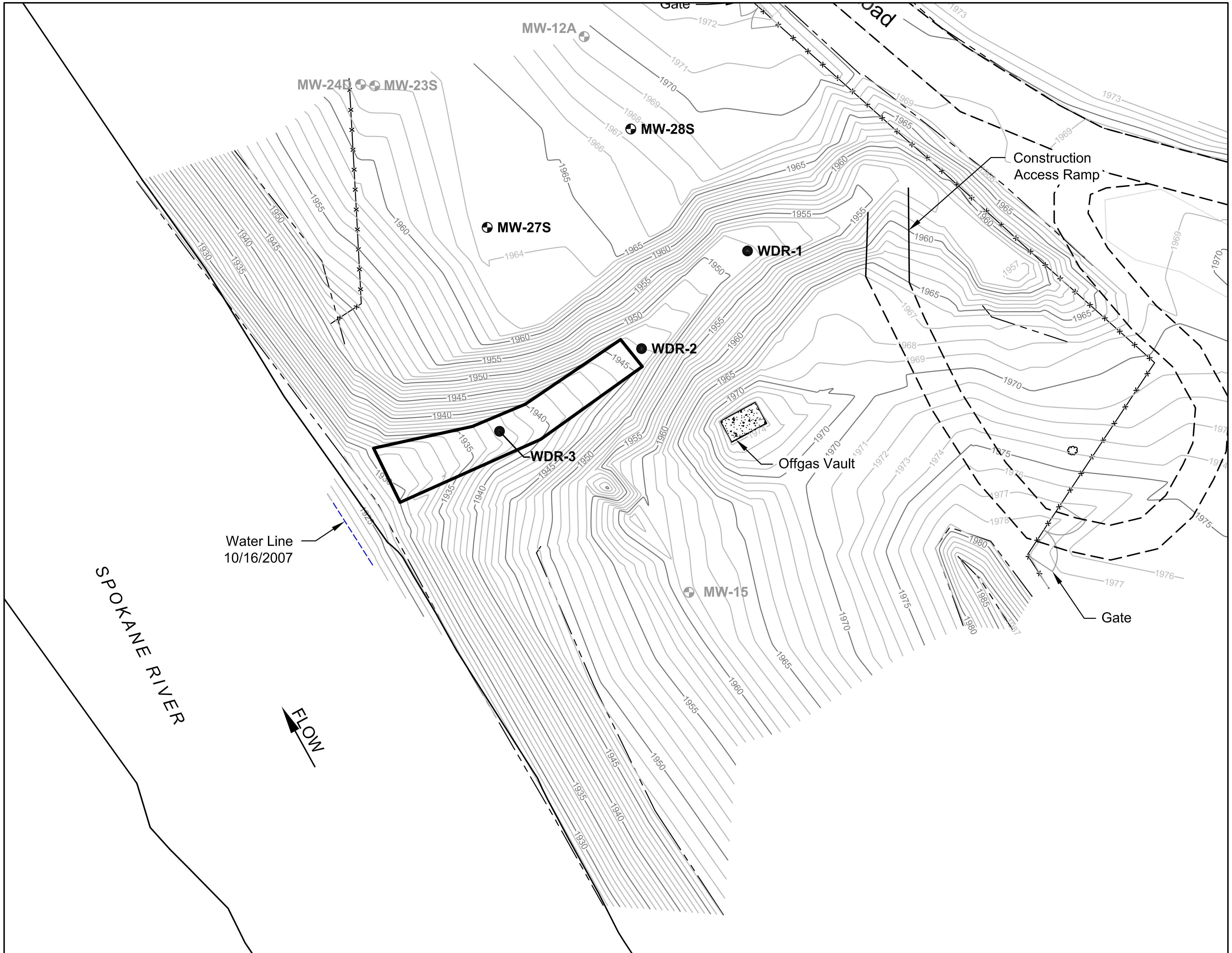
Former WDR Vicinity Plan and PCB AOC



Exploration Location and Number

MW-27S — Monitoring Well

WDR-1 — Soil Boring

Smear Zone PCB AOC

Notes:
1. Vertical datum is 1988 North American Vertical Datum (NAVD88).
2. Topography labels adjusted based on 2011 survey data. Contours not necessarily representative of actual topography.

N

0 50 100

Scale in Feet

EAL 05/9/12 2644128-004.DWG

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2644-128 ***5/12***

Figure 2

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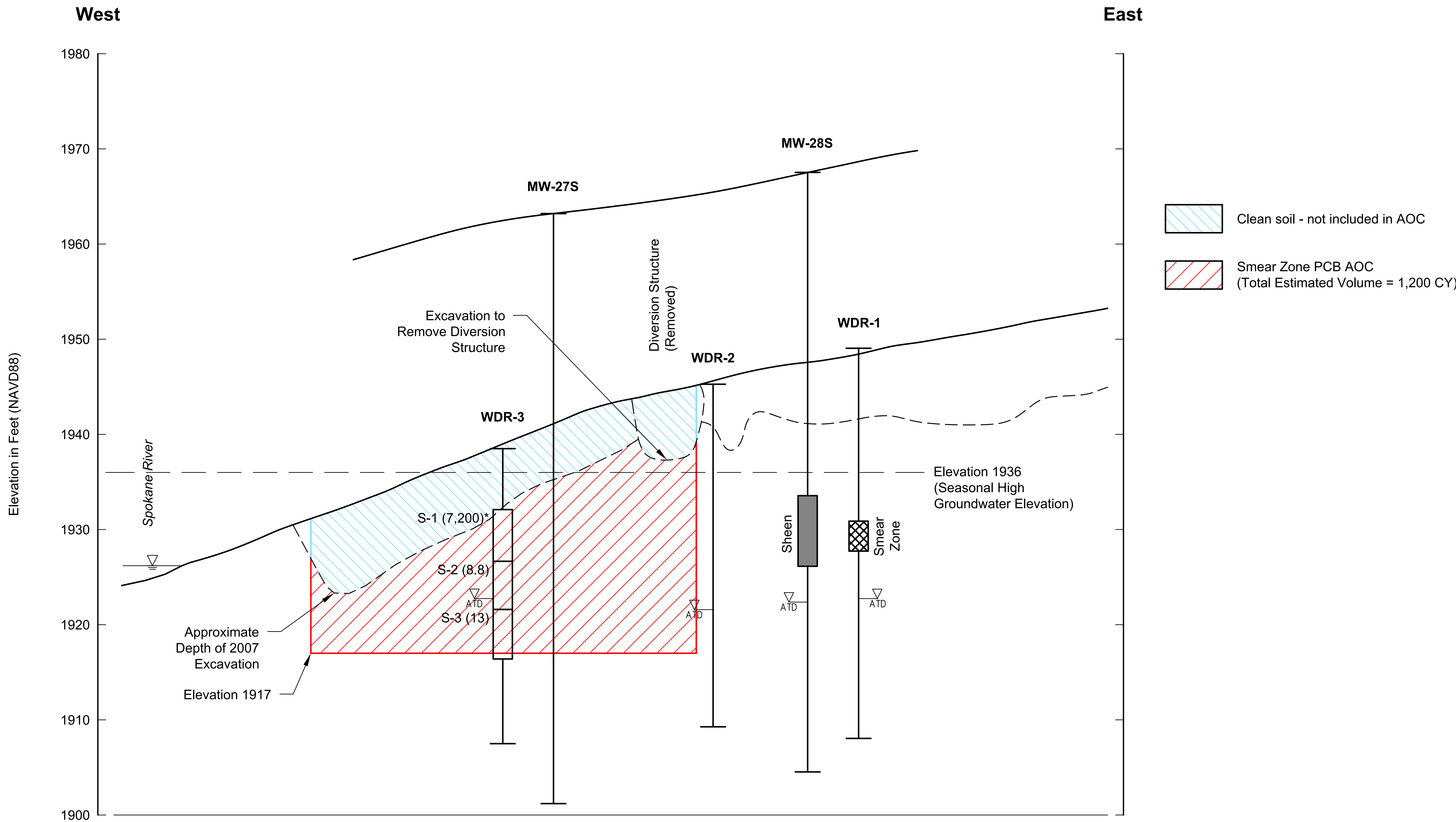
Vertical Extent of AOC



*7,200 ug/kg Total PCB, EPA Method 8082

JAB 05/11/12 2644128-005.DWG

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Figure 3

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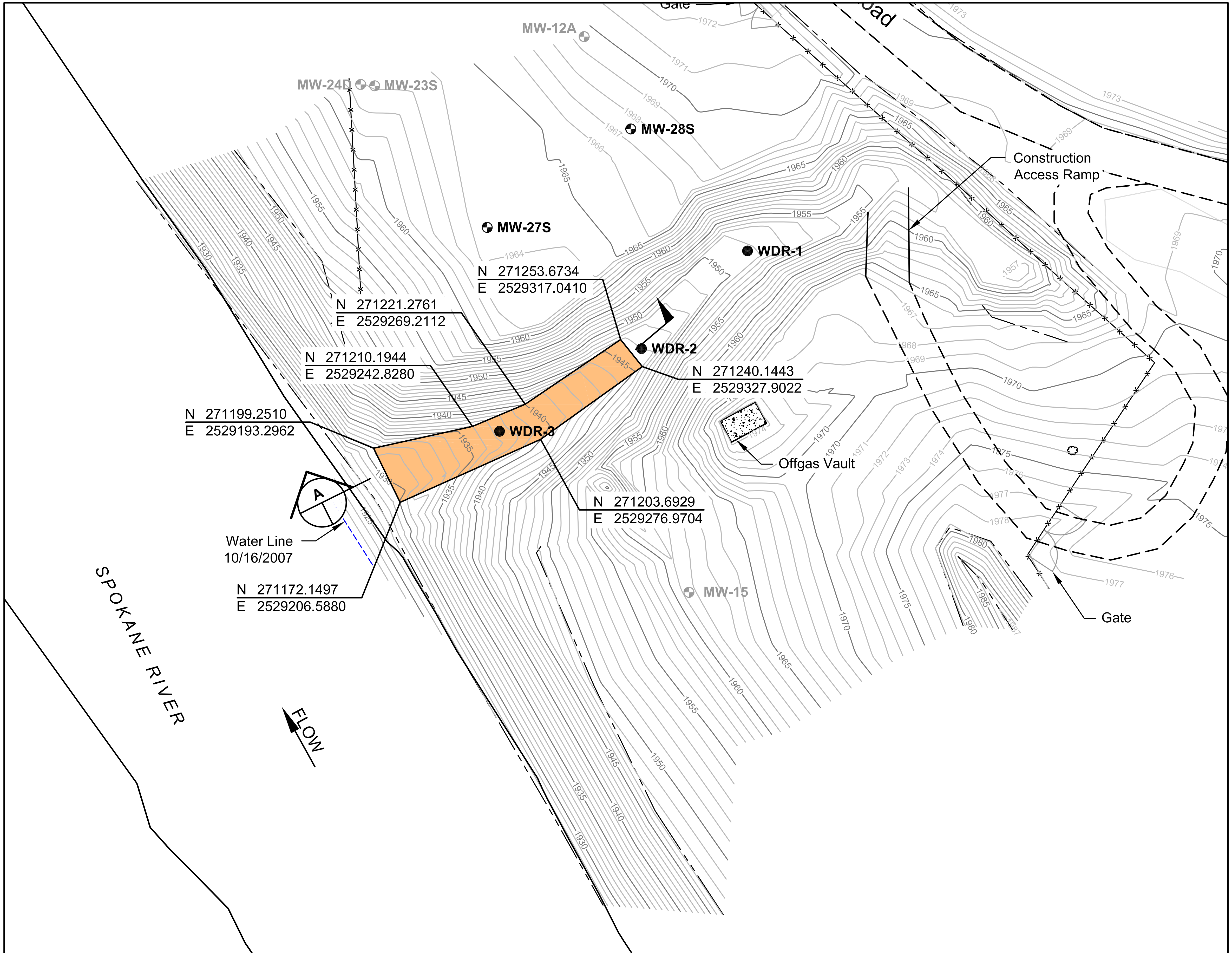
Alternative E2 - Proposed Excavation Plan



Supplemental Remedial Investigation Exploration Location and Number

MW-27S ⊕ Monitoring Well

WDR-1 ● Soil Boring

Extent of Proposed Excavation

N 271172.1497
E 2529206.5880 Corner of Proposed Excavation Coordinate

Notes:

1. Vertical datum is 1988 North American Vertical Datum (NAVD88).
2. Topography labels adjusted based on 2011 survey data. Contours not necessarily representative of actual topography.

N

0 50 100
Scale in Feet

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Figure 4

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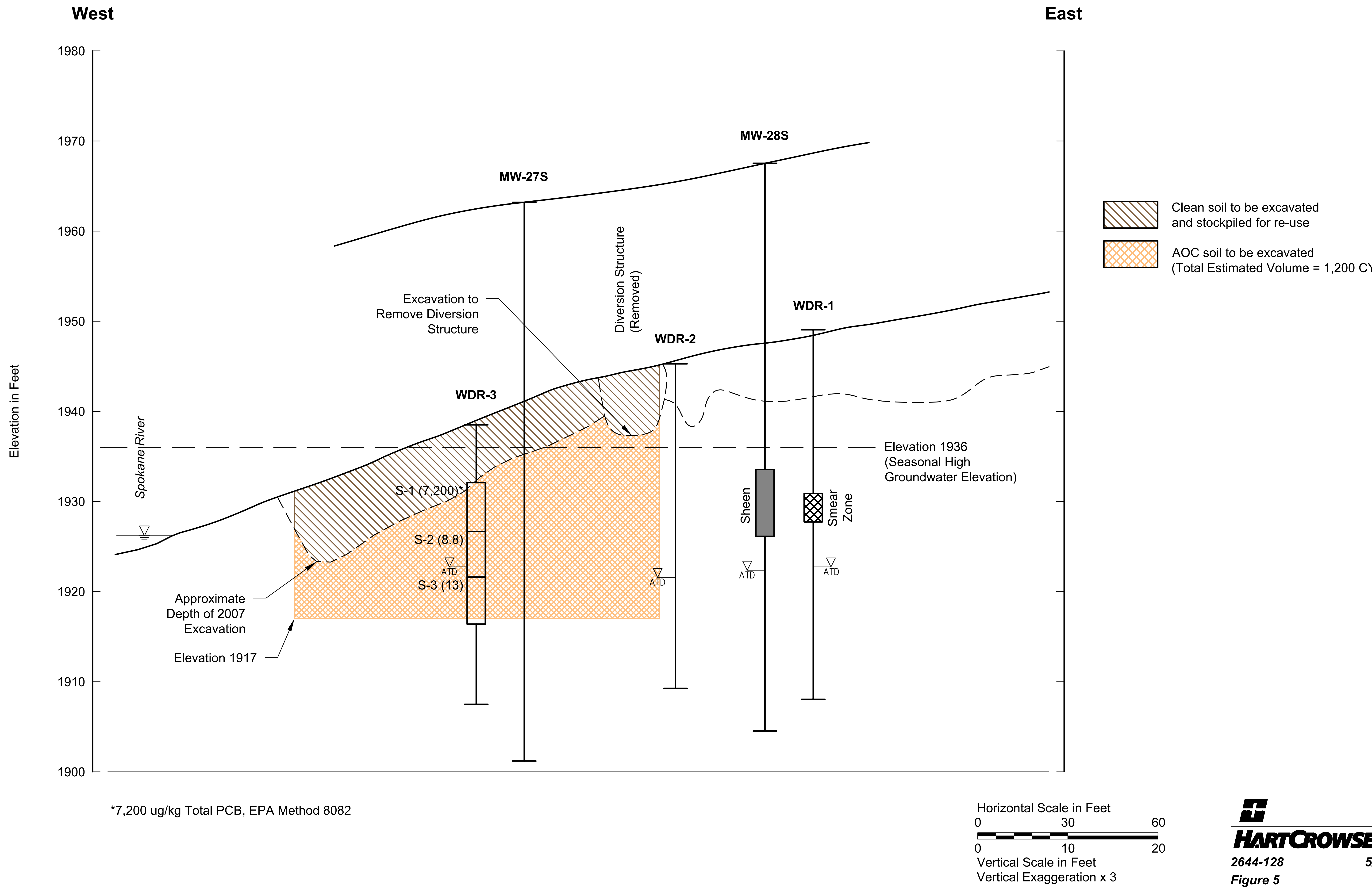
Alternative E2 - Proposed Excavation Section



*7,200 ug/kg Total PCB, EPA Method 8082

JAB 05/11/12 2644128-002.DWG

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2644-128 **5/12**

Figure 5

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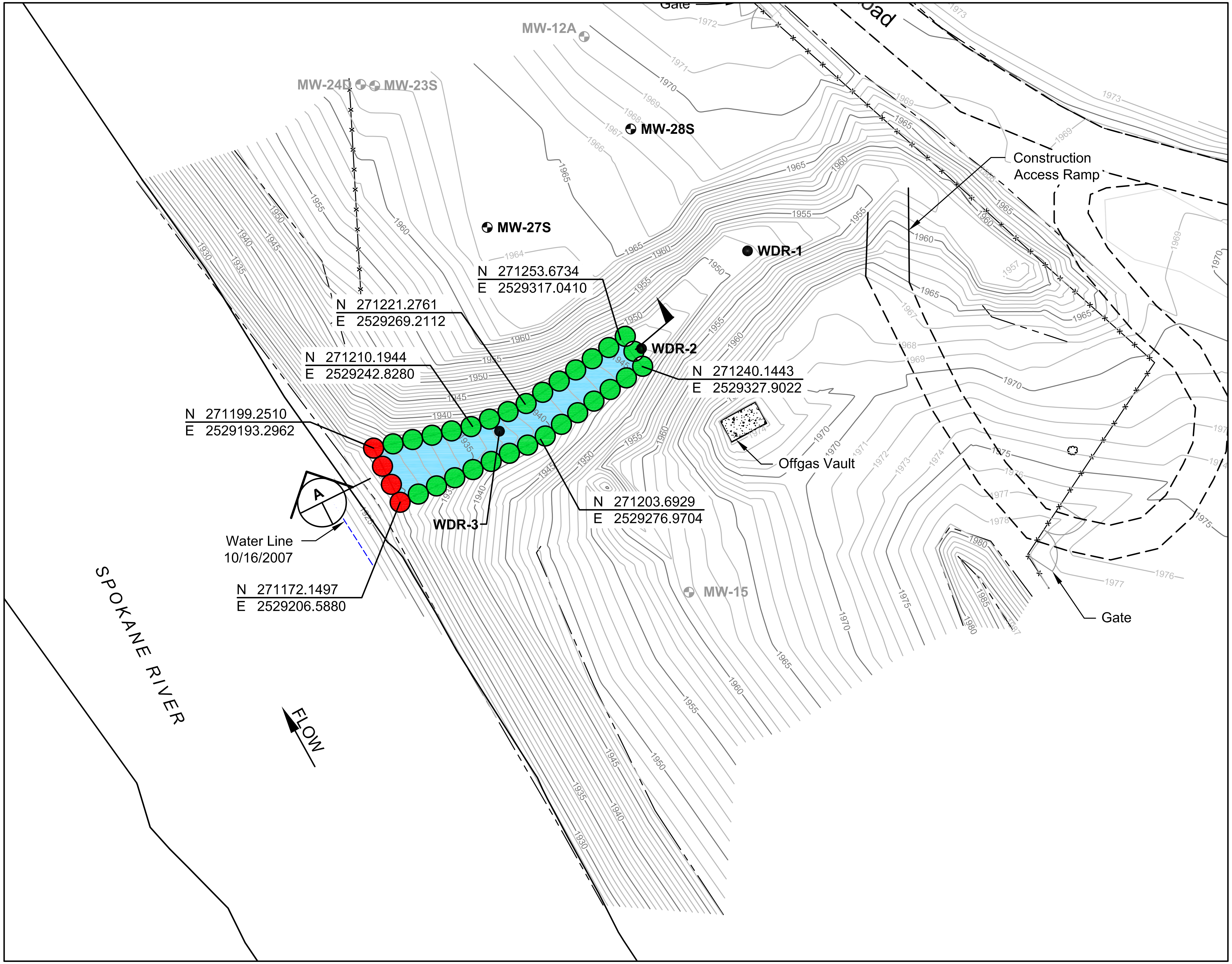
Alternative E3 - Proposed ISS Plan



Supplemental Remedial Investigation Exploration Location and Number

MW-27S ⊕ Monitoring Well

WDR-1 ● Soil Boring

N 271172.1497 / E 2529206.5880 — Corner of Proposed Excavation Coordinate

10-Foot Soil Column (First Application)

10-Foot Soil Column (Second Application)

In-Fill Injection Area (Third Application)

Notes:

1. Contractor shall allow 48-hour cure time between applications.
2. Vertical datum is 1988 North American Vertical Datum (NAVD88).
3. Topography labels adjusted based on 2011 survey data. Contours not necessarily representative of actual topography.

N

0 50 100

Scale in Feet

EAL 05/10/12 2644128-006.DWG

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2644-128 ***5/12***

Figure 6

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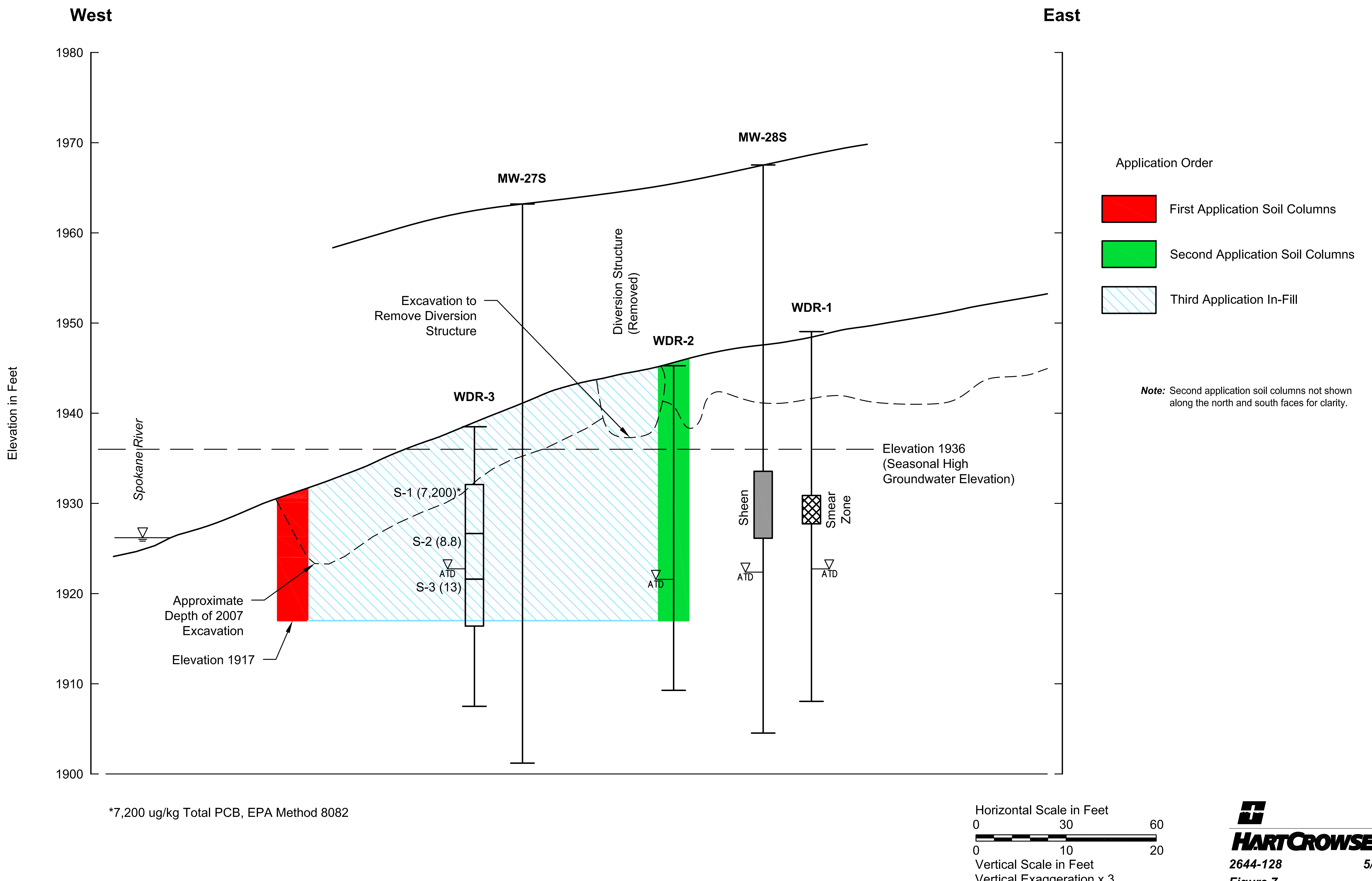
Alternative E3 - Proposed ISS Section



*7,200 ug/kg Total PCB, EPA Method 8082

EAL 05/7/12 2644128-007.DWG

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2644-128 5/12
Figure 7

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APPENDIX A
COST ESTIMATES FOR REMEDIAL ALTERNATIVES

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Table A-1 - Alternative E2 Estimated Cost Summary

Location:	Kaiser Trentwood Facility
	Spokane Valley, WA
Phase:	Feasibility Study (-35% to +50%)
Base Year:	2012
Date:	May 2012

Description: Soil excavation and *off-site* disposal. The cost elements presented below are in addition to those for Alternative E1. Capital cost elements unique to Alternative E2 are expected to be completed in one year. Alternative E2 assumes an operating period of 3 years following contruction in the development of this cost estimate. Refer to Table A-3 ***Excavation and Screening Cost Backup*** for details.

CAPITAL COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Soil Excavation and Screening					
Mobilization/demobilization	1	LS	$ 32,791	$ 32,791	Previous project experience.
Permits	1	LS	$ 5,000	$ 5,000	Previous project experience. SEPA checklist, etc.
Excavation, loading	2,230	BCY	$ 13	$ 29,945	2 CY backhoe, 2010 RSMeans 31 23 16.16 6060. 15% surcharge for loading trucks, 2010 RSMeans 31 23 16.16 9024. Local adjustment factor for Spokane, WA, applied (2010 RSMeans p. 696). Unit cost adjusted to 2012 basis.
Shoring system	1	LS	$ 105,143	$ 105,143	Slide-rail shoring system. Engineer's estimate.
Hauling, screening, stockpiling	1,652	ton	$ 7.49	$ 12,379	Cost for previous work provided by Kaiser. Adjusted from 2009 to 2012 basis (2012 RSMeans).
Acquire, transport, place imported backfill	1,357	LCY	$ 22	$ 29,576	Clean structural fill. Cost for previous work provided by Kaiser.
Load, transport, place overburden as backfill	1,208	LCY	$ 6.44	$ 7,775	Clean overburden. F.E. loader, 2010 RSMeans 31 23 23.15 4070. Off-road truck, 2010 RSMeans 31 23 23.20 5130. Dozer, 2010 RSMeans 31 23 23.17 0020. Local adjustment factor for Spokane, WA, applied (2010 RSMeans p.696). Unit cost adjusted to 2012 basis.
Site revegetation	1	LS	$ 7,994	$ 7,994	Hydroseeding and planting. Previous project experience. See Table A-4.
Soil Excavation and Screening Subtotal				**$ 230,604**	
Off-Site Disposal					
Transport & dispose of soil at Subtitle D landfill	1,156	ton	$ 54	$ 62,208	Cost for previous work provided by Kaiser. Adjusted from 2007 to 2012 basis (2012 RSMeans).
Transport & dispose of soil at Subtitle C landfill	0	ton	$ 172	$ -	
Off-Site Disposal Subtotal				**$ 62,208**	
Monitoring, Sampling, Testing, and Analysis (for components not included in Alt. E1)					
Excavation monitoring and sampling	8.9	wk	$ 5,843	$ 52,120	1 FTE for duration of excavation (refer to Table A-3). Includes construction observation, confirmation soil sample collection, dust monitoring.
Analysis of confirmation samples	1	LS	$ 13,085	$ 13,085	Wall and floor samples (analytical costs, equipment, shipping). See Table A-3.
Stockpile & screening area sampling & analysis	1	LS	$ 4,461	$ 4,461	Stockpile characterization. Visual inspections of screen/sampling under tears. See Table A-6.
Monitoring, Sampling, Testing, and Analysis Subtotal				**$ 69,665**	
Contingency	10%	--	--	**$ 36,248**	Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					Percentage of sum of capital cost and contingency.
Project management	5%	--	--	$ 19,936	EPA 540-R-00-002. Includes reports referenced in WAC 173-340-400(6)(b).
Remedial design	8%	--	--	$ 31,898	EPA 540-R-00-002.
Construction management	6%	--	--	$ 23,923	EPA 540-R-00-002. Includes reports referenced in WAC 173-340-400(6)(b).
Ecology oversight	1	LS	$ 2,200	$ 2,200	Assume 10% of FS Alt. A1 Ecology oversight cost.
Professional/Technical Services Subtotal				**$ 77,958**	
TOTAL CAPITAL COST				**$ 476,682**	

ANNUAL O&M COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Natural Restoration Monitoring					
Site monitoring	1	LS	$ 1,409	$ 1,409	One day per year. Assume three years total.
Reporting	1	LS	$ 2,428	$ 2,428	One annual report. Assume three years total.
Natural Restoration Monitoring Subtotal				$ 3,837	
TOTAL ANNUAL O&M COST				**$ 3,837**	

PERIODIC COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
TOTAL PERIODIC COSTS				**$ -**	No periodic costs for elements unique to Alternative E2.

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Table A-1 - Alternative E2 Estimated Cost Summary

Location:	Kaiser Trentwood Facility Spokane Valley, WA	**Description:** Soil excavation and *off-site* disposal. The cost elements presented below are in addition to those for Alternative E1. Capital cost elements unique to Alternative E2 are expected to be completed in one year. Alternative E2 assumes an operating period of 3 years following contruction in the development of this cost estimate. Refer to Table A-3 ***Excavation and Screening Cost Backup*** for details.
Phase:	Feasibility Study (-35% to +50%)	
Base Year:	2012	
Date:	May 2012	

PRESENT VALUE ANALYSIS

Discount rate 7.0%
Total years 3

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR	NET PRESENT VALUE	NOTES
Capital	0	$ 476,682	$ 476,682	1.000	$ 476,682	
Annual O&M	1 - 3	$ 11,510	$ 3,837	2.624	$ 10,068	
Periodic	5	$ -	$ -	0.713	$ -	No periodic costs for elements unique to Alternative E2.
		$ 488,192			$ 486,751	Net present value of elements unique to Alternative E2.
Total Net Present Value of Alternative E2 (2012 dollars)					**$ 486,751**	

Notes:
Costs taken from RSMeans have been adjusted by Spokane location adjustment factor of 0.93.
Costs from previous work greater than 1 year old have been adjusted using historical cost index factors provided in 2012 RSMeans.
Present value analysis uses a 30-year discount rate of 7.0%.

Table A-2 - Alternative E3 Estimated Cost Summary

Location:	Kaiser Trentwood Facility Spokane Valley, WA	**Description:** *In situ* soil solidification and stabilization. The cost elements presented below are in addition to those for Alternative E1. Capital cost elements unique to Alternative E3 are expected to be completed in one year. Alternative E3 assumes an operating period of 3 years following contruction in the development of this cost estimate. Refer to Table A-5 ISS ***In Situ Solidfication and Stabilization Cost Backup*** details.
Phase:	Feasibility Study (-35% to +50%)	
Base Year:	2012	
Date:	May 2012	

CAPITAL COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Pressure Grouting					
Mobilization/demobilization	1	LS	$ 7,791	$ 7,791	Previous project experience.
Permits	1	LS	$ 5,000	$ 5,000	Previous project experience. SEPA checklist, etc.
Pressure grouting labor & equipment	1	LS	$ 114,886	$ 114,886	Includes batch plant, drilling, injection. Local adjustment factor for Spokane, WA, applied (2010 RSMeans p. 696). Unit cost adjusted to 2012 basis. See Table A-5.
Pressure grouting cement	1	LS	$ 27,852	$ 27,852	Portland cement, type III, high early stength. 2010 RSMeans 03 05 13.30 0400 and R033105-20. Local adjustment factor for Spokane, WA, applied (2010 RSMeans p. 696). Unit cost adjusted to 2012 basis. See Table A-5.
Pressure Grouting Subtotal				**$ 155,529**	
Surface Soil Replacement					
Mobilization/demobilization	1	LS	$ 7,791	$ 7,791	Previous project experience.
Excavation, loading	210	BCY	$ 13	$ 2,820	2 CY backhoe, 2010 RSMeans 31 23 16.16 6060. 15% surcharge for loading trucks, 2010 RSMeans 31 23 16.16 9024. Local adjustment factor for Spokane, WA, applied (2010 RSMeans p. 696). Unit cost adjusted to 2012 basis.
Hauling, stockpiling	294	ton	$ 4.45	$ 1,309	Cost for previous work provided by Kaiser. Adjusted from 2009 to 2012 basis (2012 RSMeans).
Acquire, transport, place imported backfill	242	LCY	$ 22	$ 5,263	Clean structural fill. Cost for previous work provided by Kaiser.
Site revegetation	1	LS	$ 7,994	$ 7,994	Hydroseeding and planting. Previous project experience. See Table A-4.
Surface Soil Replacement Subtotal				**$ 25,178**	
Off-Site Disposal					
Transport & dispose of soil at Subtitle D landfill	294	ton	$ 54	$ 15,816	Cost for previous work provided by Kaiser. Adjusted from 2007 to 2012 basis (2012 RSMeans).
Transport & dispose of soil at Subtitle C landfill	0	ton	$ 172	$ -	
Off-Site Disposal Subtotal				**$ 15,816**	
Monitoring, Sampling, Testing, and Analysis (for components not included in Alt. E1)					
On-site construction monitoring	3.7	wk	$ 5,843	$ 21,619	1 FTE for duration of construction work (refer to Table A-3). Includes construction observation, stockpile sample collection, dust monitoring.
Stockpile sample analysis	1	LS	$ 1,487	$ 1,487	Stockpile characterization. See Table A-6.
Monitoring, Sampling, Testing, and Analysis Subtotal				**$ 23,106**	
Contingency	10%	--	--	**$ 21,963**	Scope and bid contingency. Percentage of capital costs.
Professional/Technical Services					Percentage of sum of capital cost and contingency.
Project management	8%	--	--	$ 19,327	EPA 540-R-00-002. Includes reports referenced in WAC 173-340-400(6)(b).
Remedial design	15%	--	--	$ 36,239	EPA 540-R-00-002.
Construction management	10%	--	--	$ 24,159	EPA 540-R-00-002. Includes reports referenced in WAC 173-340-400(6)(b).
Ecology oversight	1	LS	$ 2,200	$ 2,200	Assume 10% of FS Alt. A1 Ecology oversight cost.
Professional/Technical Services Subtotal				**$ 81,925**	
TOTAL CAPITAL COST				**$ 323,516**	

ANNUAL O&M COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
Natural Restoration Monitoring					
Site monitoring	1	LS	$ 1,409	$ 1,409	One day per year. Assume three years total.
Reporting	1	LS	$ 2,428	$ 2,428	One annual report. Assume three years total.
Natural Restoration Monitoring Subtotal				$ 3,837	
TOTAL ANNUAL O&M COST				**$ 3,837**	

PERIODIC COSTS

DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL	NOTES
TOTAL PERIODIC COSTS				**$ -**	No periodic costs for elements unique to Alternative E3.

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Table A-2 - Alternative E3 Estimated Cost Summary

Location:	Kaiser Trentwood Facility Spokane Valley, WA
Phase:	Feasibility Study (-35% to +50%)
Base Year:	2012
Date:	May 2012

Description: *In situ* soil solidification and stabilization. The cost elements presented below are in addition to those for Alternative E1. Capital cost elements unique to Alternative E3 are expected to be completed in one year. Alternative E3 assumes an operating period of 3 years following contruction in the development of this cost estimate. Refer to Table A-5 ISS ***In Situ Solidfication and Stabilization Cost Backup*** details.

PRESENT VALUE ANALYSIS

Discount rate 7.0%
Total years 3

COST TYPE	YEAR	TOTAL COST	TOTAL COST PER YEAR	DISCOUNT FACTOR	NET PRESENT VALUE	NOTES
Capital	0	$ 323,516	$ 323,516	1.000	$ 323,516	
Annual O&M	1 - 3	$ 11,510	$ 3,837	2.624	$ 10,068	
Periodic	5	$ -	$ -	0.713	$ -	No periodic costs for elements unique to Alternative E3.
		$ 335,026			$ 333,585	Net present value of elements unique to Alternative E3.
Total Net Present Value of Alternative E3 (2012 dollars)					**$ 333,585**	

Notes:
Costs taken from RSMeans have been adjusted by Spokane location adjustment factor of 0.93.
Costs from previous work greater than 1 year old have been adjusted using historical cost index factors provided in 2012 RSMeans.
Present value analysis uses a 30-year discount rate of 7.0%.

Table A-3 - Excavation and Screening Cost Backup

Alternative E2

Excavation

Wall area	6,876	SF	
Floor area	2,814	SF	
Depth	various		
Total volume	2,230	BCY	
Contaminated volume	1,180	BCY	
Clean overburden volume	1,050	BCY	Assume approx. top 10 ft as clean.
Bulking factor	1.15	LCY/BCY	
Clean overburden volume	1,208	LCY	
Volume to haul	1,357	LCY	Haul contaminated soil to screening area.
Bulk density	1.4	ton/BCY	
Total mass	3,122	ton	
Contaminated mass	1,652	ton	

Shoring

Slide-rail system	$ 762	$/LF	
Excavation length	138	ft	
Subtotal	$ 105,143		

Screening

Contaminated volume	1,180	BCY	
Screening efficiency	70%		
Net volume	826	BCY	
Net volume	950	LCY	
Bulk density	1.4	ton/BCY	
Bulk mass	1,156	ton	

Disposal

Subtitle C percentage	0%		Assume all contaminated soil sent to Subtitle C facility.
Subtitle D percentage	100%		
Mass to dispose	1,156	ton	Post screening.
Subtitle C mass	0	ton	
Subtitle D mass	1,156	ton	

Excavation Oversight

Total excavated volume	2,230	BCY	
Daily output for excavation	200	BCY/day	2-CY backhoe, 2010 RSMeans 31 23 16.16 6060.
Output adjustment	-75%		Output reduced for slide-rail use and difficult AOC accessibility.
Adjusted output	50	BCY/day	
Duration of excavation	45	days	
Duration of excavation	8.9	weeks	

Analysis of Confirmational Samples from Excavations

Assume labor for sampling is part of excavation oversight.

Floor samples	13	samples	1 sample per 225 SF.
Wall samples	31	samples	1 sample per 225 SF.

	quantity	unit	unit cost	total	notes
Equipment/shipping	1	LS	$ 5,000	$ 5,000	Engineer's estimate.
PCBs	44	samples	$ 175	$ 7,700	
Data management	5%	--	--	$ 385	Assume 5% of analytical cost.
Subtotal				$ 13,085	

Screening Operations Monitoring & Stockpile Characterization

Screening area samples	5	samples	Assume up to 5 tears in liner.
Stockpile samples	10	samples	1,001 - 2,000 CY stockpiled soil: 10 samples (Ecology 1991)
Subtotal	15	samples	

	quantity	unit	unit cost	total	notes
Equipment/shipping	1	LS	$ 1,705	$ 1,705	Engineer's estimate.
PCBs	15	samples	$ 175	$ 2,625	
Data management	5%	--	--	$ 131	Assume 5% of analytical cost.
Subtotal				$ 4,461	

Table A-3 - Excavation and Screening Cost Backup

Alternative E3

Excavation

Depth	2	ft	
Total volume	210	BCY	
Bulking factor	1.15	LCY/BCY	
Total volume	242	LCY	
Volume to haul	242	LCY	Haul contaminated soil to screening area.
Bulk density	1.4	ton/BCY	
Total mass	294	ton	

Disposal

Subtitle C percentage	0%		
Subtitle D percentage	100%		Assume all soil sent to Subtitle D facility.
Mass to dispose	294	ton	
Subtitle C mass	0	ton	
Subtitle D mass	294	ton	

Excavation Oversight

Total excavated volume	210	BCY	
Daily output for excavation	200	BCY/day	2-CY backhoe, 2010 RSMeans 31 23 16.16 6060.
Duration of excavation	2	days	
Duration of excavation	0.4	weeks	

Stockpile Characterization

Stockpile samples	5	samples	101 - 500 CY stockpiled soil: 5 samples (Ecology 1991).

	quantity	unit	unit cost	total	notes
Equipment/shipping	1	LS	$ 568	$ 568	Engineer's estimate.
PCBs	5	samples	$ 175	$ 875	
Data management	5%	--	--	$ 44	Assume 5% of analytical cost.
Subtotal				$ 1,487	

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Table A-4 - Site Restoration/Revegetation Cost Backup

Description	Qty.	Unit	Unit Cost	Total	Notes
Hydroseeding	1	LS	$ 2,484	$ 2,484	Assume 50% of 2007 Zanetti estimate for lower ravine.
Planting	1	LS	$ 5,509	$ 5,509	Assume 50% of 2007 Zanetti estimate for lower ravine.
Subtotal				$ 7,994	
Restoration monitoring - reporting					Assume work performed by Hart Crowser staff.
Principal	2	hr	$ 198	$ 396	
Sr. Project	8	hr	$ 140	$ 1,120	
Sr. Staff	4	hr	$ 100	$ 400	
Staff	2	hr	$ 83	$ 166	
Sr. Drafter	2	hr	$ 108	$ 216	
Clerical	2	hr	$ 65	$ 130	
Total				$ 2,428	

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Table A-5 - *In Situ* Solidfication and Stabilization Cost Backup

Description		Qty.	Unit	Notes
Treatment area measurements:				
Total soil volume		3,128	CY	AOC footprint plus additional soil within injection radius.
Porosity		0.30		
Pore volume		938	CY	
Pore volume		25,337	CF	
Pressure grouting labor & equipment:				
Production rate		2	points/day	
Injection points		33	points	
Production time		17	days	
Production time		3.3	weeks	
Batch plant & injection:				
Labor & equipment unit cost - injection	$	2,525	$/day	1 foreman, 3 laborers, 1 equip. op., 1 cement mixer (2 CY), 1 air compressor (160 cfm). 2010 RSMeans 31 43 13.13 0710.
Add'l labor for batch plant	$	1,312	$/day	2 laborers, 1 equip. op. 2010 RSMeans 31 43 13.13 0710, Crew B-61.
Total unit cost - batch plant & injection	$	3,837	$/day	
Subtotal - batch plant & injection cost	$	63,304		
Drilling:				
Labor & equipment unit cost - drilling	$	77	$/ft	Unit cost based on vendor quote (see Draft Final FS, Appendix A, Table A-10). Includes mob/demob, drilling, materials, 8.7% sales tax.
Total drilling depth		706	ft	33 points to el. 1,917 ft (accounts for depth variation with surface slope).
Subtotal - drilling cost	$	54,270		
Location adjustment factor		0.93		2010 RSMeans p. 696.
Cost basis adjustment factor		1.051		Convert to 2012 basis. 2012 RSMeans.
Total labor & equipment cost	$	114,886		
Pressure grouting materials:				
Cement mass per bag		94	lb/bag	2010 RSMeans R033105-20.
Cement density		94	lb/CF	
Cement volume per bag		1	CF/bag	
Cement unit cost	$	12.50	$/bag	Portland cement, type III, high early stength. 2010 RSMeans 03 05 13.30 0400.
Cement unit cost	$	12.50	$/CF	Per CF of cement volume (not soil volume).
Mixing ratio		30%		Assume 30% mix.
Pore space volume		7,601	CF	
Cement total volume		2,280	CF	
Location adjustment factor		0.93		2010 RSMeans p. 696.
Cost basis adjustment factor		1.051		Convert to 2012 basis. 2012 RSMeans.
Cement total cost	$	27,852		

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Table A-6 - Hart Crowser and Analytical Rates Cost Backup

HC Kaiser Rates

Sr. Principal	$	209
Principal	$	198
Sr. Associate	$	175
Associate	$	160
Sr. Project	$	140
Project	$	118
Sr. Staff	$	100
Staff	$	83
Sr. Drafter	$	108
Drafter	$	85
Clerical	$	65

Sub Markup		12%	
Communication fee		0%	
Mileage		$0.555/mi.	Fed rate (7/1/11)
Truck Rental	$	85	+ mileage for over 50 mi./day
Safety ($ per hr.)	$	5	per field labor hour
Trip per diem	$	150	each way
Per diem (room & food)	$	148	Fed rate for Spokane
Per diem (food only)	$	61	

Weekly Cost for HC Oversight (Staff)

Labor	$	3,960	5 days (9 hr) for staff level, plus safety costs
Truck	$	843	5 days truck plus travel day, plus $333 for miles over 50
Travel	$	300	
Per diem	$	740	
Subtotal	$	5,843	per week

Columbia Analytical Services and Advanced Analytical Laboratory Costs

Assume same price for water/soil.

Parameter		Cost / Analysis
NWTPH-HCID	$	55
TPH-Dx	$	60
TPH-G	$	60
PCBs - Ultra-Low Level	$	175
VOCs	$	130
PAHs (8270 SIM)	$	215
Metals (10)	$	180
Arsenic	$	26
Chromium	$	24
Manganese	$	26
Iron	$	24
Antimony	$	26
TSS	$	18
Chloride	$	18
Nitrate/Nitrite	$	24
Hardness	$	25
TDS	$	18
Alkalinity	$	18
Sulfate	$	18
Total arsenic, chromium, zinc, and phosphorous	$	50
Hexavalent chromium	$	50
Orthophosphate	$	20
Cyanide	$	40
BOD	$	45
Fecal coliform	$	35
Oil & grease	$	50

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APPENDIX B
POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

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APPENDIX B
POTENTIAL APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

This appendix identifies and discusses potential applicable or relevant and appropriate requirements (ARARs) to be used in assessing and implementing remedial actions at the West Discharge Ravine (WDR). Specific potential requirements pertaining to waste management, remediation of contaminated media, and surface water protection are presented. The potential ARARs focus on federal or state statutes, regulations, criteria, and guidelines. The specific types of potential ARARs evaluated include contaminant-, location-, and action-specific ARARs. Each type of ARAR is evaluated for the WDR and discussed in the sections that follow.

Contaminant-Specific ARARs are usually health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical contaminant values that are generally recognized by the regulatory agencies as allowable to protect human health and the environment.

Action-Specific ARARs are pertinent to particular remediation methods and technologies, and to actions conducted to support cleanup.

Location-Specific ARARs are restrictions placed on the presence of hazardous substances, or the conduct of activities, solely because they occur in specific locations.

In general, only the substantive requirements of ARARs are applied to Model Toxics Control Act (MTCA) cleanup sites being conducted under a legally binding agreement with the Washington State Department of Ecology (Ecology) (WAC 173-340-710[9][b]). Thus, cleanup actions under a formal agreement with Ecology are exempt from the administrative and procedural requirements specified in state and federal laws. This exemption also applies to permits or approvals required by local governments.

B.1 CONTAMINANT-SPECIFIC ARARS

A contaminant-specific requirement sets concentration limits in various environmental media for specific hazardous substances, pollutants, or contaminants. During preparation of the site-wide FS, Ecology developed preliminary cleanup levels (PCULs) for unsaturated soil, saturated soil, and groundwater at the Kaiser Facility (Ecology 2010).

MTCA authorizes Ecology to adopt standards for cleanup actions at sites impacted by hazardous substances. Chapter 173-340 WAC (MTCA Cleanup Regulation) describes a process for developing and selecting cleanup standards for environmental media (e.g., groundwater, surface water), and these standards are considered potential ARARs. Under the MTCA regulations, cleanup standards may be established by one of three methods:

- Method A may be used if a routine cleanup action, as defined in WAC 173-340-200, is being conducted at the site or relatively few hazardous substances are involved for which Method A cleanup standards have been specified in the regulation. This method is designed to be protective for unrestricted site use (e.g., residential sites).

- Under Method B, an excess cancer risk level of 10^{-6} and a hazard quotient of 1 (non-carcinogen) are established, and risk-based calculations of cleanup levels are developed for individual constituents and pathways present at the site using residential use assumptions.

- Method C industrial soil cleanup levels represent concentrations that are protective of human health and the environment based on industrial site use assumptions. Method C industrial soil cleanup levels may be established for qualifying industrial sites. The Kaiser Trentwood Facility qualifies for the use of these industrial soil cleanup levels. However, soil cleanup levels at industrial sites must also be protective of other environmental media (e.g., groundwater, surface water) and exposure pathways. For media other than soil (e.g., surface water and groundwater), Method C may be used in certain instances (see WAC 173-340-706[1]). In such cases where Method C is approved by Ecology, the CULs must meet applicable state and federal laws and be protective of human health and the environment. Generally, Method C is used to establish Remediation Levels or when Methods A or B cannot be achieved.

Because the Kaiser Facility qualifies as an industrial site per WAC 173-340-745(1), development of soil cleanup levels included an evaluation of industrial soil cleanup levels. The unsaturated and saturated soil PCULs were developed using standard MTCA soil Method C industrial criteria and the partitioning model which incorporates the preliminary groundwater cleanup levels that were developed for the protection of groundwater and surface water. Groundwater PCULs were established using standard MTCA Method B criteria, which consider criteria protective of both drinking water and surface water because site groundwater discharges into the Spokane River.

Proposed remedies for the WDR could leave hazardous substances behind in excess of cleanup levels. Then the cleanup action would be considered to comply with cleanup standards provided that the remedy (e.g., containment) is permanent to the maximum extent practicable using the procedures in WAC 173-340-360; that a compliance monitoring program demonstrates the long-term integrity of the containment system; and that institutional controls are in place (WAC 173-340-740 [6][f]).

B.2 ACTION-SPECIFIC REQUIREMENTS

Action-specific ARARs are requirements that may need to be satisfied during the performance of specific remedial actions because they prescribe how certain activities (e.g., treatment and disposal practices, media monitoring programs) must occur. Indeed, several of the potential contaminant- and location-specific ARARs discussed in this appendix also include provisions for potential action-specific ARARs to be applied once a remedial action is selected. Typically, action-specific ARARs are not fully defined until a preferred response action has been selected and the corresponding remedial action can be more completely refined. However, preliminary consideration of the range of potential action-specific ARARs may help focus the process of selecting a preferred response action and remedial action alternatives. Table B-1 presents the significant potential action-specific ARARs that may apply to the various response actions being considered for the WDR. Brief summaries of the requirements associated with these potential action-specific ARARs are provided below.

B.2.1 Soil Requirements

PCB-impacted soil at low concentrations may be left in place under the Toxic Substances Control Act (TSCA). However, if PCB-impacted soil is left in place, remediation requirements pertaining to institutional controls, containment, and cleanup must be met.

B.2.2 Surface Water Requirements

Regulations adopted pursuant to the CWA under the National Pollutant Discharge Elimination System (NPDES) mandate use of best available treatment (BAT) technologies prior to discharging contaminants to surface waters. Pertinent regulations appear in 40 CFR 129.105 (specifically for PCBs) and 40 CFR Part 467 (for aluminum forming operations). Chapter 90.48 RCW also establishes programs for regulating and controlling surface water quality in

Washington State. Chapters 173-216 and 173-220 WAC require application of all known, available, and reasonable methods of treatment (AKART) before discharging pollutants to surface waters. NPDES requirements could constitute potential ARARs for remedial actions that would result in discharge of treated wastewater to the Spokane River. Thus, associated treatment and/or pretreatment systems could be required to use BAT and/or AKART (e.g., precipitation, decanting, separation) to prevent or minimize pollutants before discharge.

Actions that result in the generation of water that contains cadmium, lead, or zinc will need to be evaluated by Ecology because of the TMDL for metals, but as long as the concentrations are less than the chronic standards described in the TMDL, restrictions are not expected.

The Spokane County Shoreline Master Plan is promulgated and authorized pursuant to Chapter 173-19 WAC, the Shoreline Management Act of 1971 – State Master Program. In keeping with the policies and objectives of the Spokane County Master Plan, remedial actions that may impact the shoreline should be designed and implemented in a manner that will minimize loss of shoreline, stabilize existing and remaining shoreline areas, and retain a property configuration that encourages water-dependent uses.

B.2.3 Waste Management Requirements

During remedial actions at the WDR, wastes and recovered products may be generated that will need to be treated, stored, recycled, or disposed of. Regulations adopted pursuant to the Resource Conservation and Recovery Act (RCRA) describe numerous action-specific requirements may be potential ARARs if wastes are hazardous or otherwise subject to the recycling provisions of the RCRA regulations, including hazardous waste management under RCRA Subtitle C (40 CFR Parts 260 to 279). In addition, solid waste land disposal restrictions described in 40 CFR 268 and WAC 173-303-140 may be potential ARARs for management of waste.

EPA regulations promulgated under RCRA Subtitle D set forth management standards for municipal and solid wastes (40 CFR Parts 257 and 258) and Washington State regulations describe management standards for solid waste in Chapter 173-350 WAC and for municipal solid waste landfills in Chapter 173-351 WAC. Some of these management standards may be potential ARARs for non-hazardous solid wastes generated during remedial actions at the WDR.

Federal regulations at 40 CFR Part 761 describe management requirements for PCB wastes and materials. If PCB-affected wastes are generated, the PCB management standards may be potential ARARs for such wastes.

In general, the kinds of action-specific requirements that may apply to wastes and recovered product may involve the following actions and precautions:

- Packaging, labeling, placarding, and manifesting of off-site waste shipments;
- Inspecting waste management areas to ensure proper performance and safe conditions;
- Preparation of plans and procedures to train personnel and respond to emergencies; and
- Management standards for containers, tanks, and treatment units.

Many of these requirements will depend on the particular remedial actions undertaken, the types of waste and/or recovered product generated, and their methods of disposition.

B.2.4 Other Requirements

Other potential ARARs may exist that pertain to the construction of the remedial action. Implementation of some remedial actions may need to meet permitting requirements, such as meeting the requirements of the Construction Stormwater General Permit established by Title 33 USC, 1251 and RCW 90.48, and complying with substantive requirement of grading activities necessary for soil work.

Implementation of the remedial actions will need to observe the requirements of the WISHA regulations described in Chapter 296-24 WAC.

B.3 LOCATION-SPECIFIC REQUIREMENTS

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because they are in a specific location. Some examples of special locations include floodplains, wetlands, historic sites, and sensitive ecosystems or habitats. Table B-2 catalogs the location-specific standards identified in existing federal and state requirements, and indicates which of these may be potential ARARs. The

"Comments" column of Table B-2 states the rationale for a requirement being, or not being, identified as a potential ARAR. In summary, the following requirements have been identified as potential location-specific ARARs:

- **Groundwater.** The Kaiser Facility is located near the Spokane Valley Sole Source Aquifer. Because of this sole source designation, activities that may affect the aquifer are potentially subject to various restrictions (e.g., prohibition of waste disposal). Thus, the sole source aquifer standards may be potential ARARs.

- **Shorelines and Surface Waters.** A number of requirements constrain activities in proximity to shorelines and surface waters. Remedial actions at the WDR may occur in proximity to shorelines or in the floodplain associated with the Spokane River. Potential ARARs would require that precautions (e.g., ensure no net loss of shoreline, preserve beneficial values of floodplain) be taken to minimize adverse effects.

  The Spokane River adjacent to the Facility has a TMDL for dissolved oxygen as required by WAC 173-201A. Kaiser and other dischargers are under an allocation that restricts the pounds of phosphorous, ammonia, and carbonaceous biological oxygen demand (CBOD) the Facility can discharge in a day. Because of Kaiser's location along the river reach covered by the dissolved oxygen TMDL, restrictions may be placed on activities that result in increased loads on these parameters.

- **Cadmium, Lead, and Zinc TMDL.** In August 1999, Ecology issued TMDLs for cadmium, lead, and zinc in the Spokane River. The TMDLs were initiated as a result of high metals concentrations entering Washington from mining operations in Idaho, which have resulted in exceedances of water quality standards for these three metals in the river. The TMDLs prohibit discharge of cadmium, lead, and zinc at concentrations that exceed the hardness-based water quality standard at the end of the discharge pipe. The limits for any individual discharger may be performance-based. Existing wastewater dischargers are not allowed to discharge these three metals at concentrations that are statistically above what their treatment system can consistently achieve, even if it is well below the water quality standard. Kaiser has recently been issued a facility-specific permit limit incorporating the revised metal TMDL approach for its NPDES permit discharge. It is not likely, however, that groundwater discharges to the Spokane River from the WDR will be affected by the TMDLs for cadmium, lead, and zinc. The Kaiser and area-wide concentrations of these metals in groundwater are less than the water quality standards. However, any groundwater remedial action conducted by Kaiser that results in an increase in the concentration of these three metals in discharges to the river would need to be evaluated by Ecology in consideration of the TMDLs.

- **Polychlorinated Biphenyls.** A draft TMDL for PCB was issued by Ecology in June 2006, but it has not been finalized. Because there are a variety of known PCB sources to the river, and others that may be identified by the regulatory agencies, Ecology is in the process of implementing a toxics reduction strategy for the Spokane River. This strategy includes PCB source identification and reduction activities. A TMDL for PCBs may eventually be established for the Spokane River in the future. This TMDL, if established, will be an ARAR for the WDR.

- **Air.** The Facility is located in the Spokane Valley airshed. The Spokane Valley airshed has been in nonattainment for particulate matter (PM10) and carbon monoxide (CO) in the past but is current meeting attainment for both of these parameters. If the airshed were to become a nonattainment area for one or more parameter in the future, sources of air emissions would typically be subject to greater restrictions in these areas. Thus, these restrictions may be potential ARARs for remedial actions at the WDR that could result in emissions of PM10 or CO.

B.4 REFERENCES FOR APPENDIX B

Ecology 1998. Cadmium, Lead, and Zinc in the Spokane River Recommendations for Total Maximum Daily Loads and Waste Load Allocations. Washington State Department of Ecology Publication No. 98-329. September 1998.

Ecology 2010. Kaiser Trentwood Site Draft Cleanup Standards. Issued to Kaiser Aluminum Washington, LLC, by the Washington State Department of Ecology. May 2010.

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Table B-1 - Potential Action-Specific ARARs for the West Discharge Ravine

Response Action	Potential Action-Specific ARARs	Citation	ARAR?	Comments
Institutional Controls	Long-term groundwater monitoring consistent with MTCA.	Chapter 173-340 WAC	Yes	Groundwater monitoring system with quarterly sampling and analysis; potential 30-year (typical for post-closure care) monitoring time period.
	Groundwater well construction and maintenance consistent with state requirements.	Chapters 173-160 and 173-162 WAC	Yes	Construction and maintenance of monitoring wells to prevent adverse impacts to groundwater.
Monitored Natural Attenuation (MNA)	Natural attenuation as a remedial action consistent with expectations defined by MTCA.	WAC 173-340-370(7)	Yes	Ecology expects that natural attenuation may be appropriate at sites where source control has been conducted to the maximum practicable extent; remaining impacts do not pose an unacceptable risk to human health or the environment; there is evidence that natural attenuation is occurring; and appropriate monitoring is conducted.
Excavation and Off-Site Disposal	Transportation of impacted soil or hazardous materials consistent with state and federal requirements.	49 CFR 100 and 177; Chapter 446-50 WAC	Yes	Transportation of hazardous waste or materials required to meet state and federal requirements.
	Management of excavated soil consistent with solid waste handling and disposal facility requirements.	40 CFR 241 and 257; Chapters 173-350 and 173-351 WAC	Yes	Handling and disposal of solid waste required to meet state and federal requirements.
	Management of excavated soil consistent with solid waste land disposal restrictions.	40 CFR 268; WAC 173-303-140	Potential	Best management practices for dangerous wastes required to meet state and federal requirements.
	Disposal of waste consistent with RCRA Subtitle C requirements for management of hazardous waste.	40 CFR 260 to 279	Potential	Off-site disposal of impacted soil meeting hazardous waste criteria may require disposal at Subtitle C landfill.
	Disposal of waste consistent with RCRA Subtitle D requirements for management of solid waste.	40 CFR 257 and 258	Potential	Disposal of impacted soil not defined as hazardous waste may be disposed of at Subtitle D landfill.
In Situ Stabilization/ Solidification	Solidification of soil containing PCBs consistent with federal TSCA requirements.	40 CFR 761	Potential	PCB-impacted soil at low concentrations may be left in place under TSCA; however, remediation requirements such as institutional controls, containment, and cleanup must be met.

Table B-1 - Potential Action-Specific ARARs for the West Discharge Ravine

Response Action	Potential Action-Specific ARARs	Citation	ARAR?	Comments
Construction of Response Action	Implementation of response action consistent with occupational health and safety requirements.	Chapter 296-24 WAC	Yes	Worker and visitor health and safety requirements established by the Washington Industrial Safety and Health Act (WISHA) will be met during implementation of the response action.
	Implementation of response action consistent with local permitting requirements.	City of Spokane Valley Ordnance	Yes	Appropriate substantive requirements to be met for implementation of response action (for example, meeting runoff quality requirements for grading activities).
	Implementation of response action consistent with construction stormwater general permit.	Title 33 USC, 1251 RCW 90.48	Potential	Appropriate permitting requirements to be met during implementation of response action.

Table B-2 - Potential Location-Specific ARARs for the West Discharge Ravine

Geological

Location	Requirement	Prerequisite	Citation	ARAR?	Comments
On or adjacent to a fault displaced in Holocene time	Solid waste landfills and hazardous waste facilities prohibited.	Waste management within 200 feet (solid waste) or 500 feet (hazardous waste) of a Holocene fault.	40 CFR 264.18 WAC 173-303-282, and WAC 173-351-130	No	No solid or hazardous waste management facilities will be established.
Seismic impact zones and subsidence areas	Solid and hazardous waste facilities prohibited in areas with potential for impacts during seismic events.	Solid and hazardous waste management activities in seismic impact zones and unstable areas.	WAC 173-303-282, WAC 173-304-130, and WAC 173-351-130	No	No solid or hazardous waste management facilities will be established.
Slopes	Solid and hazardous waste facilities prohibited from areas with unstable slopes or soils.	Solid or hazardous waste management on an unstable slope or soil.	WAC 173-303-282 and WAC 173-304-130	No	No solid or hazardous waste management facilities will be established.
Salt dome and salt bed formations, underground mines, and caves	Placement of non-containerized or bulk liquid hazardous wastes is prohibited.	Hazardous waste placement in salt dome, salt bed, mine, or cave.	40 CFR 264.18	No	No bulk liquid hazardous waste will be managed.

Drinking Water Supply

Location	Requirement	Prerequisite	Citation	ARAR?	Comments
Drinking water supply well	Solid waste management prohibited near drinking water supply well.	Solid waste management within 1,000 feet or 90-day travel time upgradient of drinking water supply well.	WAC 173-304-130 and WAC 173-351-140	No	No drinking water supply wells are within 1,000 feet downgradient of project.
Water supply intake	Hazardous waste management facilities prohibited near surface water and groundwater intake for domestic use.	Hazardous waste management within 500 feet (non land-based) or 1/4 mile (land-based) of intake.	WAC 173-303-282	Potential	If hazardous waste is encountered during cleanup, management activities will need to be conducted in accordance with the state set back requirements.
Watershed	Solid and hazardous waste management areas prohibited within a watershed used by a public water supply system for municipal drinking water.	Solid and hazardous waste management within a public watershed.	WAC 173-303-282, WAC 173-304-130, and WAC 173-351-140	No	No solid or hazardous waste management will occur within a designated watershed used for water supply.

Groundwater

Location	Requirement	Prerequisite	Citation	ARAR?	Comments
Sole-source aquifer	Solid and hazardous waste land based management facilities prohibited over a sole-source aquifer.	Disposal or land based management over a sole source aquifer.	WAC 173-303-282, WAC 173-304-130, and WAC 173-351-140	Potential	Actions may occur in the vicinity of the Spokane Sole-Source Aquifer.
Aquifer	Prevent depletion, excessive level decline, and/or reduction in water quality of the aquifer.	Withdrawal of groundwater from the aquifer.	Chapter 173-154 WAC	No	No withdrawal of groundwater will occur.
	Bottom of lowest liner of solid waste disposal facility must be at least 10 feet above seasonal high water in the aquifer (5 feet if hydraulic gradient controls installed).	Solid waste disposal within 10 feet above aquifer.	WAC 173-304-130 and WAC 173-351-140	No	No solid waste disposal facility will be established.
	Hazardous waste management facilities prohibited in close proximity to aquifer.	Hazardous waste management within 10 feet (non-land based) or 50 feet (land based) above aquifer.	WAC 173-303-282	No	No hazardous waste management facility will be established
Aquifer Protection Areas	Activities restricted within designated Aquifer Protection Areas.	Activities within an Aquifer Protection Area.	RCW 36.36	Future Potential	No Aquifer Protection Area has been designated yet. This may occur in the future.
Groundwater Management Areas	Activities restricted within Groundwater Management Areas.	Activities within a Groundwater Management Area.	Chapter 173-100 WAC; WAC 173-303-282	Future Potential	No Groundwater Management Area has been defined. This may occur in the future.
Special Protection Areas	Activities restricted within Special Protection Areas.	Activities within a Special Protection Area. Hazardous waste management facilities prohibited.	WAC 173-200-090 and WAC 173-303-282	Future Potential	No Special Protection Area has been defined. This may occur in the future.
Wellhead Protection Areas	Activities restricted within Wellhead Protection Areas.	Activities within a Wellhead Protection Area.	WAC 246-290-135	Future Potential	Wellhead Protection program has not been established. Such a program, which may integrate the sole source aquifer, aquifer protection, and special protection programs may be established in the future.
Groundwater use	Water right required for groundwater use.	Withdrawal of groundwater requires a right.	RCW 90.54; Chapter 173-150 WAC	No	No withdrawal of groundwater will occur.

Surface Water

Location	Requirement	Prerequisite	Citation	ARAR?	Comments
Rivers and streams	Avoid diversion, channeling, or other actions that modify streams or rivers, or adversely affect fish or wildlife habitats and water resources.	Actions modifying a stream or river and affecting fish or wildlife.	Chapters 220-110 and 232-14 WAC	No	No modification or diversion of rivers or streams will occur,
Shorelines/Surface waters	Actions prohibited near shorelines of statewide significance unless permitted,	Actions within 200 feet of shorelines.	RCW 90.58; Chapters 173-14 and 173-16 WAC	Yes	Actions will occur within 200 feet of the Spokane River,
	Solid waste facilities prohibited near surface water.	Solid waste disposal within 200 feet of surface water (stream, lake, pond, river, saltwater body).	WAC 173-304-130 and WAC173-351-140	No	No solid waste disposal facility will be established within 200 feet of a surface water.
	Hazardous waste management facilities prohibited near perennial surface water bodies.	Hazardous waste management within 500 feet (non land-based) or 1/4 mile (land-based) of water body.	WAC 173-303-282	No	No hazardous waste management facility will be established.
	Restrictions on dissolved oxygen loading to the Spokane River	TMDL for dissolved oxygen restricts pounds of phosphorous, ammonia, and carbonaceous BOD. No new sources are allowed. Kaiser cannot exceed its current allocation.	Chapter 173-201A WAC; Dissolved oxygen TMDL	Yes	No exceedance of dissolved oxygen TMDL.
	Restrictions on cadmium, lead, and zinc loading in the Spokane River.	TMDLs for these metals cannot be exceeded.	Ecology 1998	Yes	Not likely to be a limiting factor for soil remediation at the WDR.
Floodplains	Solid and hazardous waste facilities must be designed, built, operated, and maintained to prevent washout.	Solid or hazardous waste management in a 100-year floodplain.	40 CFR 264.18; WAC 173-303-282, WAC 173-304-460, and WAC 173-351-130	No	No solid or hazardous waste management facility will be established.
	Hazardous waste land-based facilities prohibited in 500-year floodplain.	Hazardous waste disposal/land-based management in a 500-year floodplain.	WAC 173-303-282	No	No hazardous waste disposal facility will be established.
Floodplains (continued)	Avoid adverse effects, minimize potential harm, restore/preserve natural and beneficial values in floodplains.	Actions occurring in a floodplain.	Chapters 173-16 and 173-158 WAC	Potential	Actions may occur within a designated floodplain.

Location	Requirement	Prerequisite	Citation	ARAR?	Comments
Wetlands	Solid waste facilities prohibited in wetlands.	Solid waste management in a wetland (swamps, marshes, bogs, estuaries, and similar areas).	WAC 173-304-130 and WAC 173-351-130	No	No delineated wetlands located in vicinity of project.
	Hazardous waste facilities prohibited near wetlands.	Hazardous waste management within 500 feet (non land-based) or 1/4 mile (land-based) of wetlands	WAC 173-303-282	No	No delineated wetlands located in vicinity of project.
	Work or structures in navigable waters prohibited without permit. Discharge of dredged or fill materials into wetlands prohibited without a permit.	Work or construction in navigable waters; discharges to wetlands.	40 CFR 230 to 233; 33 CFR 322 to 323	No	No actions within navigable waters. No discharges to delineated wetlands.
	Minimize potential harm, avoid adverse effects, preserve and enhance wetlands.	Construction or management of property in wetlands.	Chapters 173-16 and 173-22 WAC	No	No delineated wetlands located in vicinity of project.

Air

Location	Requirement	Prerequisite	Citation	ARAR?	Comments
Non-attainment areas	Spokane Valley has been nonattainment for PM10 and CO in the past but is now meeting attainment. If the restrictions on air emissions would be required if nonattainment were to reoccur under state and federal air quality programs.	Activities within a designated non-attainment area and Class I PSD Air Quality Zones.	40 CFR 51 and 52; Chapter 173-400 WAC and WAC 173-303-282	Potential	Would only apply if Spokane Valley becomes a nonattainment area again. In such cases actions at the WDR may occur within a designated non-attainment area.

Table B-2 - Potential Location-Specific ARARs for the West Discharge Ravine

Land Use

Location	Requirement	Prerequisite	Citation	ARAR?	Comments
Neighboring properties	Solid and hazardous waste management prohibited near Facility's property line.	Solid waste management within 100 feet of Facility's property line; hazardous waste management within 200 feet (non land-based) or 500 feet (land-based) of Facility property line.	WAC 173-304-130, WAC 173-351-140, and WAC 173-303-282	No	No solid or hazardous waste management facilities will be established.
	No solid waste management areas within 250 feet of property line of residential zone properties.	Solid waste management within 250 feet of property line of residential property.	WAC 173-304-130 and WAC 173-351-140	No	No residential zone properties in vicinity of project.
	Hazardous waste management prohibited near residences or public gathering places.	Hazardous waste management within 500 feet (non land-based) or 1/4 mile (incineration and land-based) of residences or public gathering places.	WAC 173-303-282	No	No hazardous waste management facility will be established.
Farmland	Hazardous waste management prohibited near prime farmland.	Hazardous waste management within 500 feet (non land-based) or 1/4 mile (land-based) of prime farmland	WAC 173-303-282	No	No prime farmland in vicinity of project.
Proximity to airports	Disposal of solid waste that could attract birds prohibited near airport runways.	Solid waste disposal within 5,000 feet (piston-type aircraft) or 10,000 feet (turbojet aircraft) of airport runways.	WAC 173-304-130	No	No airport runways in vicinity of project.

Sensitive Environments

Location	Requirement	Prerequisite	Citation	ARAR?	Comments
Endangered/threatened species habitats	Solid waste management prohibited from areas designated by US Fish and Wildlife Service as critical habitats for endangered or threatened species.	Solid waste management within critical habitats.	WAC 173-304-130, 173-351-140	No	No actions will occur within a critical habitat.
	Hazardous waste management prohibited near critical habitats and habitats essential for recovery of state threatened or endangered species.	Hazardous waste management within 500 feet (non land-based) or 1/4 mile (land-based) of critical and essential habitats.	WAC 173-303-282	No	No critical or essential habitats in vicinity of project.
	Actions within critical habitats must conserve endangered and threatened species.	Activities where endangered or threatened species exist.	50 CFR 17, 222 to 227, 402, and 424; Chapter 232-12 WAC	No	No actions will occur within a critical habitat or affect endangered/threatened species.

Location	Requirement	Prerequisite	Citation	ARAR?	Comments
Parks/Recreation areas/Monuments	Solid waste management prohibited near state or national park.	Solid waste management within 1,000 feet of state/national park.	WAC 173-304-130 and WAC 173-351-140	No	No solid waste management facilities will be established.
	Hazardous waste management prohibited near state or federal park, recreation area, or national monument.	Hazardous waste management within 500 feet (non land-based) or 1/4 mile (land-based) of state or federal park, recreation area, or national monument.	WAC 173-303-282	No	No hazardous waste management facilities will be established.
	Restrictions on activities in areas that are designated state parks, or recreation/conservation areas.	Activities within state parks or recreation/conservation areas.	Chapter 352-32 WAC	No	No actions will occur within state parks or recreation/conservation areas.
Wilderness areas	Actions within designated wilderness areas must ensure area is preserved and not impaired.	Activities within designated wilderness areas.	50 CFR 35	No	No wilderness areas in vicinity of project.
	Hazardous waste management prohibited near wilderness areas.	Hazardous waste management within 500 feet (non land-based) or 1/4 mile (land-based) of wilderness area	WAC 173-303-282	No	No wilderness areas in vicinity of project.
Wildlife refuge	Restrictions on actions in areas that are part of the National Wildlife Refuge System.	Activities within designated wildlife refuges.	50 CFR 27	No	No wildlife refuges in vicinity of project.
	Hazardous waste management prohibited near wildlife refuge, preserve, or bald eagle protection area.	Hazardous waste management within 500 feet (non land-based) or 1/4 mile (land-based) of wildlife refuge, preserve, or bald eagle protection area.	WAC 173-303-282	No	No wildlife refuges, preserves, or bald eagle protection areas in vicinity of project.
Natural area preserves	Activities restricted in areas designated as having special habitat value (Natural Heritage Resources).	Activities within identified natural area preserve.	Chapter 332-60 WAC	No	No natural area preserve in vicinity of project.
	Hazardous waste management prohibited near natural area preserves.	Hazardous waste management within 500 feet (non land-based) or 1/4 mile (land-based) of natural area preserve.	WAC 173-303-282	No	No natural area preserve in vicinity of project.

Location	Requirement	Prerequisite	Citation	ARAR?	Comments
Wild, scenic, or recreational rivers	Avoid actions that would have adverse effects on designated wild, scenic, or recreational rivers.	Activities near wild, scenic, and recreational rivers; hazardous waste management facilities prohibited within viewshed.	16 USC 1261 et seq.; RCW 79.72; WAC 173-303-282	No	No designated wild, scenic, or recreational rivers in vicinity of project.

Unique Lands and Properties

Location	Requirement	Prerequisite	Citation	ARAR?	Comments
Natural resource conservation areas	Restrictions on activities within designated conservation areas.	Activities within designated conservation areas.	RCW 79.71	No	No conservation areas in vicinity of project.
Forest lands	Activities restricted within state forest lands to minimize fire hazards and other adverse impacts.	Activities within state forest lands.	Chapter 332-24 WAC	No	Project is not within state forest land.
	Restrictions on activities in state and federal forest lands.	Activities within state and federal forest lands.	16 USC 1601 et seq.; RCW 76.09	No	Project is not within state or federal forest land.
Public lands	Activities on public lands are restricted, regulated, or proscribed.	Activities on state-owned lands.	RCW 79.01	No	No actions will occur on state-owned land.
Scenic vistas	Restrictions on activities that can occur in designated scenic areas.	Activities within designated scenic vista area.	RCW 47.42	No	Project is not within scenic vista area.
Historic areas	Actions must be taken to preserve and recover significant artifacts, preserve historic and archaeologic properties and resources, and minimize harm to national landmarks.	Activities that could affect historic or archaeologic sites or artifacts; hazardous waste management facilities prohibited in archaeologic and historic sites.	16 USC 469, 470 et seq.; 36 CFR 65 and 800; RCW 27.34, 27.44, 27.48, 27.53, and 27.58; Chapters 25-46 and 25-48 WAC, and WAC 173-303-282	No	No known historic or archaeologic sites or artifacts in vicinity of project.

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