August 5, 2015

Guy Barrett
Washington Department of Ecology
Southwest Regional Office Toxics Cleanup Program,
P.O. Box 47775
Olympia, WA 98504-7775

Subject: Agreed Order No. DE 10483- Former Columbia Gorge Aluminum Smelter
Final Remedial Investigation Work Plan

Pursuant to Section VII in Agreed Order No. DE 10483 and Task 1 of the Statement of Work, this transmits the two hard copies and two electronic (CD-ROM) copies of the Final Remedial Investigation (RI) Work Plan for the Goldendale facility.

The Agreed Order requires two phases of RI work plan preparation (Phase 1 and Phase 2) that have been prepared as two separate volumes of the Final RI Work Plan: Volume 1 is the Phase 1 Work Plan and Volume 2 is the Phase 2 Work Plan.

The Final Phase 1 Work Plan (Volume 1) and Final Phase 2 Work Plan (Volume 2) incorporate responses to the January 25, 2015 and July 6, 2015 Ecology and Yakama Nation comments on the draft plans.

We look forward to obtaining Ecology's approval of the Final RI Work Plan.

Very Truly Yours,

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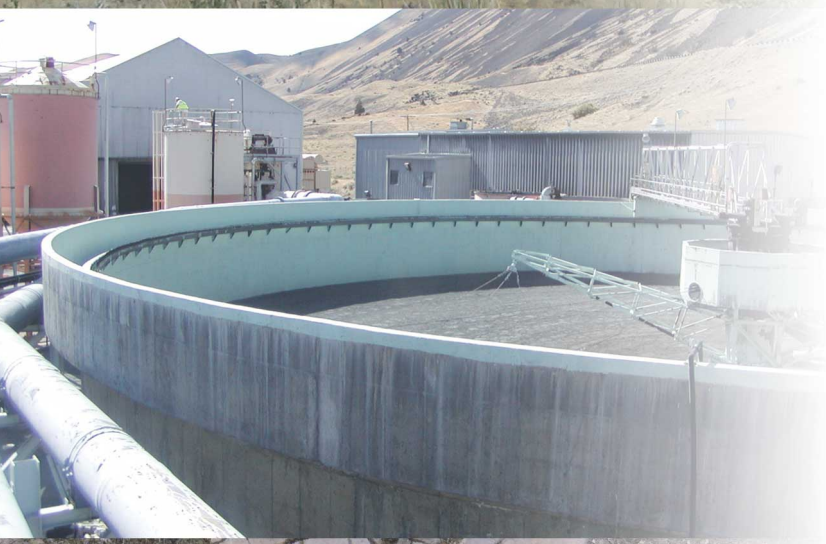

FINAL
REMEDIAL INVESTIGATION WORK PLAN

VOLUME 1: PHASE 1 WORK PLAN

Columbia Gorge Aluminum Smelter Site

Revision 0
Goldendale, WA
Facility Site ID #95415874

Agreed Order DE 10483

August 5, 2015

On behalf of:

Lockheed Martin Corporation
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Bethesda MD 20817

NSC Smelter LLC
3313 West Second Street
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Prepared by:

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Acronyms

AC	Alternating Current
ACOE	US Army Corps of Engineers
AOC	Area of Concern
ARAR	Applicable, Relevant, and/or Appropriate Requirement
ASTs	Aboveground Storage Tanks
BA	Basalt Aquifer
BAL	Basalt Aquifer – Lower Zone
BAU	Basalt Aquifer – Upper Zone
bgs	Below ground surface
BMEC	Blue Mountain Environmental Consultants, Inc.
BPA	Bonneville Power Administration
CAP	Cleanup Action Plan
CLARC	Washington State Cleanup Levels and Risk Calculations database
COPC	Chemicals of Potential Concern
cPAHs	Carcinogenic Polynuclear Aromatic Hydrocarbons
CSL	Cleanup Screening Level
DC	Direct Chill
Ecology	Washington Department of Ecology
EELF	East End Landfill
EHW	Extremely Hazardous Waste
EPA	U.S. Environmental Protection Agency
ESDA	East Surface Deposit Area
ESI	East Surface Impoundment
FS	Feasibility Study
GIS	Geographic Information System
gpm	Gallons per minute
GWIS	Geographic Water Right Information System
HASP	Health and Safety Plan
HEAF	High Efficiency Air Filtration
JARPA	Joint Aquatic Resources Permit Application
Lockheed Martin	Lockheed Martin Corporation
MCLs	Maximum Contaminant Levels
mg/kg	Milligrams per kilogram

mg/L	Milligrams per liter
msl	Mean sea level
MTCA	Model Toxics Control Act
NESI	North of the East Surface Impoundment
NPDES	National Pollutant Discharge Elimination System
NSC	NSC Smelter, LLC
OCBs	Oil Circuit Breakers
OMM	Operations, Maintenance and Monitoring
PAHs	Polynuclear Aromatic Hydrocarbons
PA/SI	Preliminary Assessment/Site Investigation
PCBs	Polychlorinated Biphenyls
PEC	Probable Effects Concentrations
PGG	Plateau Geoscience Group, LLC
PUD	Public Utility District
POM	Particulate Organic Matter
QAPP	Quality Assurance Program Plan
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RSET	The Regional Sediment Advisory Team
SAP	Sampling and Analysis Plan
SCO	Sediment Cleanup Objective
SCUM II	Ecology Sediment Cleanup User's Manual
SEF	Sediment Evaluation Framework
SEM/AVS	Simultaneously Extracted Metals/Acid-Volatile Sulfides
SL	Screening Level
SMS	Washington State Sediment Management Standards
SPL	Spent Pot Liner
SPLP	Synthetic Precipitation Leaching Procedure
SWMU	Solid Waste Management Unit
SVOCs	Semivolatile Organic Compounds
TCLP	Toxic Characteristic Leaching Procedure
TEC	Threshold Effects Concentrations
Tetra Tech	Tetra Tech, Inc.
TFAS	Treaty Fishing Access Site
TPH	Total Petroleum Hydrocarbons

TPH-DX	Total Petroleum Hydrocarbons – Diesel extended range
TPH-Gx	Total Petroleum Hydrocarbons – Gasoline extended range
TSS	Total Suspended Solids
TTEC	Total Toxicity Equivalent Concentrations
µg/kg	Micrograms per Kilogram
µg/L	Micrograms per Liter
UA	Unconsolidated Aquifer
UCL	Upper Confidence Limit
VOCs	Volatile Organic Compounds
WDFW	Washington Department of Fish and Wildlife
WELF	West End Landfill
WESP	Wet Electrostatic Precipitator
WSI	West Surface Impoundment
WRTS	Water Right Tracking System

Solid Waste Management Units (SWMUs) and Areas of Concern
(Agreed Order No. DE 10483)

Solid Waste Management Units (SWMUs)

NPDES Ponds (SWMU #1)
East Surface Impoundment (ESI) (SWMU #2)
Intermittent Sludge Disposal Ponds (SWMU #3)
West Surface Impoundment (SWMU #4)
Line A Secondary Scrubber Recycle Station (SWMU #5)
Line B, C, D Secondary Scrubber Recycle Stations (SWMU #6)
Decommissioned Air Pollution Control Equipment (SWMU #7)
Tertiary Treatment Plant (SWMU #8)
Paste Plant Recycle Water System (SWMU #9)
North Pot Liner Soaking Station (SWMU #10)
South Pot Liner Soaking Station (SWMU #11)
East SPL Storage Area (SWMU #12)
West SPL Storage Area (SWMU #13)
North SPL Storage Containment Building (SWMU #14)
South SPL Storage Building (SWMU #15)
SPL Handling Containment Building (SWMU #16)
East End Landfill (SWMU #17)
West End Landfill (SWMU #18)
Plant Construction Landfill (SWMU #19)
Drum Storage Area (SWMU #20)
Construction Rubble Storage Area (SWMU #21)
Wood Pallet Storage Area (SWMU #22)
Reduction Cell Skirt Storage Area (SWMU #23)
Carbon Waste Roll-off Area (SWMU #24)
Solid Waste Collection Bin and Dumpsters (SWMU #25)
HEAF Filter Roll-Off Bin (SWMU #26)
Tire and Wheel Storage Area (SWMU #27)
90-Day Drum Storage Area (SWMU #28)
Caustic Spill (SWMU #29)

Paste Plant Spill (SWMU #30)
Smelter Sign Area (SWMU #31)
Stormwater pond and appurtenant facilities (SWMU #32)

Areas of Concern (AOCs)

Columbia River Sediments
Groundwater in the Uppermost Aquifer at the Facility
Wetlands
Rectifier Yard
Plant Area

Section 1
Introduction

This section provides an introduction and overview of the project including project objectives, scope, involved parties, and plan organization. This Phase 1 Work Plan has been prepared to address the requirements of the 2014 Agreed Order No. DE 10483 issued by Washington Department of Ecology and dated May 1, 2014. The Agreed Order requires two phases of Remedial Investigation (RI) Work Plan preparation (Phase 1 and Phase 2) that have been prepared as two separate volumes with the following scope:

- This Final Phase 1 Work Plan (Volume 1) summarizes available information and data regarding each Solid Waste Management Unit (SWMU) and area of concern (AOC) identified in the Agreed Order, screens each SWMU and AOC to determine if they require further investigation, and if so, identify data gaps and data needs for each SWMU and AOC.

- The Final Phase 2 Work Plan (Volume 2) defines the specific investigation and evaluation activities for each SWMU and AOC that requires further investigation to characterize the nature and extent of contamination. The Phase 2 Work Plan includes a sampling and analysis plan (SAP), quality assurance project plan (QAPP), and site-specific health and safety plan (HASP). The plans will guide the investigation of the SWMUs and AOCs to complete characterization of the nature and extent of contamination and to obtain the information necessary to identify, define, and evaluate remedial action alternatives in the Feasibility Study (FS). The Phase 2 Work Plan includes an overall description of the RI activities and clearly describe the project management strategy for implementing and reporting on RI activities.

The Draft Phase 1 Work Plan was submitted to Ecology on November 25, 2014 (Tetra Tech et al. 2014). Ecology and Yakama nation comments on the Draft Phase 1 Work Plan were received on January 25, 2015 (Ecology 2015a). Some of the comments were related to specific investigation and evaluation activities for SWMUs and AOCS, which is the objective of the Phase 2 Work Plan. The Draft Phase 2 Work Plan (Tetra Tech et al. 2015), which was submitted to Ecology on May 8, 2015, addressed those comments and specified investigation methods for the SWMUs and AOCs that were retained after the Phase 1 screening. Ecology and Yakama Nation comments on the Draft Phase 2 Work Plan were received on July 6, 2015 (Ecology 2015c). The Final Phase 1 Work Plan (Volume 1)

and Final Phase 2 Work Plan (Volume 2) incorporate responses to the January 25, 2015 and July 6, 2015 comments.

1.1 PROJECT OBJECTIVES

The overall objective of the Agreed Order for all parties is to provide for remedial action where there has been a release or threatened release of hazardous substances (Ecology 2014a). The objective of the Remedial Investigation/Feasibility Study (RI/FS) under the Washington State Model Toxics Control Act (MTCA) is to collect, develop, and evaluate sufficient information regarding a site to select cleanup actions consistent with MTCA requirements. The primary objective of this Phase 1 Work Plan is to perform scoping activities to focus the collection of environmental data. These scoping activities include assembly and evaluation of existing data and information, development of the preliminary conceptual site model, identification of initial screening levels for the environmental media (i.e., soil, groundwater and sediment), determination of data gaps and RI data needs, and preliminary identification of potential cleanup action components for sites that clearly appear to warrant remedial action at this early investigation phase.

1.2 SCOPE OF PHASE 1 WORK PLAN

The Phase 1 Work Plan includes the following: description of general facility information; SWMU and AOC history and conditions; regulatory status where applicable; project background; a conceptual site model; evaluation of contaminant migration pathways; summary and evaluation of geology and groundwater system characteristics; land use; natural resources and ecological receptors including wetlands; hazardous substances sources, and contaminants of concern in compliance with WAC 173-340-350 and WAC 173-204-560.

This Phase 1 Work Plan includes a summary of all past independent field investigations and remedial actions for each of the 32 SWMUs and 4 AOCs listed in the Agreed Order. In addition, a fifth AOC, labeled the Plant Area AOC was identified during preparation of this Phase 1 Work Plan and reported to Ecology in a notification letter (Lockheed Martin and BMEC 2014). All existing environmental data (soil, groundwater, surface water, and sediment) for each SWMU and AOC have been compiled and evaluated for data gaps. The data gaps were used to define RI data needs and investigation objectives and as the basis for specifying additional SWMU and AOC RI

investigations. Ultimately, the RI results will be used to prepare a FS, and select a remedial alternative for each SWMU or AOC as appropriate.

1.3 INVOLVED PARTIES

Washington State Department of Ecology (Ecology) is the lead regulatory agency for the work to be conducted under the 2014 Agreed Order (Ecology 2014a). NSC Smelter, LLC (NSC) and Lockheed Martin Corporation (Lockheed Martin) are the named parties required to undertake actions under the terms and conditions of the Agreed Order. A team of consultants including Tetra Tech, Inc. (Tetra Tech), Blue Mountain Environmental Consultants, Inc. (BMEC), and Plateau Geoscience Group, LLC (PGG) are working for the parties named in the Agreed Order in support of plan preparation. The Confederated Tribes and Bands of the Yakama Nation are an interested party because the site is located in a treaty-defined usual and accustomed fishing area and adjacent to the upland North Shore Treaty Fishing Access Site (TFAS) (Ecology 2014a).

1.4 REPORT ORGANIZATION

The report has been organized into the following major sections:

Section 1.0 **Introduction –** Provides a summary of the project objective, scope, involved parties, and report organization.

Section 2.0 **Background –** Summarizes basic background information about the site including facility description and history, environmental setting, and previous investigations.

Section 3.0 **Regulatory Framework –** Summarizes the regulatory framework relevant to environmental cleanup activities including: permitting and regulatory history overview, chemicals of potential concern, and screening levels for potentially contaminated media at the site including soil, groundwater, and sediment.

Section 4.0 **Site Conceptual Model –** Summarizes the conceptual site model including current and future land use, potential sources and release mechanisms,

transport pathways, exposure media and routes, and human and ecological receptors.

Section 5.0 **SWMU and AOC Evaluation Approach –** Provides an overview of SWMU and AOC data compilation, summary and evaluation approach adopted in this Phase 1 Work Plan.

Section 6.0 **SWMU Summary and Evaluations –** Summarizes and evaluates each SWMU, including: operational history, investigation history, previous environmental data, and a data gaps and data needs evaluation.

Section 7.0 **AOC Summary and Evaluations –** Presents the summary and evaluations for each of the AOC including operational or use history, investigation history, previous environmental data, and a data gaps and data needs evaluation.

Section 8.0 **Identified Data Gaps and Needs –** Summarizes the data gaps and data needs associated with each SWMU and AOC.

Section 9.0 **References –** Lists the cited references for this Phase 1 Work Plan.

Section 2
Background

This section summarized background information regarding the facility including facility description and history, environmental setting, and previous investigations.

2.1 FACILITY DESCRIPTION AND HISTORY

The former Columbia Gorge Aluminum Smelter (site) is located at 85 John Day Dam Road, Goldendale, Washington. It incorporates an area of approximately 350 acres in active use within a 7,000 acre parcel of land currently under the same ownership. The site is located adjacent to the Columbia River approximately 9 miles southeast of the City of Goldendale in Klickitat County (Figure 2-1). The site includes portions of Sections 20 and 21 in T3N, R17E, Willamette Meridian.

The facility was operated nearly continuously as a primary aluminum smelter from its completion of construction in the early 1970s until 2003 when aluminum smelter operations were permanently suspended. The current owner (NSC) plans to redevelop the site for commercial and industrial purposes. Figure 2-2 shows the main features of the former smelter and surrounding area.

When the aluminum reduction facility was in operation, there were a total of 525 electrolytic reduction cells in which aluminum metal was produced. At full capacity, the smelter produced a nominal 176,000 tons of aluminum and aluminum alloys per year and required a work force of 650 employees. During peak operation, the smelter facilities included a carbon plant, four reduction cell lines (Landau 1995), a cast house, rectifier building and electrical substations, a laboratory, administrative offices, storm water and groundwater collection systems, and a sewage treatment plant. In April 2003, the plant was shut down due to the cost of the electrical power. Demolition of all buildings directly associated with the smelter operations, including the reduction cell lines, began in 2011 and was completed in spring 2013.

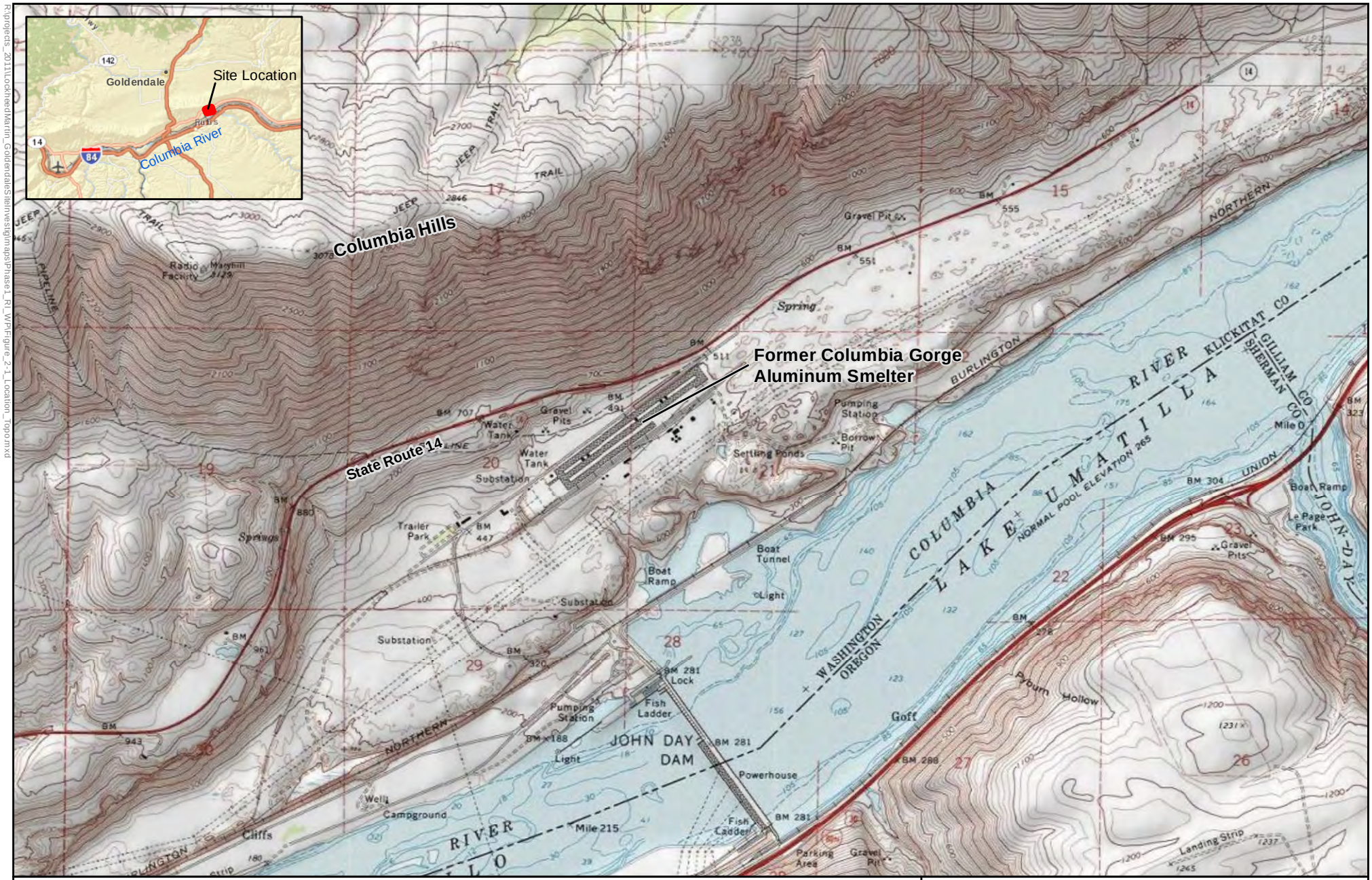

Figure 2-1
Project Location Topographic Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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Legend

Wetlands

N
W E
S

0 500 1,000 2,000

Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 2-2
Primary Site and Vicinity Features Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

The reduction process utilized molten cryolite into which the alumina is dissolved. The electrolytic reaction in the reduction cell caused molten aluminum to precipitate on the cathode in the cell, where it was periodically decanted. During this process, the anode is consumed and particulate and gas emissions were collected and treated. These emissions include polynuclear aromatic hydrocarbon (PAH) compounds that are present in the binder for the carbon anodes and fluoride. Wet scrubbers were used during the early years of plant operation, and wet scrubber effluent that contained PAHs was settled in various impoundments on the site prior to discharge under and NPDES Permit. Replenishment anode material was manufactured onsite in the carbon (paste) plant. In the paste plant, calcined petroleum coke was crushed, screened, and blended with coal tar pitch to form briquettes. Wastes associated with briquette production were non-hazardous wastes, and during the early years of operation these wastes were disposed of at the site.

As a result of aluminum production, the carbon briquettes (pot liners) in the reduction cells accumulated fluoride and cyanide and were periodically replaced when a reduction cell was rebuilt. The spent pot liners (SPL) are currently a listed hazardous waste (K088) due to their content of cyanide salts. During the 1980s, SPL was not a listed waste and was handled at the plant as a solid waste. The principal contaminants associated with the aluminum production process include PAHs, fluoride, and cyanide salts. Other constituents are also present in wastes generated by the facility, including sodium, sulfate and other metals.

Ecology has identified 32 SWMUs and 4 AOCs in the Agreed Order based upon the findings of the PA/SI (Ecology 1989), RCRA Part B Permit Applications (Goldendale Aluminum Company 1997b, ENSR 1991, Parametrix 2004a), historical environment reports and data in Ecology site files, and knowledge of past operations. On October 20, 2014, NSC and Lockheed Martin identified a fifth AOC that incorporates the plant general area. These SWMUS and AOCs are the focus for the RI and development of this Phase 1 Work Plan.

2.2 OWNERSHIP HISTORY

The facility was originally constructed and owned by Harvey Aluminum, who sold it to Martin Marietta in 1971, before the plant became operational. Martin Marietta started operations at the plant in 1971 and continued operations until 1985. In 1985, Martin Marietta sold the plant to Commonwealth Aluminum, who subsequently operated the plan until early 1987. After one-half year of inactivity, Columbia Aluminum purchased and restarted the plant. Columbia Aluminum

operated the plant until 1996, when it was sold to Northwest Aluminum, a subsidiary of Columbia Aluminum, who operated the facility as Goldendale Aluminum Company. The Goldendale Aluminum Company owned the plant until about April 2005, when all assets and liabilities were transferred to NSC (doing business as Columbia Gorge Aluminum). NSC is the current owner and operator of the facility. NSC has plans to redevelop and sell its land. Surface water and groundwater rights and physical water infrastructure are in the process of being conveyed to Klickitat County PUD.

2.3 ENVIRONMENTAL SETTING

This section describes the environmental setting for the facility including location, topography, climate, geology and hydrogeology, surface water, wetlands, and ecology.

2.3.1 Topography

The former smelter is located on a topographic bench about 450 to 540 feet in elevation about 0.5 miles from the Columbia River (see Figure 2-1). South of the site, the bench generally terminates in a line of cliffs above the Columbia River. The Columbia River surface water elevation is about 268 feet mean sea level (msl) in the Lake Umatilla pool upstream of the John Day Dam in the site vicinity. North of the site, the Columbia Hills form a steep ridge with about 2,500 feet of relief with a talus slope extending down slope onto the site. Three natural seasonal drainages are present to the south of the former smelter and north of the Columbia River. One of these drainages was modified during initial plant construction into a series of settling ponds called the National Pollutant Discharge Elimination System (NPDES) Ponds A through D (Figure 2-2).

2.3.2 Climate

The site is located in the eastern portion of the Columbia River gorge in a semi-arid region. Average annual rainfall is about 9 to 12 inches per year with the driest periods occurring during summer through early Fall. The site is characterized by hot, and dry conditions in the summer (average daytime high temperature of 90º F in July) and relatively cold conditions in the winter (average daytime high temperatures of 40º F in December) (The Weather Channel 2014). Locally, most of the precipitation in the area occurs November through February. The wettest months are December and January with an average rainfall of about 2.5 inches per month.

2.3.3 Geology and Hydrogeology

The site is located on the Columbia River Plateau where the bedrock is composed of the Miocene Columbia River Basalt Group. Specifically, the lower to middle Miocene Grande Ronde Basalt Formation underlies the topographic bench in the former smelter vicinity. The Grande Ronde Basalts are generally fine grained and petrographically non-distinctive (Bela 1982). Individual flows range in thickness from less than 3 feet to more than 160 feet but are generally between 50 and 80 feet (Bela 1982). The Grande Ronde Basalts are estimated to be greater than 1,500 feet thick along the lower John Day River (Bela 1982).

The Columbia Hills geologic structure consists of a series of east-west trending anticlines and synclines that are cut by or overlie north-dipping thrust faults (Bela 1982, USGS 2014). A second series of northwest/southeast trending high-angle faults (with associated folds) divide the east west trending folds and faults into a series of segments (Bela 1982, USGS 2014). There is suspected Quaternary movement along some of the northwest/southeast trending fault sections (USGS 2014). An east-west trending thrust fault is present near the base of the Columbia Hills to the north of the site based upon a repeated section within the Grande Ronde Basalt (Bela 1982). The axis of an east-west trending anticline is also mapped within the repeated section of the Grand Ronde Basalt on the northern (upper) side of the thrust fault and may indicate that the fold and thrust fault are interrelated. Rocks of the Middle Miocene Frenchman Springs Member of the Wanapum Basalt Formation forms the crest of the ridge to the north of the site Basalt bedrock in the site vicinity and south of the fault is approximately flat-lying.

Two generally northwest-southeast trending faults, one named Goldendale strike-slip fault and the other a combination strike-slip and normal fault, intersect the thrust fault in the site vicinity (KPUD 2014) (refer to Appendix B-2.3). The Goldendale fault appears to be located west of the WSI, and about one mile downstream of John Day Dam. The second fault passes under the former location of the aluminum plant with the fault trace appearing to coincide with the western gulley that leads from the western end of the Boat Basin up to the western end of the former plant area. According to the John Day Pool pumped storage pre-application document (KPUD 2014), it is unlikely that the faults in the immediate site vicinity are active or have the potential to produce earthquakes.

The bench area represents an erosional feature formed by erosional scour during the Pleistocene Missoula Floods. Unconsolidated deposits in the site vicinity consist of glacial fluvial sediments, alluvium, colluvium shed from the ridge to the north, potential localized eolian deposits, and man-made fill associated with highway construction, dam construction, and smelter construction and operations. These unconsolidated deposits are present as either a discrete stratigraphic unit ranging from a few feet to over 60 feet thick or localized areas within flood-scoured depressions on the basalt bench surface.

Conceptually, the aquifer system can be seen as an unconsolidated alluvial/colluvial aquifer underlain by a series of basalt bedrock aquifer zones that represent the more permeable zones within the basalts. A series of aquifer zones have been previously described including an unconsolidated alluvium/colluvium aquifer zone and a series of water-bearing zones within the basalt bedrock at the site (URS 2009, 2011). A total of 54 monitoring wells and 3 production wells area present at the site (Figure 2-3).

Twenty-nine monitoring wells are completed in the unconsolidated aquifer zone with depths to groundwater ranging from 2 to 54 feet below ground surface (URS 2009). Groundwater flow within this zone is influenced by the geometry of the bedrock depressions and thickness of the unconsolidated materials with overall flow within the unconsolidated aquifer zone to the southwest toward the Columbia River. Hydrologic inputs to the unconsolidated system on site include direct precipitation and runoff, and groundwater input from the south facing slope of the Columbia Hills (URS 2009, 2011).

Twenty-five monitoring wells are completed within the basalt aquifer system. Basalt flows commonly consist of a dense interior bounded by more permeable fractured and vesicular zones at the flow tops and flow bottoms. In some cases, sedimentary and volcaniclastic interbeds can be present between the flows. However, interflow zones have not been correlated with confidence across the site (URS 2009, 2011) and the degree of hydraulic interconnection vertically and horizontally appears to be variable.

Groundwater flow within the basalt is reportedly to the southwest toward the Columbia River and consistent with area topography. Hydrologic inputs to the basalt aquifer system at the site include direct precipitation and runoff where the unconsolidated aquifer is absent, leakage from the

Legend

MW-9A
Monitoring Well Location

Well #1
Production Well Location

N
W E
S

0 500 1,000 2,000
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 2-3
Existing Well Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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unconsolidated aquifer, and groundwater input from the south facing slope of the Columbia Hills (URS 2009, 2011).

Three production wells are present near the smelter (refer to Figure 2-3). These wells are 1,000, 504, and 1,128 feet deep and are completed within the basalt aquifer system at elevations below the Columbia River surface elevation upstream of John Day Dam.

Additional details regarding the occurrence of groundwater, site hydrogeology, and groundwater quality are provided in Section 7.2.

2.3.4 Surface Water

The Columbia River is the major water body in the site vicinity (Figure 2-1). The John Day River flows from Oregon into the Columbia River about 1 mile upstream of the former smelter.

The John Day Dam spans the Columbia River and is equipped with fish passages that are used by various runs of salmon and steelhead, including some that are threatened. The Columbia River in the site vicinity is expected to represent a depositional area characterized by a fairly rapid depositional rate because of the nearby influx of sediment from the John Day River and the position of the reach of the Columbia River near the site that is upstream of the John Day Dam (Figure 2-1).

The site is located in a treaty-defined usual and accustomed fishing area of the Confederated Tribes and Bands of the Yakama Nation. The upland North Shore TFAS is located adjacent to the Columbia River immediately upstream of the John Day Dam (Ecology 2014a). Enrolled Yakama tribal members exercise treaty reserved fishing rights for ceremonial, subsistence, and commercial purposes from numerous traditional platforms on the Washington shore of the Columbia River within a mile of the site (Ecology 2014a).

A public boat launch area and Boat Basin are located about 0.5 miles from the former smelter and upstream from the John Day Dam. The North Shore TFAS represents an upland area located immediately west of the boat launch and Boat Basin, and is operated and maintained under the jurisdiction of the Yakama Nation and the United States (Ecology 2014a). All of these features are on land owned by the U.S. Army Corps of Engineers (Figures 2-1 and 2-2).

Use designations for the reach of Columbia River in the site vicinity under the Washington State Surface Water Regulations (WAC 173-201A-602, Table 602) include: 1) aquatic life uses of spawning and rearing, 2) primary recreation use, 3) water supply uses including domestic, industrial, agricultural, and stock water and 4) miscellaneous uses including wildlife habitat, harvesting, commerce/navigation, boating, and aesthetics.

There are three natural drainages that lead from the southern margin of the former smelter. The easternmost drainage contains the NPDES ponds and two drainages farther west drain into the Boat Basin. The two westernmost drainages correspond with wetland areas of the facility (refer to Figure 2-2).

2.3.5 Wetlands

Wetlands have been delineated and studied in the site vicinity (PGG 2013a,b; Tetra Tech 2011b) and consist primarily of Category III and IV palustrine emergent and/or palustrine scrub/shrub wetlands. About 14 wetland areas have been mapped, at the site (PGG 2013a,b; Tetra Tech 2011b). Most of these wetlands have been disturbed by grazing, and historical grading activities. Category III and Category IV wetlands represent wetlands with a moderate to low level functions that generally have been disturbed in some ways and are often smaller, less diverse, and/or more isolated from other natural resources than other higher functional category wetlands.

2.3.6 Ecology

The subject property is part of Eastern Washington shrub-steppe community that includes sagebrush, bunch grass, and rabbit brush. The habitat near the site is commonly referred to as "scablands" that includes sagebrush and grasses between areas of exposed bedrock with a hummocky topography. The basalt also forms cliffs in areas along the Columbia River and steep talus slopes north of the site along the base of the Columbia Hills (refer to Figure 2-1). In wetter areas, such as near depression wetlands at the site or where the water table is relatively shallow, tree species include oak, pine, hackberry, willow, and Russian olive.

The area provides habitat for numerous bird species such as sparrows, chukar, quail, turkeys, crows, and raptors including the red-tailed hawk, and golden eagle. Ponds and wetland areas provide habitat for ducks, geese and other water birds. Mammals may include mice and other rodents, rabbits,

raccoons, skunks, foxes, coyotes, and deer. A few reptile species including rattlesnakes occur in the site vicinity.

State or federally designated threatened and endangered species are listed to occur in the site vicinity, and in the nearby Columbia River. Listed species include the western gray squirrel (state listing as threatened) as well as various federally listed threatened fish including particular bull trout, steelhead, Chinook salmon, and chum salmon runs. The Snake River sockeye salmon is federally listed as endangered.

2.4 PREVIOUS INVESTIGATIONS

The former aluminum reduction facility in Goldendale was in operation from 1971 to 2003, and has a correspondingly long history of environmental investigation, cleanup, and site closure performed in association with environmental permits and regulations in place at the time.

NSC and Lockheed Martin have conducted independent investigations and remedial actions at the site in accordance with cleanup responsibilities as identified in a November 3, 1993 Settlement Agreement. Environment investigations have been previously conducted at several of the SWMUs and AOCs and independent remedial actions have been performed at the NPDES Ponds (SWMU 1) and the Intermittent Sludge Disposal Ponds (SWMU3). In addition, some of the SWMUs have also been formally closed under Resource Conservation and Recovery Act (RCRA) regulations including: the East Surface Impoundment (SWMU 2) closed in 1987 and the West Surface Impoundment (SWMU 4) closed in 2004. The West SPL Storage Area (SWMU 13) was closed under the Washington State solid waste regulations in 1988.

Past investigation history and environmental data for each SWMU and AOC are summarized in detail in Sections 6.0 and 7.0 of this Work Plan.

Section 3
Regulatory Framework

This section summarizes the environmental regulatory framework for site and this RI/FS project.

3.1 PERMIT AND REGULATORY HISTORY OVERVIEW

This section summarizes key environmental permitting and regulatory history of the site.

3.1.1 RCRA Permit

A significant part of the RCRA permit history of the facility relates to the listing, delisting, and subsequent relisting of SPL as a RCRA listed hazardous waste. SPL was initially listed as a RCRA hazardous waste by EPA in July 1980 because of its cyanide content, but was then delisted on January 16, 1981 resulting from a Congressional mandate that excluded mineral processing wastes. On September 13, 1988, EPA again listed SPL as a hazardous waste. Ecology has responded to the delisting and listing process by modifying the authorized state regulations (Washington State Dangerous Waste Regulations, WAC 173-303) to reflect the RCRA listing status of SPL. The RCRA permit history for the facility reflects these changes in regulation.

In addition to the SPL, the wastewater sludges disposed of in surface impoundments [East Surface Impoundment (SWMU 2) and West Surface Impoundment (SWMU 4)] were found to have received state-only dangerous wastes based on bioassay criteria in place at that time and regulated under the RCRA Permit.

The extremely hazardous waste state designation for wastes containing PAHs at concentrations greater than one percent (WAC 173-303-100[6]) will be applicable or relevant for future investigation and remediation activities that may generate PAH-containing wastes.

Major RCRA Permit milestones include the following as described in the Agreed Order:

- SPL was listed as a RCRA hazardous waste in July 1980 because of its cyanide content.
- On January 14, 1981, Martin Marietta submitted a RCRA Part A permit application to EPA. In the Part A application, ongoing dangerous waste management of SPL

was identified. Pursuant to this notification, EPA issued identification number WAD990828642.

- SPL was then delisted as a RCRA hazardous waste on January 16, 1981.

- On August 6, 1982, Martin Marietta submitted a RCRA Part A permit application and notified Ecology of the storage of dangerous waste at the facility.

- In 1982, Ecology tested SPL at the facility for extraction procedure toxicity and fish bioassay toxicity. Martin Marietta tested SPL in 1984 for fish and rat toxicity. The SPL passed these characteristic tests and did not designate as a dangerous waste.

- On July 3, 1984, Martin Marietta submitted a modified RCRA Part A permit application to Ecology that removed the delisted SPL and added treatment and storage of primary sulfur dioxide scrubber wastewater in the East Surface Impoundment (ESI) and West Surface Impoundment (WSI). The scrubber wastewater was designated as a Washington State Dangerous Waste based on bioassay results.

- In 1987, the ESI was closed under RCRA after receiving Ecology approval.

- The West SPL Storage Area (SWMU 13) was closed as a solid waste landfill during 1988 prior to the re-listing of SPL as a hazardous waste.

- On September 13, 1988, EPA again listed SPL as a hazardous waste (designated as K088).

- The owner of the site on and following the date of re-listing of SPL (Columbia Aluminum Corporation) became subject to RCRA requirements for the re-listed SPL

- Ecology performed a preliminary assessment/site investigation (PA/SI) at the Facility from 1987-1989. The PA/SI was used to identify those areas at a Dangerous Waste Management Facility where releases(s) or threat of releases of hazardous substances many have occurred or may be occurring. The SWMUs at the site were defined in the various iterations of the RCRA Part B Permit Application (Goldendale Aluminum Company 1997b, ENSR 1991, Parametrix 2004a). The PA/SI was also used to determine the site ranking and priority for cleanup. The Final Site Inspection Report was completed in May 1989 (Ecology 1989).

- The site was listed on Ecology's Hazardous Sites List (Site Register) on August 28, 1990 with a ranking of three (3). Sites with a ranking of one (1) are the state's highest priority and five (5) the lowest priority.

- On April 7, 1991, the modification to the state regulations with respect to SPL went into effect, and the North SPL storage Containment Building, the South SPL Storage Building, and the SPL Handling Containment Building became regulated Dangerous Waste Management Units.

- During the early to mid-1990s, Columbia Aluminum submitted a modified RCRA Part A application in response to the regulation change. A RCRA Part B Closure Permit Application was also submitted to Ecology and EPA for the North and South SPL Storage Buildings (SWMUs 14 and 15), the SPL Handling Containment Building (SWMU 16), and the WSI (SWMU 4).

- The closure plan for the WSI was updated in February 1995.

- In April 1996, EPA adopted land disposal restrictions (land ban) for SPL. Columbia Aluminum was required either to remove its enclosed SPL waste piles or change its dangerous waste management status to an acceptable classification.

- The South SPL Storage Building (SWMU 15) was clean closed under RCRA in 1996.

- Prior to the land ban effective date of October 1997, the enclosed SPL waste pile buildings were converted to containment buildings. A modified Part A permit application was submitted to Ecology by the then current owner, Goldendale Aluminum Corporation to reflect this change. In 1997, a modified RCRA Part B Permit Closure application was submitted for the SPL Containment Buildings (SWMUs 14 and 15).

- Aluminum smelter operations were permanently shut down on March 30, 2003 when all cell operations ceased. Most waste management operations were ceased after plant shutdown.

- The RCRA closure process for the WSI was started in 2004. A revised RCRA Part B application was submitted in August 2004 to reflect closure of the WSI. Ecology approved the WSI closure plan in October 2004 and the WSI was closed on November 30, 2005.

- The North SPL Storage Containment Building (SWMU 14) was clean closed under RCRA during July 2009.

- The SPL Handling Containment Building (SWMU 16) was clean closed under RCRA and demolished in November 2011.

- A final status permit has not been issued and the Facility continues as a RCRA interim status facility (Ecology 2014).

3.1.2 MTCA Agreed Order

Investigation and potential cleanup of the Ecology-identified SWMUs and AOCs will be conducted under the requirements of the Agreed Order, which was issued pursuant to the Washington Model Toxics Control Act (WAC 173-340). Investigation and cleanup of the SWMUs and AOC will be conducted consistent with MTCA requirements. The Agreed Order requires preparation of a remedial investigation work plan, performance of an RI/FS, and development of a Draft Cleanup

Action Plan for the former Columbia Gorge Aluminum Smelter site. Preparation of this Phase 1 Work Plan was conducted consistent with MTCA RI/FS requirements (WAC 173-340-350).

There is also provision in the Agreed Order for performance of interim measures before completion of the RI/FS if necessary to a reduce a threat to human health and the environment, correct a problem that may become substantially worse or cost substantially more, or that may be needed for completion of the remedy design and RI/FS.

3.1.3 Wastewater Discharge Permitting

Wastewater discharges at the site have been permitted since the initial construction of the facility in the early 1970's. Waste streams from the facility's air pollution control scrubber systems were discharged under a NPDES permit into Ponds A and B and the discharge from these ponds was historically combined with plant's other industrial discharges (e.g., cooling water, storm water run-off, and treated sewage) as well as the secondary smelter scrubber effluent stream at a point down stream of Pond B. These combined discharges historically flowed down an associated drainage channel into gravel-lined Ponds C and D (refer to Figure 2-2).

The permit conditions have been modified several times during the long period of operation of the smelter to reflect changes in the wastewater discharge regulations, smelter operations, air pollution controls, and associated wastewater treatment.

During the most recent period of active smelter industrial operations, a water treatment plant was operated to remove fluoride and suspended solids from the blowdown of two secondary scrubber recirculated water streams and two primary emission control system $S0_2$ scrubbers. The NPDES Permit (No. WA 000054-0), effective June 1, 2002, was issued to allow the discharge of treated scrubber water to the Columbia River. Industrial wastewater and stormwater effluent limits and/or monitoring were included in the permit for aluminum, total suspended solids (TSS) fluoride, oil and grease, benzo(a)pyrene, antimony, nickel, arsenic, pH, temperature, and flow. This permit was later re-issued on April 1, 2008, modified on March 30, 2012, and was scheduled to expire on May 1, 2013 (Ecology 2012). However, Ecology and NSC are reportedly still in discussion regarding the modified permit which remains in effect at the time of this Work Plan.

In 2010, Lockheed Martin cleaned up the NPDES ponds and associated discharges as part of an independent cleanup action (ARCADIS 2011a). A bypass pipeline was constructed in May 2010 to route stormwater around the former ponds. Currently, there are no active industrial waste water discharges to the Columbia River as the plant ceased operations during 2003. Stormwater from the facility continues to discharge to the Columbia River through the pipeline that was constructed in 2010.

3.1.4 Air Permitting

Emissions from the smelter have been regulated and permitted since initial construction of the facility. The facility has been subject to the air operating permit requirements of WAC 173-401 that were established to meet Title V of the Federal Clean Air Act. Monitored and regulated emissions have included particulate matter (PM_{10}), CO, SO_2, NO_x, volatile organic compounds (VOCs), total fluoride (expressed as HF), carbonyl sulfide, and particulate organic matter (POM) (Landau 1995).

At the peak plant expansion and capacity, the primary smelter consisted of four production lines, a paste plant, and a cast house. Primary air emissions from the reduction cells were treated by dry scrubbing to remove particulates and fluoride, followed by wet scrubbing for removal of sulfur dioxide. Secondary fugitive air emissions from the pot rooms that were not captured by the primary system were treated by wet roof scrubbers. Before 1980, a wet scrubber system was used to control all air emissions.

3.1.5 Water Rights and Use

Surface water and groundwater in the site vicinity has been primarily used for commercial, industrial, irrigation, and domestic purposes. The Department of Ecology's Water Resources Program maintains for the State of Washington various documents and records related to existing or requested water rights and water claims.

The water rights information summarized below was obtained from the Washington Water Rights Explorer Database (Ecology 2014b). This geographic information system (GIS) application contains pertinent information regarding Water Right Applications, Examinations, Permits, Claims, and Certificates that has been put into the Water Right Tracking System (WRTS) database. The spatial components (place of water use and the source location) of these documents have been included in the Geographic Water-Right Information System (GWIS) database. Information from this database

was accessed online during June 2014. Water rights records for the site and immediate vicinity are briefly summarized in Table 3-1.

The largest water rights in the vicinity were associated with aluminum smelter operation. The rights originally included both groundwater and surface water. The surface water right was for commercial and industrial purposes. The water right has been transferred to Klickitat County Public Utility District (PUD); the water use designation recently has been changed from industrial to municipal and the place of use has been expanded to various locations in Klickitat County. The groundwater right is for three wells and the designated use was for commercial, industrial and domestic purposes. This water right appears to have been transferred to Klickitat County PUD, with a change in use to Municipal Use. Records of approval of this application were not found in the database records at the time of this Work Plan.

There are also a few records of domestic, irrigation, and stock watering water rights (groundwater and surface water springs) in the site vicinity located west and northwest of the smelter. The U.S. Army Corps of Engineers has groundwater rights for heat exchange/cooling water and domestic use associated with operations of the John Day Dam located south of the site.

3.2 CHEMICALS OF POTENTIAL CONCERN

Chemicals of potential concern (COPC) for the site include the typical suite of chemicals associated with aluminum reduction facilities. These include: cyanide, fluoride, sulfate, and PAHs. In addition, polychlorinated biphenyls (PCBs), some metals (e.g., arsenic, cadmium, nickel, and lead), VOCs related to fuels and solvents, and total petroleum hydrocarbons (TPH) represent COPC for some areas and media at the site.

Table 3-1
Water Rights Summary

Columbia Gorge Aluminum Smelter Site Vicinity
Goldendale, Washington

Water Rights Numbers		Water Rights Holder Name	Well Identification and Point of Withdrawal	Water Type	Authorized Water Quantity		Water Use Designation	Place of Use/Location
WRTS File Number	Certificate Number				Instantaneous (gpm)	Yearly (Acre-feet per year)		
G4-01130ALWRIS	G4-0113000	Martin Marietta	2 wells	Groundwater	900	1,440	Commercial, industrial, and domestic	Production area of former facility
S3-00845WRIS	83-00845C	Martin Marietta	Columbia River	Surface water	35.3	25,416	Commercial and Industrial	Production area of facility
CS3-00845C@1	S3-00845C (Application for Change of Use)	Columbia Gorge Aluminum	Columbia River	Surface water	35.3 cfs	17,048	Commercial and Industrial	Existing is for general plant property, change in place of use
S14-122046CL	Pre- 97-98 Claim	Burlington Northern	Spring	Surface water	Unknown	Unknown	Railway operations	Railway property west of dam
S4-052977CL	Pre-97-98 claim	Cora Wegner	Spring	Surface water	21	33.0 acre feet over 0.5 irrigated acres	Domestic general, irrigation, stock water	West of John Day Dam
S4-011231CL	Pre-97-98 claim	Washington DNR	Spring	Surface water	1	0.1	Stock water	Hillside north-northeast of former plant
G7-27850WRIS	G7-27580C	ACOE	Well	Groundwater	600	968	Heat exchange	Near John Day Dam
G4-*05724WRIS	Volume 10, page 4575-A	ACOE	Well	Groundwater	600	960	Domestic single, heat exchange	Near John Day Dam
G3-00874CWRIS	G3-00874C	Holden GR and NJ	Wells	Groundwater	150	240	Domestic, multiple	NW of facility
CG4-01130C	Application only	Klickitat County PUD	3 wells	Groundwater	900	1,440	Change of use to municipal	North of facility
CS3-00845C@2	S3-00845C as changed under CS3-00845C	Klickitat County PUD	Columbia River	Surface water	35.3	15,591	Change of use to municipal	Portions of Klickitat County (including Cliffs Water System)
CS3-00845C@4	S3-00845C as changed under CS3-00845C@2	Klickitat County PUD	Change point of diversion to Roosevelt pump station	Surface water	0.67 cfs	112	Change of use to municipal/power	Portions of Klickitat County

Notes:
cfs Cubic feet per second
gpm Gallons per minute
WRTS Water Rights Tracking System

Cyanide, fluoride, and sulfate are related to smelter operations and used pot liners at the site. Fluoride is present in the cryolite bath material. PAHs and sulfate are present in the coke and pitch for the manufacture of briquettes used to line the pots. Cyanide is produced in trace amounts within the pot liners during the aluminum reduction process. PCBs were historically used in oils in the capacitors and transformers at the site.

PAH particulates from the aluminum processing cells became entrained in gaseous emissions and removed by the scrubber air pollution control system (in particular the wet air scrubber system), which then generated a PAH-containing waste water stream and sludges.

3.3 SCREENING LEVELS

This section summarizes a range of screening levels appropriate for this Phase 1 Work Plan. These levels have been used as an initial basis of comparison to help evaluate the need for further investigation of specific SWMUs and AOCs at the site. Under Superfund terminology, these screening levels represent potential chemical-specific applicable, relevant, and appropriate requirements (ARARs) for the project that will be further evaluated during the RI/FS. Identification and summarization of location and action-specific ARARs will be presented in the RI report, and FS report, as appropriate.

For soil and groundwater media, the primary screening levels identified for use in this Phase 1 Work Plan are MTCA Method A, B, and C Cleanup Levels (Chapter 173-340 WAC). A brief summary description of Method A, B, and C Cleanup Levels follows:

- Method A provides tables of cleanup levels that are protective of human health for the 25 to 30 most common hazardous substances for soil and groundwater and including petroleum hydrocarbons. Method A is designed for cleanups that are relatively straightforward or involve only a few hazardous substances. Use of Method A may be appropriate for some specific-SWMUs at the site.

- Method B represents the universal method under MTCA with cleanup levels acceptable for unrestricted (all) land uses and consistent with state and federal requirements. Human health levels for individual carcinogens cannot exceed one-in-a-million and cumulative site cancer-risk levels may not exceed 1 in 100,000. Levels of non-carcinogens cannot exceed the point at which a substance may cause illness in humans (that is the hazard quotient must be less than 1).

- Method C is a conditional method that is fairly commonly used to set soil cleanup levels at qualifying industrial sites and for groundwater in some specific circumstances. Method C based on less stringent exposure assumptions and higher lifetime cancer risk thresholds than Method B. Institutional controls must be implemented and maintained as part of site cleanup action in which Method C cleanup levels are adopted.

Note that the screening levels presented in this section do not represent established site cleanup levels, rather will be used for initial site screening in this Phase 1 Work Plan. Site cleanup levels will be evaluated and proposed in the RI report and FS report as well as in the draft Cleanup Action Plan (CAP). Cleanup levels will be evaluated based on the remedial investigation results consistent with MTCA requirements.

The screening levels in this Phase 1 Work Plan have been used to help identify and confirm sites needing further investigation, and to help determine data needs for the RI. Three factors have been evaluated in determining which sites are carried forward for further RI field investigation: 1) information regarding past operations, disposal practices, and the potential for releases, 2) comparison of existing environmental data with the screening levels, and 3) the adequacy of the characterization of the nature and extent of contamination at particular sites based on the existing environmental data.

Standard formula values have been adopted from the Cleanup and Risk Calculation (CLARC) Data Summary Tables accessed online during June and August 2014 (Ecology 2014d). In cases where formula values for both non-cancer and carcinogenic risks were provided, the lower of the two formula value cleanup levels (usually carcinogenic) was included.

3.3.1 Soil

A variety of cleanup levels have been used for characterization and cleanup at the site over the years. Ecology has stated in comments on the Draft Phase 2 Work Plan (Ecology 2015c) that for the purposes of the RI/FS, future industrial land use will be considered, which suggests that MTCA Method A and C Industrial Soil Cleanup Levels may be appropriate. MTCA Methods A, B, C, and MTCA terrestrial ecologic screening levels have been adopted for screening purposes in this Phase 1 Work Plan. Soil screening levels for site COPC are summarized in Table 3-2.

Table 3-2
Soil Screening Level Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
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Chemicals of Potential Concern	MTCA Screening Levels (Concentrations in mg/kg)						Range of Background Concentrations
	Method A		Method B	Method C	Protection of Groundwater	Ecological (e) Unrestricted/Industrial	
	Unrestricted Land Use	Industrial					
Aluminum Smelting							
Cyanide (Free)	NE	NE	48	2,100	NE	NE	NE
Fluoride	NE	NE	3,200	140,000	NE	NE	14.11(i)
Sulfate	NE	NE	NE	700,000	NE	NE	NE
Polynuclear Aromatic Hydrocarbons (PAHs)							
Acenaphthene	NE	NE	4,800	210,000	NE	20(f) plants	NE
Acenaphthylene	NE	NE	NE	NE	NE	NE	NE
Anthracene	NE	NE	NE	NE	NE	NE	NE
Benzo(g,h,i)perylene	NE	NE	NE	NE	NE	NE	NE
Fluoranthene	NE	NE	3,200	140,000	NE	NE	NE
Fluorene	NE	NE	3,200	140,000	NE	30(f) soil biota	NE
1-Methylnaphthalene	NL(a)	NL(a)	34.5	4,530	NL(a)	NE	NE
2-Methylnaphthalene	NL(a)	NL(a)	320	14,000	NL(a)	NE	NE
Naphthalene	5 (a)	5 (a)	1,600	70,000	5 (a,g)	NE	NE
Phenanthrene	NE	NE	NE	NE	NE	NE	NE
Pyrene	NE	NE	2,400	100,000	NE	NE	NE
Carcinogenic PAHs							
Total Toxicity Equivalent Concentration (TTEC)	0.1 (b)	2(b)	0.14 (c)	18	0.1(b,g)	NE	NE
Benzo(a)pyrene	0.1(b)	2(b)	0.137	18	0.1(b,g)	30/300	NE
Benzo(a)anthracene	NL(b)	NL(b)	1.37	180	NL(b)	NE	NE
Benzo(b)fluoranthene	NL(b)	NL(b)	1.37	180	NL(b)	NE	NE
Benzo(k)fluoranthene	NL(b)	NL(b)	13.7	1,800	NL(b)	NE	NE
Chrysene	NL(b)	NL(b)	137	18,000	NL(b)	NE	NE
Dibenz(a,h)anthracene	NL(b)	NL(b)	0.137	18	NL(b)	NE	NE
Indeno(1,2,3-cd)pyrene	NL(b)	NL(b)	1.37	180	NL(b)	NE	NE
Polychlorinated Biphenyls (PCBs)							
Total PCBs	1.0	10.0	0.5	65.6	NE	2/2	NE
Aroclors							
1016	NE	NE	14.3	245	NE	NE	NE
1221	NE	NE	NE	NE	NE	NE	NE
1232	NE	NE	NE	NE	NE	NE	NE
1242	NE	NE	NE	NE	NE	NE	NE
1248	NE	NE	NE	NE	NE	NE	NE
1254	NE	NE	0.5	65.6	NE	NE	NE
1260	NE	NE	0.5	65.6	NE	NE	NE

Table 3-2
Soil Screening Level Summary
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 2 of 3)

Chemicals of Potential Concern	MTCA Screening Levels (Concentrations in mg/kg)						Range of Background Concentrations
	Method A		Method B	Method C	Protection of Groundwater	Ecological (e) Unrestricted/Industrial	
	Unrestricted Land Use	Industrial					
Metals							
Aluminum	NE	NE	80,000	3,500,000	NE	50(f) plants	12,692 (i)/28,299 (h)
Arsenic	20	20	0.667	87.5	20 (g)	20/20	1.9 (i)/7.61 (h)
Cadmium	2	2	80	3,500	2(g)	25/36	0.07(i)/ 0.81 (h)
Chromium (III)	2,000	2,000	120,000	5,250,000	2,000(g)	42/135	12.37(i)/ 31.88(h)
Copper	NE	NE	3,200	140,000	NE	100/550	28.4 (h)
Lead	250	1,000	NE	NE	NE	220/220	5.19(i)/13.1 (h)
Mercury	2	2	NE	NE	2 (g)	9/9 (inorganic Hg)	0.0015(i)/0.04 (h)
Nickel (d)	NE	NE	880	38,500	NE	100/1,850	24.54 (h)
Selenium	NE	NE	400	17,500	NE	0.8/0.8	0.29(i),
Silver	NE	NE	400	17,500	NE	2(f) plants	0.14(i)
Zinc	NE	NE	24,000	1,050,000	NE	270/570	80.91(h)
Total Petroleum Hydrocarbons (TPHs)							
TPH-Gx (gasoline-extended range)	100 (if sum of BTEX <1 percent), 30	100 (if sum of BTEX <1 percent), 30	NE	NE	NA	200/12,000 with no residual saturation	NA
TPH-Dx (diesel and heavy-oil ranges)	2,000	2,000	NE	NE	NA	460/15,000 with no residual saturation	NA
Volatile Organic Compounds (VOCs)							
Fuel-Related							
Benzene	0.03	0.3	18.2	2,390	0.03 (g)	NE	NA
Toluene	7	7	6,400	280,000	7 (g)	NE	NA
Ethyl benzene	6	6	8,000	350,000	6 (g)	NE	NA
Xylenes	9	9	16,000	700,000	9 (g)	NE	NA
Solvent-Related							
Tetrachloroethene (PCE)	0.05	0.05	480(j)	21,000(j)	0.05(g)	NE	NA
Trichloroethene (TCE)	0.03	0.03	11(j)	1,800(j)	0.03(g)	NE	NA
1,1,1-Trichloroethane (1,1,1-TCA)	2.0	2.0	160,000	7,000,000	2(g)	NE	NA
1,2,-Dichloroethane (1,2-DCA)	NE	NE	11	1,440	NE	NE	NA
cis-1,2-Dichlorothene (cis-1,2-DCE)	NE	NE	160	7,000	NE	NE	NA
Vinyl chloride	NE	NE	0.67(j)	87.5(j)	NE	NE	NA

Notes:

(a) Method A level includes sum of 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene.
(b) Method A level based on toxicity equivalency factor summation approach specified in WAC 173-340-708(8) and Table 708-2 of MTCA.
(c) Represents Method B level used at SWMU 1 (NPDES ponds) based on toxicity equivalency factor summation approach specified in WAC 173-340-708(8) and Table 708-2 of MTCA.
(d) CLARC value for nickel refinery dusts adopted for screening purposes.

Table 3-2
Soil Screening Level Summary
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
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Notes (Continued):

(e) Priority Contaminants of Ecological Concern for Sites that Qualify for the Simplified Terrestrial Ecological Evaluation Procedure, Table 749-2, WAC 173-340-7492.
(f) Ecological indicator soil concentration for protection of plants, soil biota, or wildlife (Table 749-3, WAC 173-340-7493, MTCA).
(g) Method A soil level is designed to be protective of groundwater drinking water use.
(h) Natural background based on Ecology (1994) soil natural background concentration study. Value represents 90th percentile of eastern Washington data set.
(i) Site-specific background value from PGG (2013a) site investigation.
(j) Includes updated CLARC values for PCE, TCE, and vinyl chloride.

CLARC Cleanup Level and Risk Calculations Summary Tables and guidance accessed online during June 2014.
MTCA Model Toxics Control Act
NA Not applicable
NE Not established in look-up Tables.
NL Not listed. Screening level for specific chemical is not listed, but is accounted for by summation process. Refer to footnotes.

3.3.1.1 MTCA Method A, B, and C

MTCA Method A, B, and C soil cleanup levels have been included for screening comparison purposes in this Phase 1 Work Plan. Method A Cleanup levels for both Unrestricted Land Use and Industrial properties are included. Note that for some chemicals, the Method A soil cleanup level is based on protection of groundwater.

3.3.1.2 Terrestrial Ecologic Soil Screening Values

MTCA (WAC 1173-340-7490) defines procedures for determining whether a release of hazardous substances to soil may pose a threat to terrestrial ecologic receptors. The procedures are not intended to evaluate potential threats to ecological receptors in sediments or surface water. The regulation includes procedures for both a simplified terrestrial ecological evaluation and site-specific terrestrial ecologic evaluation. Table 749-2 and 749-3 (WAC 173-340-900) include soil screening values for sites that qualify for the simplified terrestrial ecological evaluation procedure and ecological indicator soil concentration for protection of terrestrial plants and animals, respectively. Soil screening values for Site COPC have been adopted from these Tables for ecological screening purposes in this Phase 1 Work Plan for those SWMUs outside of the former smelter footprint with available habitat. The evaluation approach and screening procedures for terrestrial ecologic evaluation for the RI are fully described in the Phase 2 Work Plan.

3.3.2 Groundwater

Table 3-3 summarizes groundwater screening levels considered for use in support of this Phase 1 Work Plan. Based on initial review of water rights and groundwater use, it appears that MTCA Method A and Method B groundwater cleanup levels are appropriate. Groundwater at this site is considered to represent a potential source of drinking water as that represents its highest beneficial use consistent with MTCA requirements, and given the recent change of groundwater rights for the former plant production wells to municipal use. However, Method C industrial groundwater cleanup levels are also provided for general comparison purposes.

3.3.3 Sediment

Sediment screening levels are summarized in Table 3-4. The Washington Sediment Management Standards represent the main regulations for conducting sediment cleanups in the State of

Table 3-3
Groundwater Screening Level Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 1 of 2)

Chemicals of Potential Concern	MTCA Screening Levels Concentrations in µg/L			WA MCL
	Method A	Method B	Method C	
Aluminum Smelting				
Cyanide	NE	9.6	21	200
Fluoride	NE	640	1,400	4,000
Sulfate	NE	NE	NE	250,000 (federal secondary)
Polynuclear Aromatic Hydrocarbons (PAHs)				
Acenaphthene	NE	960	2,100	NE
Acenaphthylene	NE	NE	NE	NE
Anthracene	NE	4,830	10,500	NE
Benzo(g,h,i)perylene	NE	NE	NE	NE
Fluoranthene	NE	640	1,400	NE
Fluorene	NE	640	1,400	NE
1-Methylnaphthalene	NL(a)	1.51	15.1	NE
2-Methylnaphthalene	NL(a)	32	70	NE
Naphthalene	160 (a)	160	350	NE
Phenanthrene	NE	NE	NE	NE
Pyrene	NE	480	1,050	NE
Carcinogenic PAHs				
Total Toxicity Equivalent Concentration (TTEC)	0.1	NE	NE	NE
Benzo(a)pyrene	0.1(b)	0.012	0.12	0.2
Benzo(a)anthracene	NL(b)	0.12	1.2	NE
Benzo(b)fluoranthene	NL(b)	0.12	1.2	NE
Benzo(k)fluoranthene	NL(b)	1.2	12	NE
Chrysene	NL(b)	12	120	NE
Dibenz(a,h)anthracene	NL(b)	0.012	0.12	NE
Indeno(1,2,3-cd)pyrene	NL(b)	0.12	1.2	NE
Polychlorinated Biphenyls (PCBs)				
Total PCBs	0.1	0.0438	0.438	0.5
1016	NE	1.12	12.5	NE
1221	NE	NE	NE	NE
1232	NE	NE	NE	NE
1242	NE	NE	NE	NE
1248	NE	NE	NE	NE
1254	NE	0.0438	0.438	NE
1260	NE	0.0438	0.438	NE
Metals				
Aluminum	NE	16,000	35,000	NE
Arsenic	5	0.0583	0.583	100
Cadmium	5	8	17.5	5
Chromium (total)	50	NE	52,500 (Cr III)	100
Copper	NE	320	700	13,000
Lead	15	NE	NE	15
Mercury	2	NE	NE	2
Nickel (d)	NE	176	385	100
Selenium	NE	80	175	50
Silver	NE	80	175	NE
Zinc	NE	4,800	10,500	NE

Table 3-3
Groundwater Screening Level Summary
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 2 of 2)

Chemicals of Potential Concern	MTCA Screening Levels Concentrations in µg/L			WA MCL
	Method A	Method B	Method C	
Total Petroleum Hydrocarbons (TPHs)				
TPH-Gx (gasoline-extended range)	100 (no benzene) 80 (benzene present)	NE	NE	NE
TPH-Dx (diesel and heavy-oil ranges)	500	NE	NE	NE
Volatile Organic Compounds (VOCs)				
Fuel-Related				
Benzene	5	0.795	70	5
Toluene	1,000	640	1,400	1,000
Ethyl benzene	700	800	1,750	700
Xylenes	1,000	1,600	3,500	10,000
Solvent-Related				
Tetrachloroethene (PCE)	5	5(d)	5(d)	5
Trichloroethene (TCE)	5	4(d)	5(d)	5
1,1,1-Trichloroethane (1,1,1-TCA)	200	16,000	35,000	200
1,2,-Dichloroethane (1,2-DCA)	5	0.481	4.81	5
cis-1,2-Dichlorothene (cis-1,2-DCE)	NE	16	35	70
Vinyl chloride	0.2	0.029(d)	0.29(d)	2

Notes:

(a) Method A level includes sum of 1-methylnaphthalene, 2-methylnaphthalene, and naphthalene.
(b) Method A level based on toxicity equivalency factor summation approach specified in WAC 173-340-708(8) and Table 708-2 of MTCA.
(c) CLARC Method B and C values for nickel refinery dusts or nickel soluble salts depending on available values.
(d) Includes updated CLARC values for PCE, TCE, and vinyl chloride.

Chloride and iron are included in the monitoring programs for the WSI and ESI, respectively, and have historically exceeded secondary MCLs, but are not included as COPC in this table.

The approved monitoring plan for the WSI (Parametrix 2004b) includes different MTCA Method B cleanup levels for total cyanide (320 µg/L) and fluoride (960 µg/L) than are included in the current version of CLARC.

µg/L Micrograms per liter.
CLARC Cleanup Level and Risk Calculations Summary Tables accessed online during June 2014.
MCL Maximum Contaminant Level.
MTCA Model Toxics Control Act.
NE Not established in look-up Tables.
NL Not listed. Screening level for specific chemical is not listed, but is accounted for by summation process. Refer to footnotes.
WA Washington.

Table 3-4
Sediment Freshwater Screening Level Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Concentrations in mg/kg dry weight)
(Page 1 of 2)

Chemicals of Potential Concern	Washington SMS Freshwater (a)		RSET Sediment Quality Guidelines (f) Freshwater		Consensus Based Freshwater (b)		Range of Background Concentrations (c)
	SCO	CSL	SL1	SL2	TEC	PEC	
Aluminum Smelting							
Cyanide	NE	NE	NE	NE	0.1(g)	NE	<0.8
Fluoride	NE	NE	NE	NE	NE	NE	1,100
Sulfate	NE	NE	NE	NE	NE	NE	NE
Polynuclear Aromatic Hydrocarbons (PAHs)							
Total PAHs	17	30	NE	NE	1.61(d)	22.8(d)	NE
Acenaphthene	NE	NE	1.1	1.3	NE/6.71 TEL (d)	NE	ND, <0.00073 to <0.330
Acenaphthylene	NE	NE	0.47	0.64	NE	NE	ND, <0.02 to <0.330
Anthracene	NE	NE	1.2	1.6	0.0572	0.845	ND, <0.02 to <0.330
Benzo(g,h,i)perylene	NE	NE	4.0	5.2	NE	NE	ND, <0.1 to <0.2
Fluoranthene	NE	NE	11	15	0.423	2.23	<0.330 to 0.083
Fluorene	NE	NE	1.0	3.0	0.0774	0.536	ND, <0.00082 to <0.330
1-Methylnaphthalene	NE	NE	NE	NE	NE	NE	NE
2-Methylnaphthalene	NE	NE	0.47	0.56	NE	NE	ND, <0.00076 to <0.02
Naphthalene	NE	NE	0.5	1.3	0.176	0.561	ND, <0.00076 to <0.02
Phenanthrene	NE	NE	6.1	7.6	0.204	1.17	<0.330 to 0.027
Pyrene	NE	NE	8.8	16.0	0.195	1.52	<0.330 to 0.077
Carcinogenic PAHs							
Total HPAH	NE	NE	31	55	NE	NE	NE
Benzo(a)pyrene	NE	NE	3.3	4.8	0.150	1.45	<0.330 to 0.7
Benzo(a)anthracene	NE	NE	4.3	5.8	0.108	1.05	<0.330 to 1
Benzo(b)fluoranthene	NE	NE	NE	NE	NE	NE	<0.330 to 0.4
Benzo(k)fluoranthene	NE	NE	NE	NE	NE	NE	<0.330 to 0.4
Benzofluoranthene(b+k)	NE	NE	0.6	4.0	NE	NE	NE
Chrysene	NE	NE	5.9	6.4	NE	NE	0.039 to 0.8
Dibenz(a,h)anthracene	NE	NE	0.80	0.84	0.033	NE	<0.1 to 0.0074
Indeno(1,2,3-cd)pyrene	NE	NE	4.1	5.3	NE	NE	ND, <0.2
Polychlorinated Biphenyls (PCBs)							
Total Aroclors	0.110	2.5	60	120	0.0598	0.676	ND
1016	NE	NE	NE	NE	NE	NE	<0.033
1221	NE	NE	NE	NE	NE	NE	<0.067
1232	NE	NE	NE	NE	NE	NE	<0.033
1242	NE	NE	NE	NE	NE	NE	<0.033
1248	NE	NE	NE	NE	NE	NE	<0.033
1254	NE	NE	NE	NE	NE	NE	<0.033
1260	NE	NE	NE	NE	NE	NE	<0.033

Table 3-4
Sediment Freshwater Screening Level Summary
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Concentrations in mg/kg dry weight)

Chemicals of Potential Concern	Washington SMS Freshwater (a)		RSET Sediment Quality Guidelines (f) Freshwater		Consensus Based Freshwater (b)		Range of Background Concentrations (c)
	SCO	CSL	SL1	SL2	TEC	PEC	
Metals							
Aluminum	NE	NE	NE	NE	2.55 percent	NE	19,000 to 65,300
Arsenic	14	120	20	51	9.79	33.0	7(e), 8.6 to 18.4
Cadmium	2.1	5.4	1.1	1.5	0.99	4.98	1 (e), 2.02 to 2.8
Chromium	72	88	95	100	43.4	111	27 to 69.3
Copper	400	1,200	80	830	31.6	149	35 to 52.0
Lead	360	>1,300	340	430	35.8	128	17(e), 23 to 76.8
Mercury (inorganic)	0.66	0.8	0.28	0.75	0.18	1.06	0.07 (e), 0.15
Nickel	26	110	60	70	22.7	48.6	25 to 36.0
Selenium	11	>20	NE	NE	NE	NE	2 (e), 0.477 to 1.5
Silver	0.57	1.7	2.0	2.5	NE	NE	0.433 to 3
Zinc	3,200	>4,200	130	400	121	459	250 to 396
Total Petroleum Hydrocarbons (TPHs)							
TPH-Diesel	340	510	NE	NE	NE	NE	NE
TPH-Residual	3,600	4,400	NE	NE	NE	NE	NE

Notes:

(a) Ecology (2013) SMS guidance, Sediment Cleanup User's Manual (SCUM) II Tables.
(b) Macdonald et al. (2000) consensus-based sediment quality guidelines.
(c) Range of background concentrations from JUB (1985), Damkaer and Dey (1986), ENSR (1994), WDOH et al. (2005), and DEQ (2007). Refer to Table 7.1-1.
(d) NOAA (2008) Screening Quick Reference Tables (SQuiRTs).
(e) Background levels from State of Oregon sediment screening level values table (DEQ 2007) for recreational and subsistence fish consumption.
(f) 2006 RSET Screening Level for freshwater sediments (Sediment Evaluation Framework for the Pacific Northwest) (RSET 2009). SL1 represents no observed adverse effects level; SL2 represent lowest observed adverse effects level.
(g) Screening level is for free cyanide and a no observed adverse effects level compiled by the EPA Region III Biological Technical Assistance Group (BTAG) (USEPA 2014a).

CSL Cleanup Screening Level
NE Not established in look-up Tables
PEC Probable effects Concentration
PRG Preliminary Remedial Goals
RSET Regional Sediment Evaluation Team
SCO Sediment Cleanup Objective
SMS Washington State Sediment Management Standards
TEC Threshold Effects Concentration

Washington (WAC 173-204). The Washington State Sediment Management Standards (SMS) rule was adopted in 1991 and revised in 1995 and 2013. The Ecology sediment cleanup user's manual (SCUM II) (Ecology 2015b) was used as the source of the screening levels in this Phase 1 Work Plan. The goal of the SMS is to reduce and ultimately eliminate adverse effects on biological resources and threats to human health from surface sediment contamination. The SMS, in conjunction with MTCA, governs the process of how sediment sites are identified, investigated, cleaned up, and monitored in Washington State.

The SMS includes numerical chemical and narrative screening levels that are designed to protect the functions and integrity of the benthic community. These include chemical and biological criteria that represent levels predicted to have no adverse non-bioaccumulative effects on the benthic community [the Sediment Cleanup Objective (SCO)], and higher levels [the Cleanup Screening Level (CSL)] that predict minor adverse effects on the benthic community.

The Regional Sediment Advisory Team (RSET) is a multi-agency committee formed to develop consistent guidance on the disposal or re-use of dredged sediment in the Pacific Northwest (RSET 2009). The RSET developed a sediment evaluation framework (SEF) guidance document in 2006 with the primary purpose to determine the suitability of dredged sediment for in-water disposal (or beneficial reuse). Although the 2006 SEF was updated in 2009, the freshwater screening levels were not updated. The freshwater sediment screening levels (SLs) included in Table 3-4 are derived from toxicity from sediment sites in the Pacific Northwest. Each SL was derived using at least three different biological endpoints and corresponds to a no observed adverse effects level (SL1) and a lowest observed adverse effects level (SL2). These screening levels are provided for general comparison purposes only and include numeric screening levels for some chemicals not listed in the SMS.

Consensus-sediment quality guidelines for freshwater ecosystem (MacDonald et al. 2000; NOAA 2008) have also been included for comparison purposes. Both Threshold Effects Concentrations (TEC) and Probable Effects Concentrations (PEC) have been adopted for screening to help evaluate the potential sediment toxicity, particularly for COPC lacking other criteria.

Numeric sediment screening levels for protection of human health are not listed on Table 3-4 because the SMS and associated SCUM II guidance (Ecology 2015b) do not include specific

numeric criteria. Risk-based sediment concentrations protective of human health will be initially evaluated and addressed using the "sediment only" approach in the SCUM II guidance. Consistent with the SCUM II guidance, this approach is appropriate because it is expected that risk-based sediment concentrations will be below background concentrations for bioaccumulative carcinogenic chemicals including PCB congeners and cPAHs. During the initial phase of the RI, sediment concentration data from the site investigation area will be compared against the SMS screening levels, RSET screening levels, and consensus sediment quality guidelines as well as collected site-specific background concentrations to determine if further investigation or evaluation is warranted. Practical quantitation limits for the collected chemical data will also be addressed in this comparison screening process consistent with the procedures described in SCUM II.

3.3.4 Surface Water

Table 3-5 summarizes chemical-specific screening levels for surface water including: MTCA Method B Surface Water Cleanup Levels, Washington State (WAC 340-201A) and Federal Ambient Water Criteria (acute and chronic freshwater values). The MTCA Method B formula values incorporate human health water quality criteria in the National Toxics Rule (40 CFR 131.36) and the Clean Water Act 304 (a) human criteria for water and organisms.

The surface water screening levels will be considered in the evaluation of the groundwater-to-surface-water transport pathway.

Table 3-5
Surface Water Screening Level Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Concentrations in µg/L)

Chemicals of Potential Concern	Human Health		Aquatic Life (a)	
	MTCA Method B	MTCA Method C	Freshwater Acute	Freshwater Chronic
Aluminum Smelting				
Cyanide	1,560	3,890	22	5.2
Fluoride	NE	NE	NE	NE
Sulfate	NE	NE	NE	NE
Polynuclear Aromatic Hydrocarbons (PAHs)				
Acenaphthene	648	1,620	NE	NE
Acenaphthylene	NE	NE	NE	NE
Anthracene	25,900	64,800	NE	NE
Benzo(g,h,i)perylene	NE	NE	NE	NE
Fluoranthene	86.4	216	NE	NE
Fluorene	3,460	8,640	NE	NE
1-Methylnaphthalene	NE	NE	NE	NE
2-Methylnaphthalene	NE	NE	NE	NE
Naphthalene	4,710	11,800	NE	NE
Phenanthrene	NE	NE	NE	NE
Pyrene	2,590	6,480	NE	NE
Carcinogenic PAHs				
Total Toxicity Equivalent Concentration (TTEC)	NE	NE	NE	NE
Benzo(a)pyrene	0.0296	0.74	NE	NE
Benzo(a)anthracene	0.296	7.4	NE	NE
Benzo(b)fluoranthene	0.296	7.4	NE	NE
Benzo(k)fluoranthene	2.96	74	NE	NE
Chrysene	29.6	740	NE	NE
Dibenz(a,h)anthracene	0.0296	0.74	NE	NE
Indeno(1,2,3-cd)pyrene	0.296	7.4	NE	NE
Polychlorinated Biphenyls (PCBs)				
Total PCBs	0.000105	0.00261	2	0.014
1016	0.00585	0.0146	NE	NE
1221	NE	NE	NE	NE
1232	NE	NE	NE	NE
1242	NE	NE	NE	NE
1248	NE	NE	NE	NE
1254	0.00167	0.00261	NE	NE
1260	NE	NE	NE	0.014
Metals				
Aluminum	NE	NE	750	87
Arsenic	0.0982	2.46	360	190
Cadmium	40.5 (non-potable)	101 (non-potable)	0.82	0.37
Chromium (III)	243,000	608,000	176	57.2
Copper	2,880	7,230	4.61	3.47
Lead	NE	NE	13.9	0.54
Mercury	NE	NE	13.9	0.54
Nickel (d)	1,100	2,760	438	48.7
Selenium	2,700	6,750	20	5
Silver	25,900	64,800	0.32	NE
Zinc	16,500	41,400	35.4	32.3

Table 3-5
Surface Water Screening Level Summary
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Concentrations in µg/L)

Chemicals of Potential Concern	Human Health		Aquatic Life (a)	
	MTCA Method B	MTCA Method C	Freshwater Acute	Freshwater Chronic
Total Petroleum Hydrocarbons (TPHs)				
TPH-Gx (gasoline-extended range)	NE	NE	NE	NE
TPH-Dx (diesel and heavy-oil ranges)	NE	NE	NE	NE
Volatile Organic Compounds (VOCs)				
Fuel-Related				
Benzene	22.7	567	NE	NE
Toluene	18,900	47,100	NE	NE
Ethyl benzene	6,820	17,100	NE	NE
Xylenes	NE	NE	NE	NE
Solvent-Related				
Tetrachloroethene (PCE)	0.69 or 3.3(c,d)	0.69 or 3.3(c,d)	NE	NE
Trichloroethene (TCE)	2.5 or 30 (c,d)	2.5 or 30 (c,d)	NE	NE
1,1,1-Trichloroethane (1,1,1-TCA)	926,000	2,310,000	NE	NE
1,2,-Dichloroethane (1,2-DCA)	59.4	1,480	NE	NE
cis-1,2-Dichlorothene (cis-1,2-DCE)	NE	NE	NE	NE
Vinyl chloride	0.025 or 2.4(c,d)	0.025 or 2.4 (c,d)	NE	NE

Notes:

(a) Freshwater chronic value represents Washington State (WAC 173-201A), Clean Water Act Section 304, or 40 CFR 131. Washington State values used where available.
(b) CLARC Method B and C values for nickel soluble salts or nickel refinery dust depending on available values.
(c) Includes updated CLARC values for PCE, TCE, and vinyl chloride
(d) Values derived by Ecology from revised Ambient Water Quality Criteria for consumption of water + organisms and consumption of organisms, respectively.

µg/L Micrograms per liter.
CLARC Cleanup Level and Risk Calculations Summary Tables accessed online during June 2014
MTCA Model Toxics Control Act
NE Not established in look-up Tables
WA Washington

Section 4
Site Conceptual Model

This section summarizes the preliminary site conceptual model being prepared for the Columbia Gorge Aluminum Smelter site. Information related to the environmental conditions of individual SWMUs and AOCs is provided in Sections 6.0 and 7.0, respectively. This site conceptual model will be confirmed and updated during the course of the RI/FS process. A general description of the site is provided in Section 2.0, including identification of primary site features in Figures 2-1 and 2-2.

4.1 CURRENT AND FUTURE LAND USE

Demolition of all buildings associated with the former Columbia Gorge Aluminum Smelter operations was completed in spring 2013. A description about the former plant operation and history is summarized in Section 2.1, with the features of the former plant and surrounding area shown on Figure 2-1. The only development near the project site is the John Day Hydroelectric Dam, located on the Columbia River approximately 0.5 miles to the southwest (refer to Figure 2-1). Land use surrounding the site has been limited to livestock grazing, including primarily cattle in the sagebrush/grassland habitat.

The subject property is zoned industrial, with the current owner (NSC) planning to sell its land (and other assets) for commercial and industrial purposes. Although there are no current/active facility operations, the subject site is periodically accessed to perform routine environmental monitoring, including groundwater sampling and storm water discharge monitoring. In addition, ongoing environmental investigation and cleanup is being conducted in accordance with the 2014 Agreed Order.

4.1.1 Proposed John Day Pool Pumped Storage Hydroelectric Project

A notice of intent (NOI) and a Pre-Application Document for a hydroelectric project has recently been submitted to the Federal Energy Regulatory Commission (FERC), and a portion of the proposed hydroelectric project footprint is located on the former Columbia Gorge Aluminum

Smelter Site (KPUD 2014). The timing and funding for this project are unclear, but the construction (if it occurs) is at least 10 years from completion. The proposed John Day Pool Pumped Storage Hydroelectric Project represents a closed-loop Pumped Storage Hydropower facility proposed by the Public Utility No. 1 KPUD. The project would provide necessary ancillary services and energy storage to allow for more reliable management and integration of renewable energy sources into the power grid (KPUD 2014). The timing and funding for this project are currently unclear.

The proposed project consists of a 1,200 megawatt closed-loop pumped storage hydropower facility including: 1) two Upper Reservoirs and associated rock fill embankment dams, 2) a Lower Reservoir and associated rock fill embankment dam, 3) two waterways, 4) a pit-style powerhouse, 5) a transmission line, and associated facilities including access roads and a water supply pipeline. Power from the proposed storage hydroelectric project would be routed to the existing Bonneville Power Administration substation that was formerly associated with smelter, which then ties into nearby transmission lines. The project represents a closed loop system and would use the Columbia River for initial fill and periodic make-up water.

Of the proposed facilities, the location of the Lower Reservoir is directly in the area of SWMUs and AOCs being investigated as part of the RI (KPUD 2014). The pre-application document (KPUD 2014) identifies three SWMUs within the proposed project area including: 1) the West Surface Impoundment (WSI; SWMU 4), which has already been closed under the Resource Conservation and Recovery Act (RCRA); 2) the West Spent Potliner (SPL) Storage Area (SWMU 13), which has been closed under Washington State Solid Waste Regulations, and 3) the Plant Construction Landfill (SWMU 19). The West SPL Storage Area is not within the proposed lower reservoir. The Research and Development laboratory septic drain field site (that is included as an additional investigation area in the Phase 1 Work Plan) also appears to be present in the footprint of the Lower Reservoir. The NOI does not present an approach for mitigating the conflict caused by situating the footprint of the Lower Reservoir in the area of these SWMUs.

Some additional SWMUs including the Drum and Tire Storage Area (SWMUs 20 and 27), Construction Rubble Storage Area (SWMU 21) and the West End Landfill (WELF; SWMU 18) are located in close proximity to the proposed power plant, transmission lines, and are also within the proposed project area. The proposed water supply pipeline also crosses the WELF (SWMU 18), and includes and crosses a portion of the NPDES Ponds (SWMU 1). The proposed water supply pipeline

alignment also crosses south of the East End Landfill (EELF; SWMU 17), Paste Plant Spill (SWMU 30), and the Stormwater Pond (SWMU 32).

The rock fill embankment dam for the Lower Reservoir would be 165 feet high with a total length of 7,800 feet. The Lower Reservoir would be constructed into the basalt bedrock. The surface area of the Lower Reservoir would occupy about 100 acres with a depth of about 150 feet at its maximum capacity. Construction of this large water storage feature could potentially significantly affect groundwater recharge and flow. The groundwater in the Uppermost Aquifer AOC includes the Lower Reservoir area as do the existing monitoring well networks for the WSI (SWMU 4), the West SPL Storage Area (SWMU 13), and the WELF (SWMU 18).

In addition, some of the wetlands included in the Wetlands AOC are in close proximity to the Lower Reservoir and some other wetland areas are near the proposed alignment of the water supply pipeline. Based on initial review, the pre-application NOI document does not appear to specifically discuss site wetlands.

Ecology (2015c) comments on the Draft Phase 2 Work Plan state that while Ecology is supportive of future economic development, the RI/FS is not part of any current or future land use proposal for the Columbia Gorge Aluminum Smelter site, and that the RI/FS will consider potential exposure risks and cleanup requirements within the context of future industrial uses.

4.1.2 Surrounding Area Land Use

The site is located in a treaty-defined usual and accustomed fishing area of the Confederated Tribes and Bands of the Yakama Nation. The upland North Shore TFAS is located adjacent to the Columbia River immediately upstream of the John Day Dam (Ecology 2014a). Enrolled Yakama tribal members exercise treaty reserved fishing rights for ceremonial, subsistence, and commercial purposes from numerous traditional platforms on the Washington shore of the Columbia River within a mile of the site (Ecology 2014a).

A public day-use park (Railroad Island Park) that includes a boat launch is located immediately upstream of the John Day Dam, and about 0.5 miles from the former smelter. This land is owned by the U.S. Army Corps of Engineers.

As previously discussed in Section 3.1.5, the largest water rights in the vicinity were associated with aluminum smelter operation. The rights originally included both groundwater and surface water. The surface water right was for commercial and industrial purposes and has been reportedly transferred to Klickitat County PUD; the water use designation has been changed from industrial to municipal and the place of use has been expanded to various locations in Klickitat County. The groundwater right designated use was for commercial, industrial and domestic purposes. This water right has been proposed for transfer to Klickitat County PUD, with a proposed change in use to Municipal Use.

4.2 POTENTIAL SOURCES AND RELEASE MECHANISMS

Potential contaminant sources are related to the former operation of the primary aluminum smelter from its completion of construction in the early 1970s until 2003 when aluminum smelter operations were permanently suspended. A summary of the aluminum plant processes and primary sources, as well as associated contaminants and release mechanisms is provided below.

4.2.1 Processes and Primary Sources

At the former aluminum reduction facility, aluminum was produced by the reduction of aluminum oxide, in vertical stud Soderberg cells using a Hall-Heroult reduction process. The aluminum oxide (alumina) was received by railcar and stored on-site in large silos. From these silos, it was transferred via conveyor belts through dry fluoride scrubbers. The aluminum oxide absorbs fluoride during this process and is then considered to be enriched aluminum ore, and stored in enriched ore silos (PGG 2014a).

The enriched ore was then transported to the reduction cells in specially designed wheeled vehicles. Petroleum coke and coal tar pitch were processed in the carbon plant and used as a carbon source used as anodes in the reduction cells. The enriched aluminum ore was dissolved in molten cryolite (sodium hexafluoroaluminate) in a flux process such that during the reduction process, carbon from the anodes bound to and removed oxygen, producing carbon dioxide and (essentially) pure aluminum. The molten aluminum collected in the bottom of the reduction cells was siphoned from the cells, to be shipped off-site in hot crucibles or transported to the on-site cast house where it was de-gassed, alloyed, and cast into various forms. The castings produced at the site were sent to other locations for forging, rolling, or extrusion.

During aluminum casting, the molten aluminum was fluxed to remove dissolved gasses and particulate matter. Gases generated during reduction and flux processes were collected using skirts over the process chambers. These gases contained particulates, carbon dioxide, sulfur dioxide, hydrogen fluoride, and organics such as PAHs and some metals. These waste gases were cleaned using various treatment systems over the years, each system improving on the other. Initially, wastewater from the gas cleaning systems was treated via sequential settling in Ponds A, B, C, and D, and then discharged under permit to the Columbia River (refer to Figure 2-2).

Solids that built up in the ponds was periodically dredged and disposed of in an unlined natural depression east of the aluminum production area. This depression later became a wastewater evaporation pond and was named the East Surface Impoundment. In 1978, these processes were replaced by a dry scrubber and baghouse to remove particulates and fluoride gas, with a secondary wet scrubber process to remove sulfur dioxide. Water from this process was also discharged to the East Surface Impoundment. By 1985, the wastewater was all diverted into a West Surface Impoundment (PGG 2014a) (refer to Figure 2-2).

Secondary gases (those escaping into work areas) were collected via the building ventilation system and cleaned via water scrubbing. Initially, the wastewater from this secondary scrubbing system was sequentially discharged through Ponds A, B, C, and D. In 1983, this secondary gas treatment system was replaced by a recirculating clarifier, with a tertiary treatment system to remove fluoride. Solids resulting from the clarifier and tertiary treatment system processes were disposed in the West Surface Impoundment (refer to Figure 2-2).

Smelter process wastes were placed in containers at their point of generation and shipped off-site immediately, or the containers were collected in a central storage area and then shipped off-site within 90 days. The only on-site stored waste materials were the brick and carbon portions of spent pot liners, which are the bottoms of the reduction cells. From 1971 until 1988, the brick and carbon wastes were stored on concrete slabs. In 1988, these storage areas were enclosed. By 1995, all of the spent pot liner wastes were shipped to an approved waste facility and all newly generated wastes were shipped to the same facility (PGG 2014a). Non-hazardous construction/demolition debris, facility trash, wood waste, alumina, carbon waste, and vegetation material were disposed in landfill areas located adjacent to the west and east ends of smelter plant. These landfills were operated and

closed in the 1980's and have been covered by earthen materials. The aluminum smelter operations were permanently suspended in 2003.

4.2.2 Contaminants and Release Mechanisms

As described in Section 3.2, chemicals of potential concern at the site include the typical suite of chemicals associated with aluminum reduction facilities. These include: cyanide, fluoride, sulfate, and PAHs. In addition to the aluminum smelting process, various equipment and building maintenance activities were conducted. These required petroleum products including oil and grease, and solvents. PCBs were also historically used in oils in some of the capacitors and transformers at the site.

Cyanide, fluoride, and sulfate are related to operation and use of the pot liners at the site. Fluoride is present in the cryolite bath material. PAHs and sulfate were present in the coke and pitch used in the manufacturing of briquettes used to line the pots. Cyanide is produced in trace amounts within the pots during smelting operations. The historic use of PCBs is limited to specific areas within the former reduction facility footprint. PAH particulates from the aluminum processing cells became entrained in gaseous emissions and removed by the scrubber air pollution control system (in particular the wet air scrubber system), which then generated a PAH-containing waste water stream and sludge.

The potential mechanisms for contaminant releases at the site were primarily associated with ore handling and the smelting process(s), including spills and leaks, storm and wastewater collection and discharge, and waste disposal. Discharges to the air and to the Columbia River have been conducted under permits from the appropriate state and federal agencies. From 2003 to the present, various demolition and material removal processes have been completed.

4.3 EXPOSURE MEDIA AND TRANSPORT PATHWAYS

Potentially impacted environmental media resulting from past plant operations and subsequent demolition activities include the following:

- Surface and subsurface soil surrounding the site and within downgradient swales which may have received stormwater from the site;
- Storm and wastewater in collection ponds and wet areas;

- Surface water, including seeps, springs, wetlands, and the Columbia River;
- Groundwater in the upper most aquifer(s); and
- Sediment in collection ponds, wet areas, wetlands and the Columbia River.

The above represents the potential exposure media for both human and ecological receptors of potential concern. Vegetation adjacent or downwind from the site may also represent a secondary exposure potential. A summary of COPC is included in Section 3.2, with an associated summary of potential screening levels for soils (including terrestrial soils), surface water, groundwater, and freshwater sediments provided in Section 3.3.

The primary contaminant transport mechanisms associated with the subject site include the following:

- **Infiltration and Leaching**. Infiltration of rain water and stormwater runoff, as well as from ponded and wetland areas resulting in potential leaching of chemicals to subsurface soils and shallow groundwater.
- **Volatilization**. Mechanism for potential release of VOCs to the vadose zone and indoor/outdoor air. VOCs do not represent one of the main groups of COPC for this aluminum smelter and volatilization does not appear to represent a major transport pathway at the site. Volatilization can be a mechanism for migration of free cyanide, but is not expected to be a major transport pathway at this site based on historical data from the site that shows cyanide primarily occurring in a metal cyanide form.
- **Erosion and Stormwater Runoff**. Soil erosion and transport through stormwater runoff. This potentially includes bank erosion in channeled areas including the Columbia River.
- **Stormwater and Wastewater Discharge**. Direct discharge of stormwater and/or historical wastewater (direct discharge to the Columbia River have been conducted under permits from the appropriate state and federal agencies).
- **Groundwater Flow**. Transport of dissolved and/or particulate constituents through vertical and horizontal groundwater flow. Details regarding groundwater occurrence, including flow and chemical characteristics are summarized in the Groundwater in the Uppermost Aquifer AOC discussion in the Section 7.2.
- **Sediment Suspension and Deposition**. Sediment suspension and deposition through surface water runoff and river flow and recirculation.
- **Aeolian Transport.** Wind-driven soil particle movement (re-suspension and deposition).

- **Direct and Indirect Atmospheric Inputs**. Includes potential fugitive emissions from historical plant operations.

- **Wild Fire Transport.** This mechanism was identified by the Yakama Nation for inclusion because the general area is prone to wild fires. Wild fires can potentially generate contaminants from the burning of plant-related source materials (as well as other non-plant related materials), and cause aeolian transport, as well as indirectly contribute to increased erosion and runoff in the area of the fire.

4.4 ECOLOGICAL AND HUMAN RECEPTORS

Potential exposure to chemicals (i.e., toxicity) and/or physical stresses (e.g., destruction of habitat and disturbance) represent the primary effects to potential ecological and human receptors at the site. A discussion regarding potential ecological and human receptors, including preliminary conceptual exposure models is provided in the following sections.

4.4.1 Ecological Receptors

Ecological receptors likely to be exposed at a site are dependent on the available habitat and level of physical disturbance present. Of the 7,000 acres associated with the subject property, 350 acres had been developed with buildings, structures, roads, or waste retention areas. Many of the former structures have recently been demolished. Most of the 350 acres have been significantly physically altered, and for the most part, no longer provide suitable ecological habitat. However, adjacent to the site there are grassy hillsides intermixed with talus slopes and patches of forest, sagebrush/bunchgrass scablands, cliffs, bluffs, wetlands, the storm drain pond, and the Columbia River.

4.4.1.1 Ecology Summary

The site is situated in the Columbia River gorge, which is located within the Columbia River Basin and considered to be part of the Intermountain Semi-desert ecoregion (PGG 2014a). The primary regional vegetation type is sagebrush steppe. Common native upland habitats are dominated by bunchgrass, rabbitbrush, and sagebrush. Trees are generally uncommon, except adjacent to water sources such as wetlands, ponds, streams, and rivers. In these wetter areas, common tree species include oak, pine, willow, and Russian olive. In areas suitable for agriculture the native vegetation has been replaced with grain (in wetter areas) or other row crops (including grapes) that may require

irrigation (PGG 2014a). Regionally representative terrestrial fauna and water dependent species (including those relying on significant habitat of the Columbia River) are summarized in Table 4-1.

Local ecology is also summarized in Section 2.2.6. The Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species database lists priority habitats in the Site vicinity as summarized in Table 4-1. In addition, the adjacent Columbia River provides federally designated critical habitat for Chinook salmon, steelhead, and bull trout. Threatened or endangered species, including those identified to be present near or to pass through the Columbia River adjacent to the site, are also summarized in Table 4-1. The state-threatened western gray squirrel identified in Table 4-1 would most likely be present in oak forests not immediately adjacent to the subject property (PGG 2014a).

4.4.1.2 Preliminary Conceptual Ecological Exposure Model

A preliminary conceptual ecological exposure model is presented in Figure 4-1. This preliminary model relies on the primary sources of contamination, mechanisms of release and transport, and impacted media as described in the previous sections. This preliminary model is general in terms of terrestrial and aquatic receptors and will be refined and updated during the course of the RI/FS process.

4.4.2 Human Receptors

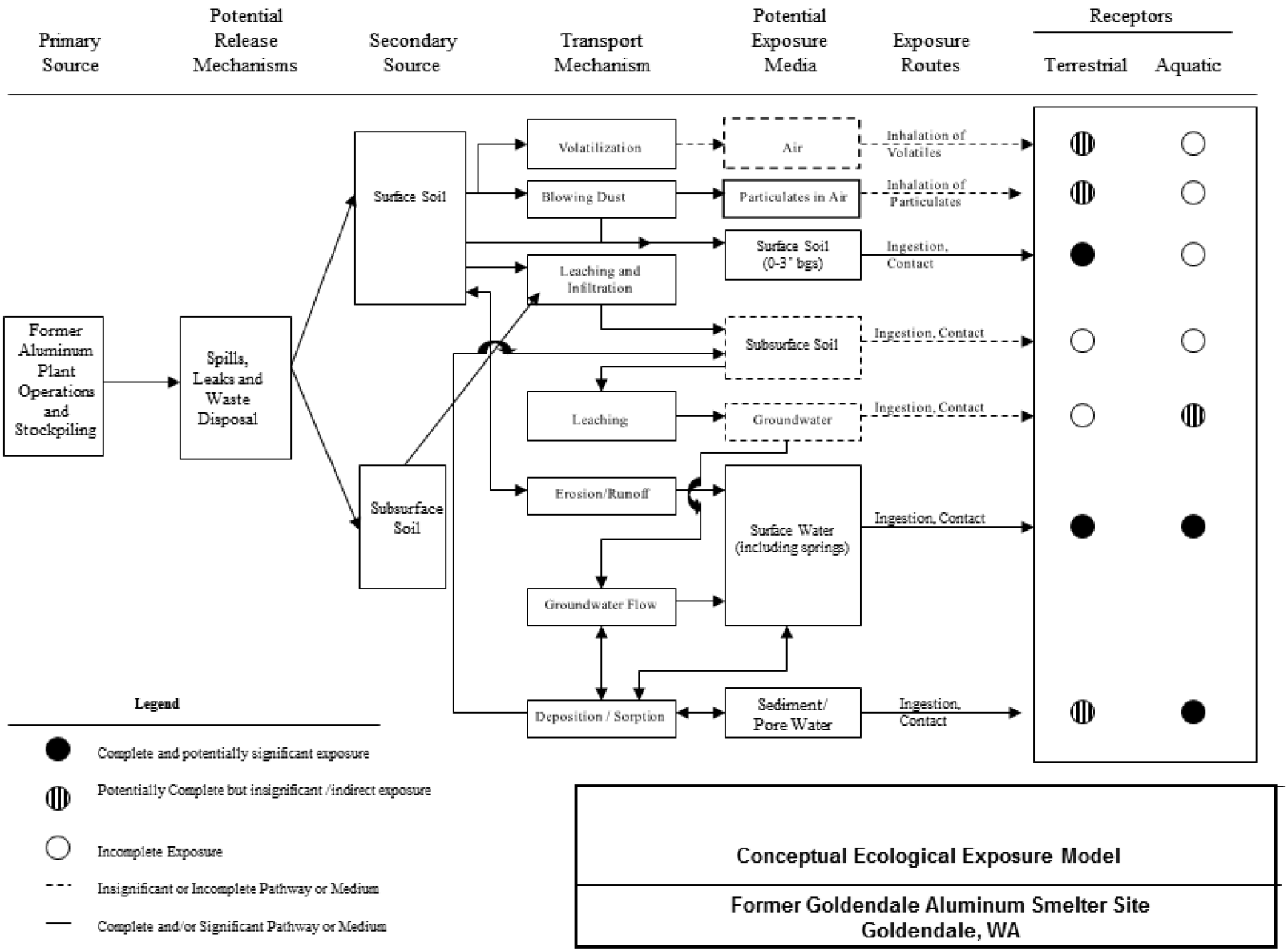
The subject property is zoned industrial and a significant portion of the buildings have been demolished. Future site use is anticipated to remain industrial. In an industrial situation such as this, the likely human receptors are those who work at the site, such as occupational workers. When demolition and re-development are occurring, construction and excavation workers are likely to be present. Therefore, based on the site conditions and likely current and future human uses of the site, the human receptors of concern include current demolition workers, current and future occupational workers, future construction/excavation workers, and potential trespassers (PGG 2014). Workers performing periodic environmental monitoring and sampling, and ongoing site investigation and cleanup action activities at the site are considered part of this group. Based on water rights, groundwater represents potential future drinking water source. For the Yakama Nation, the groundwater exposure pathway is considered as potentially complete, but with low exposure potential.

Table 4-1
Ecological Summary Information

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Regional		Local	
Potential Representative Terrestrial Fauna	**Columbia River Water Dependent Species**	**Priority Habitats in Site Vicinity [a]**	**Threatened and Endangered Species**
• Numerous terrestrial invertebrate species • A few snake and lizard species including rattlesnake • Song and perching birds such as sparrows; scavengers such as crows, ravens, and vultures; and raptors such as owls, hawks, and eagles • Small-sized mammals such as deer mice; medium-sized mammals such as raccoons, skunks, opossum, and rabbits; and large-sized mammals such as coyote and deer	• Waterfowl • Aquatic invertebrates • Benthic invertebrates • A few frog, salamander, and turtle species • Numerous fish species	• Oak and oak/pine forests • Talus slopes • Cliffs and bluffs • Palustrine wetlands In addition, the adjacent Columbia River provides federally-designated critical habitat for Chinook salmon, steelhead, and bull trout	**State Threatened** • Western gray squirrel **Federally Threatened** • Middle Columbia River bull trout • Middle Columbia River steelhead • Snake River fall, spring, and summer Chinook • Columbia River chum salmon • Upper Columbia River bull trout • Snake River bull trout • Snake River basin steelhead • Upper Columbia River steelhead **Federally Endangered** • Upper Columbia River spring Chinook salmon • Snake River sockeye salmon

a Washington Department of Fish and Wildlife (WDFW) Priority Habitats and Species database.



Conceptual Ecological Exposure Model

Former Goldendale Aluminum Smelter Site
Goldendale, WA

Source: PGG 2014

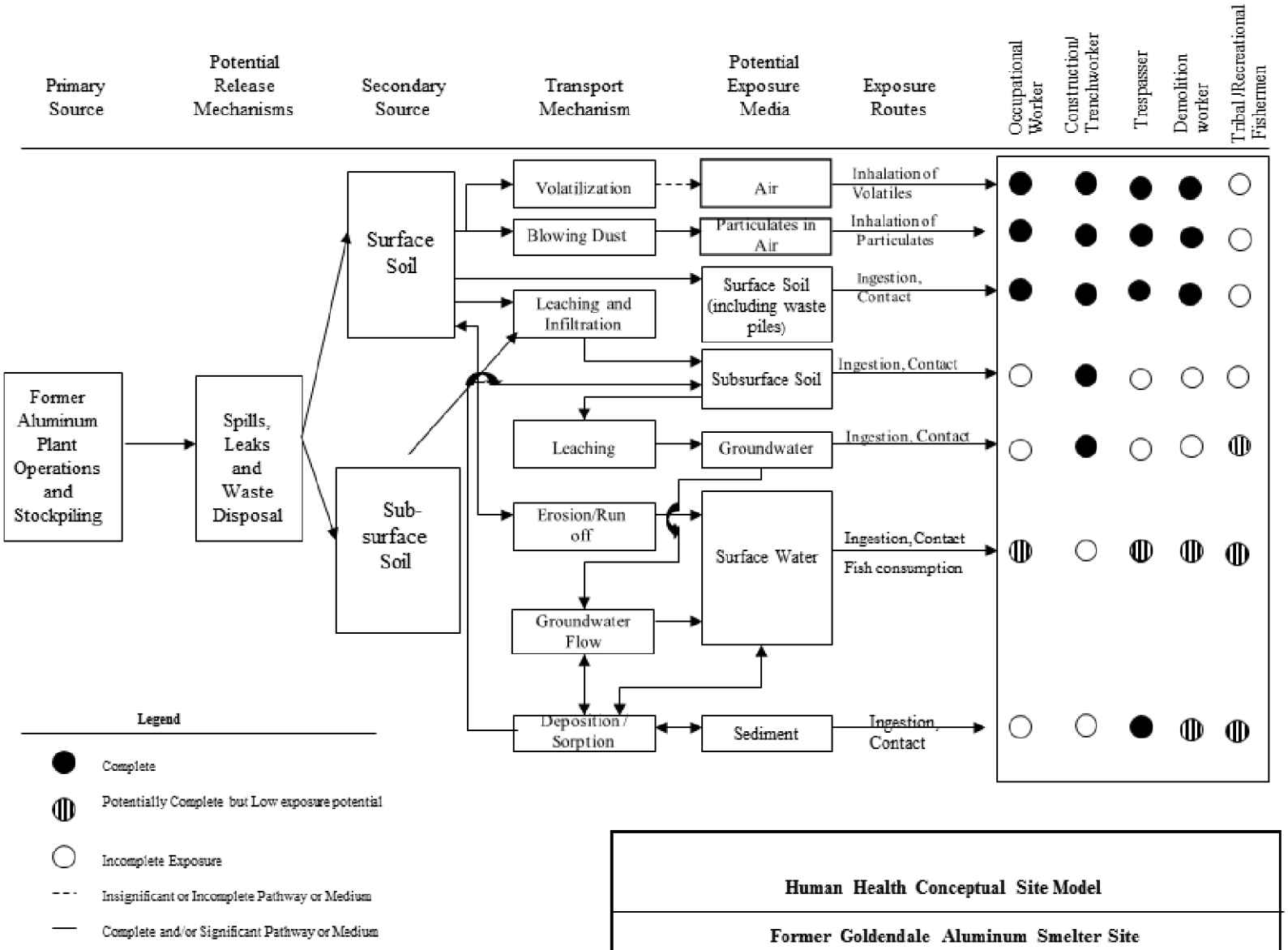
Figure 4-1

Preliminary Conceptual Ecological Exposure Model

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

In addition to the above, recreational and tribal-related uses along the Columbia River adjacent to the site are included for potential human exposure pathway consideration. The site is located in a treaty-defined usual and accustomed fishing area of the Confederated Tribes and Bands of the Yakama Nation. Use designations for the reach of the Columbia River include: 1) aquatic life uses of spawning and rearing; 2) primary recreation use; 3) water supply uses including domestic, industrial, agricultural, and stock water; and 4) miscellaneous uses including wildlife habitat, harvesting, commerce/navigation, boating, and aesthetics. Based on the above, both tribal and recreational fishermen are considered to represent potential human receptors.

A preliminary conceptual human exposure model is presented in Figure 4-2. This preliminary model relies on the primary sources of contamination, mechanisms of release and transport, and impacted media as described in the previous sections. This preliminary model will be refined and updated during the course of the RI/FS process.



Human Health Conceptual Site Model

Former Goldendale Aluminum Smelter Site
Goldendale, WA

Note:
This exposure model does not include potential municipal water use considerations for surface water and groundwater exposure media.

Source: PGG 2014

Figure 4-2

Preliminary Conceptual Human Health Exposure Model

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Section 5
SWMU and AOC Evaluation Approach

This section provides an overview of the evaluation approach that has been adopted for the Phase 1 Work Plan to meet the Agreed Order requirements.

The Phase 1 Work Plan has been prepared as a series of steps consisting of the following:

- **Site Conceptual Model Development and Preparation.** This includes a summary of the relevant environmental media, transport pathways, and receptors for the site based on existing information and are presented in Section 4.0.

- **Review and Data Summary.** Available information and data was compiled from multiple sources. Because of the long history of operations and environmental work at the site, this process has included gathering and summarizing data and information from multiple responsible parties, consultants, and sources. A centralized electronic document repository has been developed to aid in review and project communications. The summary and review of each SWMU and AOC is presented in Sections 6.0 and 7.0, respectively.

  The SWMU data summaries include recent soil and groundwater data for individual SWMUs where available. However, groundwater data are further evaluated on a site-wide basis in Section 7.2, Groundwater in the Uppermost Aquifer AOC.

- **Site Screening.** The site screening process includes the following for each SWMU and AOC: 1) comparison of existing data against Washington State MTCA standard formula values and other appropriate screening levels, and 2) evaluation of the adequacy of existing data collection efforts. Site screening is presented for each SWMU and AOC in Sections 6.0 and 7.0, respectively. In most cases, historical data has been compared against the updated screening levels presented in Section 3.3.

- **Identification of Data Gaps and Data Needs.** Data gaps and data needs that have been identified and evaluated through the review and site screening process were further evaluated, refined, and summarized in Section 8.0. In addition, preliminary remedial alternatives and remedial action objectives have been identified for SWMUs and AOCs with sufficient information to help ensure that necessary data will be collected during the RI data collection effort. Specific remedial investigation work elements will be defined in the Phase 2 Remedial Investigation.

Section 6
SWMU Summaries and Evaluations

This section summarizes available information and data regarding the SWMUs and presents the evaluation of data gaps and data needs for each SWMU.

6.1 SWMU SUMMARY AND LOCATIONS

The list of SWMUs to be evaluated in this RI are summarized in the May 2014 Agreed Order. The Agreed Order specifies evaluation of 32 SWMUs. The locations of the SWMUs listed in the Agreed Order are shown in Figure 6.1-1. Table 6.1-1 provides a brief summary of the SWMUs including an operational description from the Agreed Order and overview of environmental investigation status. Site AOCs are summarized and evaluated in Section 7.0.

The SWMUs are discussed by area for ease of presentation and also due to physical proximity. In some cases the areas are also characterized by similar industrial processes, waste handling activities, contaminants of potential concern, and planned future land use. The site has been divided into the following four primary areas: production area, northwestern area, western area, and eastern area (refer to Figure 6.1-1).

Where readily available, groundwater results related to specific SWMUs have been summarized in the following sections. Site-wide groundwater results are summarized in Section 7.2 – Groundwater in the Uppermost Aquifer AOC. In general, chemical concentrations have been compared with the screening levels used at the time the investigation work was performed as well as the current screening levels presented in Section 3. For some recent independent site investigations, the data has been compared against the current screening levels (as presented in Section 3) for consistency. Soil screening levels for protection of groundwater for drinking water use have not yet been developed consistent with MTCA requirements for this RI. For a few specific chemicals,

Legend

- SWMU Investigation Areas
- Wetlands
- 1 Solid Waste Management Unit

0 500 1,000 2,000

Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 6.1-1

Solid Waste Management Units and Investigation Areas

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_GoldendaleSite\investigmaps\Phase1_RI_WP\Figure_6.1-1_SWMU_and_Investigation_Areas.mxd

Table 6.1-1
Solid Waste Management Unit (SWMU) Description and Investigation Status Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 1 of 6)

SWMU/ AOC No.	Site Name	Section Number in Work Plan	Geographic Area	Description and Notes	Environmental Investigation Status
1	NPDES Ponds	Section 6.5.1 Pages 112-122	East	Four settling ponds (Ponds A through D) have been operated under a wastewater permit since construction of the plant. The ponds received wastewater from facility air pollution scrubbers during plant operation as well as storm water from the stormwater detention pond. A storm water bypass around the ponds was constructed during 2010.	Characterization of the pond deposits during 2008 showed that some of the sludges contained PAHs above the one percent total carcinogenic Extremely Hazardous Waste (EHW) limit. Pond sediments were characterized in 2008 (ARCADIS 2008a,b). In 2012, a voluntary soil removal action was performed with remediation of the pond sediments meeting MTCA Method B Soil Cleanup Levels (ARCADIS 2011a).
2	East Surface Impoundment (ESI)	Section 6.5.2 Pages 123-129	East	The ESI is located in a natural depression east of the production area. The ESI was operated from 1973 to 1985 as an unlined surface impoundment for disposal of NPDES pond sludge and blow down from the North SO2 scrubber. In 1985, it was taken out service. The ESI unit was closed under RCRA in 1987. The engineered and impermeable RCRA cap consists of a one-foot sand cover, 30-mil PVC liner, and a 0.05-inch geotextile fabric, one foot of transitional material, and one foot of rip-rap.	Groundwater monitoring program and cap operations, maintenance and monitoring (OMM) program is ongoing as part of the post-closure plan. The most recent groundwater monitoring data was collected during 2010 (ARCADIS 2011b).
3	Intermittent Sludge Disposal Ponds	Section 6.5.3 Pages 130-138	East	Following closure of the ESI, additional areas east of the smelter were discovered that had been used for the disposal of sludge from the NPDES ponds. Thirteen small deposits of sludge with no standing water were found. This site has accordingly also been called the East Surface Deposits.	This SWMU was investigated in 2006 and an independent soil removal action performed during 2007 (URS 2008b). The remaining soils at the SWMU meet MTCA Method A Industrial Soil Cleanup Levels.
4	West Surface Impoundment (WSI)	Section 6.3.1 Pages 70-76	Northwest	The WSI was constructed in 1981 and began operations in 1982 as part of a major smelter expansion and modernization. The WSI was designed to concentrate emission wastewater through evaporation and for storage/disposal of air emission control sludge. The impoundment is lined with 6 inches of sand and a 30-mil Hypalon liner. The unit was closed under RCRA in 2005. The impoundment was closed with an engineered RCRA cap consisting of a sand layer, a geosynthetic clay layer and soil cover.	Groundwater monitoring program is ongoing with most recent results collected during 2014 (GeoPro 2014).
5	Line A Secondary Scrubber Recycle Station	Section 6.2.1 Pages 10-12	Production Area	The recycle station consisted of a 36-foot diameter clarifier, cyclone separators, and reagent storage tanks and associated piping. Blow-down from the gas cleaning system was cleaned at the recycle station and water was returned to the secondary scrubber. There are no records or data regarding potential releases. Building s and other structures in this area have been demolished.	No environmental investigations have been conducted.

Table 6.1-1
Solid Waste Management Unit (SWMU) Description and Investigation Status Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 2 of 6)

SWMU/ AOC No.	Site Name	Section Number in Work Plan	Geographic Area	Description and Notes	Environmental Investigation Status
6	Line B, C, D Secondary Scrubber Recycle Stations	Section 6.2.1 Pages 10-12	Production Area	The secondary scrubber recycle system was installed as a part of the 1983 smelter upgrade. The system consisted of a 130-foot diameter clarifier, an emergency backup clarifier, two recycle pump tanks, 3 bulk reagent tanks and associated piping. There are no records or data regarding potential releases. Building Structures in this area have been demolished.	Clarifier sediments were sampled and disposed of associated with plant demolition. No environmental investigations of soils or shallow groundwater in this area have been conducted.
7	Decommissioned Air Pollution Control Equipment	Section 6.2.2 Page 13	Production Area	Prior to the 1983 installation of the dry alumina air scrubber equipment at the smelter, air emissions from Line A and B were removed using wet electrostatic precipitators. These units were housed on the roof between the pot rooms and included redwood towers and concrete bubblers. The equipment was removed during the 1990's. Buildings and other structures in this area have been demolished.	No environmental investigations have been conducted.
8	Tertiary Treatment Plant	Section 6.2.3 Pages 14-15	Production Area	In 1983, a tertiary treatment plant was installed to treat blow down water from the secondary scrubber systems. The treatment plant removed fluoride from the wastewater using calcium chloride to cause chemical precipitation. The plant consisted of a 12-foot thickener, 28-foot diameter clarifier, pump tanks, sand filters and associated piping. There is no documented history of releases of hazardous or toxic constituents. Buildings and other structures in this area have been demolished.	No environmental investigation has been performed.
9	Paste Plant Recycle Water System	Section 6.2.4 Pages 16-20	Production Area	A recirculated water system with settling tanks and a cooling tower was installed at the paste plant in 1986 to remove solids discharged to the NPDES pond system. In 1990, the wet gas cleaning system was converted to a dry HEAF filter system. In 1990, this system overflowed resulting in a spill (refer to SWMU 30). The Paste Plant and coke silos have been demolished.	No environmental investigation has been performed.
10	North Pot Liner Soaking Station	Section 6.2.5 Pages 21-24	Production Area	SPL was water cooled at two cooling stations located at the east end of the pot lines from 1971 through 1990. The station consisted of a below ground concrete tank, recycle pump, and a spray station. Water at this unit was treated with sodium hypochloride to oxidize cyanide that was present. The water was collected and drained back to a recycle sump. The station was paved over in early 1990s.	This unit was investigated as an independent cleanup during 2008 (URS 2008e). The soils were characterized and determined to contain PAHs above industrial screening levels and remediation was recommended.
11	South Pot Liner Soaking Station	Section 6.2.5 Pages 21-24	Production Area	Operations at this unit are the same as the North Pot Liner Soaking station (see SWMU 10 above).	Environmental investigation status is the same as the North Pot Liner Soaking Station (see SWMU 10 above).

Table 6.1-1
Solid Waste Management Unit (SWMU) Description and Investigation Status Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 3 of 6)

SWMU/ AOC No.	Site Name	Section Number in Work Plan	Geographic Area	Description and Notes	Environmental Investigation Status
12	East SPL Storage Area	Section 6.2.6 Pages 25-29	Production Area	This unit was located east of the A-line and received SPL from 1971-1984. The unit originally included a concrete pad 100 feet by 160 feet in dimension, but expanded to include adjacent unpaved areas. In 1984, visible SPL was transferred to a larger storage area west of the production area (SWMU 13), but soils were not sampled at that time. A building was constructed at this location during 1984 for the storage of cryolite bath material (URS 2008c) and is still present.	Sampling and characterization was conducted as an independent cleanup action during 2008 (URS 2008c) Further remedial action was recommended for this area.
13	West SPL Storage Area	Section 6.3.2 Pages 77-82	Northwest	This storage area was operated from 1984-1988 and then was closed as a solid waste landfill consistent with environmental regulations applicable at that time. Contains SPL under engineered cap that consisted of a soil cover, 30-mil PVC liner, sand layer, and riprap for erosion control. SPL Pile is located on a concrete pad. The unit was operated, closed, and monitored by Commonwealth Aluminum and its successor, Aleris International Limited (Aleris). Aleris filed for Chapter 11 bankruptcy in 2009 (Aleris 2010).	A monitoring well network was installed with most recent groundwater monitoring results available from 1990 to 2008 (Aleris 2010, Bakemeier 2009).
14	North SPL Containment Building	Section 6.2.7 Pages 30-34	Production Area	Constructed in 1987, the building consisted of a 20,000 square foot structure with a concrete foundation and 4-foot high concrete perimeter walls. The concrete floor slab is underlain with a PVC secondary containment liner. The building was at capacity for SPL by 1988 and sealed shut. During 1994-1995, the SPL was removed and taken off-site for permanent disposal. The unit was clean closed under RCRA during July 2009. The building is still present.	According to the Agreed Order, "based on design of the building, characteristics of the SPL stored in the building, and results of samples during closure, no releases of hazardous or toxic constituents to soil or groundwater are anticipated form this unit." Soil samples were collected as part of closure (CH2MHill 2009).
15	South SPL Storage Building	Section 6.2.8 Pages 35-37	Production Area	This building was constructed in 1988 south of the cast house. This SWMU is very similar in construction to the North SPL Storage Building and had a concrete floor and PVC liner. All SPL was removed from the building in 1995 and the building was subsequently modified. Buildings are still present in this area.	The unit was clean closed under RCRA during 1996. According to the Agreed Order, "based on the design of the building, characteristics of the SPL stored within the building, and the results of samples collected during closure, no releases of hazardous or toxic constituents to soil or groundwater are anticipated from this unit." Soil samples were collected during closure (Golder 1996b).

Table 6.1-1
Solid Waste Management Unit (SWMU) Description and Investigation Status Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 4 of 6)

SWMU/ AOC No.	Site Name	Section Number in Work Plan	Geographic Area	Description and Notes	Environmental Investigation Status
16	SPL Handling Containment Building	Section 6.2.9 Pages 38-42	Production Area	This building was constructed in 1990. The building was used to demolish failed cathode shells. The building was equipped with a concrete floor slab that is underlain with a PVC secondary containment liner and 5-foot high concrete perimeter walls. It was equipped with a dust control system consisting of fans and two bag house dust collectors. All SPL was removed from the building in 2010-2011. The building has been demolished and concrete rubble has been stored at the locations of the former foundation.	The unit was clean closed under RCRA during 2011. According to the Agreed Order, "based on the design of the building, characteristics of the SPL stored within the building, and the results of samples collected during closure, no releases of hazardous or toxic constituents to soil or groundwater are anticipated from this unit." Soil sampling and soil removal were performed during closure (PGG 2011).
17	East End Landfill (EELF)	Section 6.2.10 Pages 43-49	Production Area	The EELF is an unlined landfill located south and east of the former paste plant and was used between 1971 and 1982. It was reportedly closed prior to the establishment of RCRA by covering it with native soil. The landfill reportedly received smelter wastes that did not include waste oil, or spent solvents and may have included SPL. Most structures in this area have been demolished. The foundation of the Briquette Storage Slab is still present.	An RI/FS was performed at the site during 2008 (URS 2008a). The RI/FS included excavation of 12 test pits and installation of four monitoring wells for characterization purposes. The depth of the test pits ranged from 6 to 20 feet below ground surface (bgs). Additional investigation is planned to determine if SPL was present because some historical documentation indicated potential SPL disposal (Tetra Tech 2011a).
18	West End Landfill (WELF)	Section 6.4.1 Pages 102-109	West	The WELF is an unlined landfill located west of the main parking area for the smelter, and was used between 1982 and 1987. The site was closed by covering it with native soil. The landfill reportedly received smelter wastes with the exception of SPL, waste oil, and spent solvents. The West Landfill reportedly contains wood, demolition waste, carbon waste, contaminated alumina, asbestos, and general trash.	An independent soil and groundwater RI/FS was performed in 2008 (URS 2008f). A 100 percent design for engineered landfill cap was completed during 2011 (Tetra Tech 2012). As part of the landfill cap design project a draft cleanup action plan was prepared (Tetra Tech 2010).
19	Plant Construction Landfill	Section 6.4.2 Page 110	West	During plant construction in 1969-1970, general debris and rock were disposed of at the Plant Construction Landfill located west of the Rectifier Yard.	No environmental investigations have been performed.
20	Drum Storage Area	Section 6.3.3 Pages 83-85	Northwest	A concrete pad located on the hillside northeast of the WSI was used as a drum staging area. The drum storage area was used between 1971 and 1987 (URS 2008d). The concrete slabs of the Drum Storage Area are still present.	This SWMU was characterized as part of an independent cleanup action during 2008 (URS 2008d). Based on the sampling results, PAHs were detected below industrial cleanup levels in site soils. No further action (other than implementation of institutional controls) was recommended.
21	Construction Rubble Storage	Section 6.3.4 Pages 86-93	Northwest	Construction rubble was disposed of in the West End Landfill unit until its closure in 1987. After 1987, construction rubble was disposed of in an area east of the WSI. This SWMU was reportedly active until the smelter closed and is still present. This SWMU has also been defined by Ecology to include all disposal sites for debris generated during plant demolition. Four major areas of stockpiled concrete rubble are currently present at the site.	The Agreed Order states that because of the inert nature of the construction rubble, the possibility of soil or groundwater contamination is unlikely. In preparation for recent site demolition activities, some sampling was conducted (PGG 2012c, 2014c).

Table 6.1-1
Solid Waste Management Unit (SWMU) Description and Investigation Status Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 5 of 6)

SWMU/ AOC No.	Site Name	Section Number in Work Plan	Geographic Area	Description and Notes	Environmental Investigation Status
22	Wood Pallet Storage Area	Section 6.3.5 Page 94	Northwest	Wood waste that primarily consisted of shipping containers and pallets were disposed of in the West End Landfill until its closure in 1987. After 1987, this material was disposed of in a storage and burning area located northwest of the plant and north of the rectifier yard. Excess wood at the site was reportedly burned periodically under a permit from the county fire department. A burn pile and debris is present in this area.	No environmental investigations have been performed.
23	Reduction Cell Skirt Storage Area	Section 6.2.11 Page 50	Production Area	This area was used from 1988 to 1995 for the storage of failed "skirts" from the reduction cells prior to recycling of the steel. These steel skirts had solid bath material (cryolite salts) attached to the steel. In 1995, the skirts and the residual bath in site soils were reportedly removed and the skirts were subsequently stored on a concrete pad next to the Paste Plant.	No environmental investigations have been performed for which data can be found. The 2004 Part B Dangerous Waste Permit Application (page 98) (Parametrix 2004a) states that soil samples were analyzed, but the data has not been found.
24	Carbon Waste Roll-off Area	Section 6.2.12 Page 51	Production Area	In 1987 a 20-cubic yard roll-off bin located between the pot rooms was used to collect, store, and transport various solid wastes prior to offsite disposal. Wastes managed in this area included: fume system carbon, waste briquettes, production room floor sweeping, silo top paste and wastes stud hole paste. Specific locations of the collection point are unclear and may have changed during the history of operations. The Courtyards of the Production Area where these features were likely present are present and accessible.	No environmental investigations have been performed.
25	Solid Waste Collection Bin and Dumpsters	Section 6.2.13 Page 52	Production Area	Miscellaneous, non-hazardous solid waste was placed in small dumpsters or roll-off bins at various collection points throughout the production area. Wastes reportedly included: transite, empty cans, floor sweepings, PVC/glass pipe, and secondary treatment plant screen wastes. The wastes were disposed of at the Rabanco Landfill near Roosevelt, Washington. Specific locations of the collection points are unclear and may have changed during the history of operations. The Courtyards of the Production Area where these features were likely present are present and accessible.	The Agreed Order states "because of the small volume and characteristics of the wastes, the possibility of a release from these collection points is very low." No environmental investigations have been performed.
26	HEAF Filter Roll-off Bin	Section 6.2.14 Page 53	Production Area	The Paste Plant emission control system was converted from a wet scrubber to a dry high efficiency air filtration (HEAF) system in 1990. Particulates containing high concentrations of PAHs were removed from the off gases into fabric filters during HEAF system operations. These wastes were stored in a 20-cubic yard capacity roll-off bin located near the Paste Plant. Wastes accumulating within the roll-off bin were periodically shipped offsite for disposal. The Paste Plant and nearby coke silos have been demolished.	The Agreed Order states that "because of the nature of the storage operation, a release of hazardous constituents from the roll-off bin to soil or groundwater is unlikely." No environmental investigations have been performed.

Table 6.1-1
Solid Waste Management Unit (SWMU) Description and Investigation Status Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 6 of 6)

SWMU/ AOC No.	Site Name	Section Number in Work Plan	Geographic Area	Description and Notes	Environmental Investigation Status
27	Tire and Wheel Storage Area	Section 6.3.6 Pages 95	Northwest	Worn out rubber tires and steel wheels were stored on a concrete pad from 1987 to 1994 when the area was consumed by a brush fire. This SWMU appears to overlap with SWMU 20. The concrete slabs are still present.	This area was characterized as part of an independent cleanup action at the Drum Storage Area (SWMU 20) during 2008 (URS 2008d). The SWMU was reportedly cleaned up following a grass fire that consumed the tires and wheels stored in this area.
28	90-Day Drum Storage Area	Section 6.2.15 Pages 54-55	Production Area	After the original Drum Storage Area was closed under RCRA in 1987, the 90-Day Drum Storage Area was established at the west of the A-room/line near the Capacitor Yard. Both RCRA and non-RCRA wastes were reportedly stored in this area. In 1990, a metal building was constructed over a concrete pad and a 6-inch concrete berm was added to the perimeter of the concrete pad for spill containment. An epoxy was applied to the concrete pad to seal any cracks. The 90-Day Drum Storage Area Building is still present.	According to the Agreed Order, "the design and operation of the building and frequent inspections makes the likelihood of a release of hazardous or toxic constituents from this building to the environment unlikely." No environmental investigations have been performed.
29	Caustic Spill	Section 6.2.16 Pages 56-57	Production Area	In October 1990, approximately 5,000 gallons of a 20 percent caustic solution (NAOH) was spilled on the ground near the A-Room/Line recycle water system during a transfer between tanks. The spilled material was reportedly flushed into the storm sewer system and monitoring of the NPDES treatment system was performed. There were no exceedances of the NPDES permit limits during the spill event. The soil in the area was flushed with water. Buildings and structures in this area have been demolished.	Limited sampling was performed during Ecology (1990e,f) inspections.
30	Paste Plant Spill	Section 6.2.17 Pages 58-61	Production Area	An undetermined volume of recirculated scrubber water overflowed to the ground resulting in PAH contaminated soil in a small area south of the paste plant. In the same area, stormwater runoff from an uncontrolled Briquette Storage Area was identified as a source of PAH soil contamination. The Paste Plant and coke silos in this area have been demolished.	Soil investigation, sampling, and contaminated soil removal was performed in 1990/1991 (Technico Environmental Services 1991c). Some additional soil contamination in this area was left in place. Landfill materials were noted that could be attributed to the East End Landfill or could be related to another site feature.
31	Smelter Sign Area	Section 6.5.4 Pages 139-143	East	Evidence of SPL and other aluminum reduction wastes in the vicinity of the smelter sign and lawn was discovered and reported to Ecology in 2011. This SWMU also includes the area north of East Surface Impoundment (NESI). A disturbed Category III wetland is present in the NESI Area (Tetra Tech 2011b).	Work Plans for site characterization were prepared in 2011 (Tetra Tech 2011b,c).
32	Stormwater Pond and Appurtenant Facilities	Section 6.2.18 Pages 62-69	Production Area	Storm water is collected in a series of catch basins that are conveyed to the storm water retention pond at the southern edge of the production area. The pond was excavated into bedrock and is used to store accumulated stormwater runoff from the site prior to discharge under the NPDES permit. Stormwater collected in the pond was pumped to the industrial sump where it was mixed with process cooling water prior to discharge. The stormwater pond, stormwater, lines, and groundwater collection lines are still present. A stormwater bypass has been constructed that directs discharge around the NPDES ponds.	PAH-contaminated sediment above the 1 percent State EHW designation criteria were found in 1991 (Technico Environmental Services 1991b). Stormwater catch basins have been partially cleaned (PGG 2012b). Shallow groundwater drainage lines that drain into the stormwater pond and NPDES ponds have been documented (Columbia Aluminum Corporation 2011).

MTCA Method A Soil Cleanup Levels are based on protection of groundwater and have been used for screening purposes within this section. At a few of the SWMUs, other soil screening levels for protection of groundwater (e.g., EPA Regional Screening Levels) were cited within the original reports and the overall result of the screening comparisons have been summarized in this Work Plan.

In two cases (one in the northwestern area and one in the western area), additional locations of waste handling or past environmental investigation have been identified. Available information regarding these locations is summarized as other potential sources. Other potential sources in the area of the former main plant are summarized under the Plant Area AOC that was identified during preparation of this Phase 1 Work Plan and reported to Ecology in a notification letter (Lockheed Martin and BMEC 2014).

6.2 PRODUCTION AREA

This section describes and evaluates SWMUs in the footprint of the former production area. The production area is currently planned to be sold for industrial and commercial purposes. The production area is comprised of the following SWMUs: Line A, B, C, D Secondary Scrubber Recycle Stations (SWMUs 5 and 6), Decommissioned Air Pollution Control Equipment (SWMU 7), Tertiary Treatment Plant (SWMU 8), Paste Plant Recycle Water System (SWMU 9), North and South Pot Liner Soaking Stations (SWMUs 10 and 11), East Spent Pot Liner Storage Area (SWMU 12), North SPL Containment Building (SWMU 14), South SPL Storage Building (SWMU 15), SPL Handling Containment Building (SWMU 16), East End Landfill (SWMU 17), Reduction Cell Skirt Storage Area (SWMU 23), Carbon Waste Roll-Off Areas (SWMU 24), Solid Waste Collection Bins and Dumpsters (SWMU 25), HEAF Filter Roll-Off Bin (SWMU 26), 90-Day Drum Storage Area (SWMU 28), Caustic Spill (SWMU 29), Paste Plant Spill (SWMU 30), and the Storm Water Pond and Appurtenant Facilities (SWMU 32), refer to Figure 6.1-1 for the locations of these SWMUs.

6.2.1 Line A, B, C, D Secondary Scrubber Recycle Stations (SWMUs 5 and 6)

Primary air emissions from the pot liners were treated by dry scrubbing to remove particulates and fluoride, followed by wet scrubbing for removal of sulfur dioxide (Goldendale Aluminum Company 2002a). Secondary, or fugitive air emissions, from the pot rooms within the lines, not captured by the primary system, were treated by wet roof scrubbers (Goldendale Aluminum Company 2002a). The wet roof scrubbers were equipped with recirculated water systems that represent the Line A (SWMU 5) and Line B, C and D Secondary Scrubber Recycle Station (SWMU 6). Blowdown from the secondary scrubber recycle system clarifier was then routed to the Tertiary Treatment Plant (SWMU 8). The locations of SWMUs 5, 6, 7, and 8 are shown together on Figure 6.2.1-1 because they were all components of air emission pollution control and associated water treatment systems. SWMU 5 was located near the eastern end of Production Building A and SWMU 6 is located east of Production Building D and west of the Tertiary Treatment Plant (SWMU 8).

Fugitive emissions from the pot liner rooms were captured by the building ventilation system, which was located near the eaves of the pot liner buildings. Several low pressure high volume fans drew fugitive emissions through a series of wet scrubbers termed the secondary roof scrubber system. The secondary roof scrubbers consisted of rectangular spray chambers designed to remove fluoride and particulates from the off-gas. The spray water containing particulates, fluoride, and other pollutants removed from the gas was collected on the floor of spray chambers and flowed to the recirculated scrubber water system. The scrubber water recycle system included: particulate removal through use of material screens, cyclone separators, clarifiers, a pH control system (through addition of caustics), as well as the piping, storage tanks, and pumps necessary to recycle the water (as well as Columbia River make-up water) back to the scrubbers. A figure showing a general flow schematic of the secondary scrubber system is provided in Appendix A-5.

The Line A Secondary Scrubber Recycle Station (SWMU 5) system consisted of a screen box, cyclone separators, and a 36-foot diameter clarifier. About 6,000 gallons per minute (gpm) of contaminated scrubber water was drained through a screen box for solids removal. From the screen box the scrubber water was pumped through cyclone separators and then flowed by gravity to the 36-foot diameter clarifier. The overflow from the cyclones and clarifier was routed to a

R:\projects_2011\LockheedMartin_GoldendaleSite\investigmaps\Phase1_RI_WP\Report\Figure_6.2.1-1_Air_Pollution.mxd

N
W E
S

0 125 250 500
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 6.2.1-1
Air Pollution and Associated
Water Treatment SWMUs

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

recycle pump tank where caustic was added for pH control prior to reuse. The solids slurry clarifier underflow from the 36-foot diameter clarifier was then pumped to the 130-foot diameter clarifier associated with the Line B, C, and D Secondary Scrubber Recycle Station (SWMU 6). Refer to Appendix A-5 for a flow schematic of the Line A Secondary Scrubber Recycle Station.

The secondary scrubber system for Lines B, C, and D (SWMU 6) was installed as part of the 1983 smelter upgrade (Ecology 2014a). The recycle system consisted of a 130-foot diameter clarifier, an emergency backup 90-foot clarifier, two recycle pump tanks, three bulk reagent/recycle tanks, and appurtenant pipes (Ecology 2014a). Refer to Appendix A-6 for a schematic of the Lines B, C, and D secondary recycle system (Goldendale Aluminum Company 2002a).

No environmental investigations have been conducted at SWMUs 5 or 6 and there is no documentation regarding releases from these units. Characterization of chemical concentrations in subsurface soils and shallow groundwater in the vicinity of these SWMUs represents a data gap and data need.

6.2.2 Decommissioned Air Pollution Control Equipment (SWMU 7)

Early in the history of the plant prior to 1978, air emissions from Line A and B were removed using wet electrostatic precipitators (WESP), redwood towers, and concrete bubblers. The units were located on the roof between the pot rooms. The units were removed in or after 1997 (Ecology 1997a). A SWMU map from 1997 (Goldendale Aluminum 1997a) shows that there were six WESP units and towers (three associated with Line A and three associated with Line B). A drawing from the 1991 RCRA Permit states that there was about one WESP unit per 30 reduction cells (ENSR 1991) and since there were 340 cells in the original plant (Martin Marietta 1975, CH2MHill 1978), about 11 or 12 WESP units may have been present. Other reports (Dames & Moore 1996, 1998; Parametrix 2004a) state that there were originally 20 WESP units (10 per line) and that one was removed around the time of plant expansion. Nineteen WESP units and associated towers and bubblers were planned for removal in 1998 (Dames & Moore 1998). Figure 6.2.1-1 shows the approximate overall area where the units were placed. Refer to Appendix A-7 for a schematic drawing of the WESP units and selected correspondence.

In a 1997 letter (Ecology 1997a), Ecology stated that the concrete bubblers and redwood towers represented solid waste and could be disposed of accordingly. The letter also stated that the WESP units had high levels of PAHs deposited as scale on their interior surfaces. Ecology (1997a) required that the WESP units be disposed of in one of three ways: 1) disposal at a hazardous waste landfill without any decontamination efforts, 2) scraping the units clean using the physical extraction standards set forth in the federal hazardous debris rule with subsequent disposal of the scale as hazardous waste and the units as non-hazardous waste, and 3) recycling WESP unit as feed stock for a steel furnace after being scraped clean to a visual standard. Documentation of the disposal of the WESP units was not found at the time of preparation of this Phase 1 Work Plan.

Surface soil samples were collected in the courtyards near the WESP units during an initial investigation of the Production Area in 2010 (PGG 2010). This soil sampling effort did not specifically target the individual WESP units and other potential sources are present at the courtyards. The surface soil chemical conditions in the vicinity of the Production Building A and B courtyards will be summarized and evaluated as part of the Plant Area AOC.

6.2.3 Tertiary Treatment Plant (SWMU 8)

The Tertiary Treatment Plant (SWMU 8) was operated to remove fluoride and suspended solids from the blow down of the two secondary roof scrubber recirculated water systems and two primary emission control system SO2 scrubbers (Goldendale Aluminum Company 2002a). The Tertiary Treatment Plant was designed to treat the combined blow down from the two scrubber water recycle systems and two wet SO2 scrubbers to remove fluoride, benzo(a)pyrene, and TSS and meet the NPDES permit effluent limitations. The treatment process consisted of: 1) chemical precipitation of fluoride as calcium fluoride, 2) flocculation to increase TSS settling, 3) clarification to remove TSS, and 4) deep bed filtration to remove residual TSS prior to discharge. The Tertiary Treatment Plant was designed to treat up to 150 gpm of combined scrubber water blowdown. The Tertiary Treatment Plant was located adjacent to the Line B, C, and D Secondary Scrubber Recycle System (Figure 6.2.1-1).

According to the 2002 operations and maintenance manual (Goldendale Aluminum Company 2002a), the blowdown from the Roof Scrubber Water Recycle Systems was necessary to dispose of solids (primarily alumina) collected in the Recycle System clarifiers and to control dissolved solids (primarily fluoride) to prevent excessive calcium fluoride scale formation.

The plant consisted of a 12-foot thickener, a 28-foot diameter clarifier, pump and reaction tanks, sand filters and appurtenant pipes. Blowdown from each of the two scrubber recycle systems and two wet SO2 scrubbers was routed to the 130-foot diameter (primary) and 90-foot diameter (backup) clarifiers, respectively (that are part of the Lines B, C, and D Secondary Recycle System). Blowdown from each clarifier was directed to the treatment plant chemical mixing and reaction tank where pH was adjusted and calcium chloride was metered into the combined blowdown to precipitate fluoride as calcium fluoride. The reaction tank was equipped with a continuous monitoring for fluoride and an associated alarm station. A description of the Tertiary Treatment Plant operational processes is provided in Appendix A-8.

Effluent from the reaction tank flowed by gravity to a reactor clarifier/thickener tank where a solution of high molecular weight organic polymer was metered into the solution to promote flocculation. The reactor clarifier effluent then flowed by gravity to a surge tank from which it was pumped through two parallel deep bed filters for removal of residual suspended solids. The filters

consisted of multiple layers of filter media including coarse coal on top and fine sand at the bottom. The filter media was backwashed with Columbia River water to prevent fouling and the backwash water was routed back to the Line B, C, and D Secondary Scrubber Recycle Station for use as make-up water. The reactor clarifier slurry, filtrate, and filter cake were transported and disposed of off-site.

A monitoring station was present at the treatment plant and included automated measurement of pH, flow, turbidity, and fluoride with an associated alarm system. An automated sampler was used for collection of 24-hour composite samples of the effluent that were analyzed at a laboratory for TSS, fluoride, and benzo(a)pyrene as required by the NPDES permit.

There is no history of releases of hazardous or toxic constituents from the Tertiary Treatment Plant. Characterization of chemical concentrations in subsurface process wastewater piping, soil, and shallow groundwater in the vicinity of the Tertiary Treatment Plant represents a data gap and data need.

6.2.4 Paste Plant Recycle Water System (SWMU 9)

The Paste Plant was located in the southeastern portion of the main production area (Figures 2-2 and 6.1-1) and produced carbon paste used both anode paste and cathode paste for use in the cell anodes and cathodes for the reduction cells, respectively. During the aluminum reduction process, anode paste (paste and briquettes) was continually consumed. The aluminum smelter facility reportedly consumed about two pounds of alumina (aluminum oxide) and one-half pound of anode paste material for each pound of aluminum metal produced (Landau 1995). At the Paste Plant, petroleum coke was crushed, screened, and blended with a measured amount of coal tar pitch, then heated to and mixed in large continuous mixers to ensure an even coating of all coke particles with liquid pitch then extruded through die plates to form briquettes.

The anode paste briquette production and extrusion process required a final quenching step in which water was sprayed onto the newly-formed briquettes to re-congeal the pitch and form the required hard surface of the individual briquettes (Landau 1995, Goldendale Aluminum 1996d, ENSR 1991). The hard surfaces were necessary to ensure the even-flowing nature of the briquettes mixture as a whole. The quenching process was performed using conveyors on the eastern side of the Paste Plant Building. Water from the quenching process was recycled using several large water settling tanks also located just east of the main Paste Plant Building.

Cathode paste was also produced at the Paste Plant from start-up of the facility until about 1983. The cathode paste (also known as “ramming paste” or “cathode ramming paste”) was formed using a mixture of anthracite coal and metallurgical coal in a batch process. The cathode ramming paste was used to form the smooth interior of the cathode “pots” until an alternative source (the Alcoa plant in Wenatchee, Washington) was determined to be more economically viable around 1983.

The location of the Paste Plant Recycle Water System along with the associated scrubber and cooling tower structures were in close proximity to the Paste Plant Building. In addition to quenching the anode paste briquettes, water was also used in several fume scrubbers located within the Paste Plant Building. Both the quench water and the scrubber blow down was recycled as part of the Paste Plant Recycle Water System. Figure 6.2.4-1 shows the location of the Paste Plant Recycle Water System and nearby carbon handling, storage, and manufacturing facilities.

Legend

Approximate Area of Paste Plant Spill Investigation Area

Stormwater Drain Line

N
W E
S

0 50 100 200

Feet

Image Source: NAIP Aerial Imagery, 2006.

Figure 6.2.4-1
Paste Plant Recycle Water System and Carbon Handling, Storage and Manufacturing Facilities

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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According to the Agreed Order, a recirculated water system with settling tanks and a cooling tower was installed at the Paste Plant in 1986 to remove solids previously discharged to the NPDES pond system. Prior to 1986, the Paste Plant direct contact cooling water that was reportedly discharged into the industrial drain was eliminated in 1986 through installation of a cooling tower and recirculation pumping system, and settling tanks (Goldendale Aluminum 1996d). A small 10-gpm bleed stream from this recycle system was routed to the secondary emission system (fume scrubber mentioned earlier).

The presence of coal tar pitch distillate and the Paste Plant processes were documented to generate state designated dangerous waste and extremely hazardous waste (sludges) (Ecology 1990a, ENSR 1991, Ecology 1995d).

Based on a design drawing for the Paste Plant Area Building Storm, Monitor, and Scrubber Drains (Harvey Aluminum, Drawing A010217, Revision 1, 1985), the briquette cooling sump was originally connected to a north-south oriented stormwater drainage line. The southern extension of the line included a catch basin south of the Paste Plant and terminated in an outfall at the southern edge of the property (refer to Appendix A-9). The northern extension of the line drained to the stormwater detention pond and then to the industrial sump. The presence of this "discharge pipe, which formerly carried contaminated water outside the fence" is mentioned in the Technico Environmental Services (1991c) letter report that documents the soil removal action performed in response of the Paste Plant Spill (SWMU 30). The piping associated with the Paste Plant sump had been modified by 1988 and the sump was no longer connected to the storm drain system (Goldendale Aluminum Company 1996e). The stormwater discharge pipe along the fenceline south of the Paste Plant was still present in the 2011 SWPPP stormwater and sewer drawings (Columbia Gorge Aluminum Company 2011).

6.2.4.1 Regulatory History

Modifications to the Paste Plant Recycle Water System were implemented as required by a series of Ecology administrative orders. A spill from the Paste Plant Recycle Water System was noted by Ecology in 1990 (Ecology 1990a,b) and Ecology administrative orders were issued to reduce the potential for further spills from the system.

As a result of the inspection and overflow event, Ecology took several administrative actions directly related to the Paste Plant Recycle Water System including:

- Ecology Order no. DE 90-1001 that approved a facility request to install a HEAF unit that reduced a portion of the Paste Plant cooling wastewater stream (Ecology 1990a).
- Ecology Notice of Violation No. DE 90-1043 that directed the facility to investigate alternatives that would eliminate a portion of the Paste Plant cooling water waste stream responsible for the overflow events (Ecology 1990a).
- Ecology Order DE 90-1054 (Ecology 1990d) required that: 1) Paste Plant high-level alarms be installed, 2) a plan be prepared to detail corrective action in the event of high-level events, 3) provide for training on the content of the corrective action plan, 4) increase the Paste Plant contact cooling water system bleed stream volume to the secondary air pollution control wastewater treatment system, and 5) collect and re-route all storage slab storm water runoff and storage slab briquette cooling water for reuse in industrial processes or for direct treatment (Ecology 1990d).

6.2.4.2 System Components and Operational Changes

Refer to Appendix A-9 for information and a schematic drawing of the Paste Plant Cooling Water Recycle System that was installed by 1991 to prevent further overflow events (Columbia Aluminum Corporation 1991). The 1991 modified Paste Plant Cooling Recycle System included two connected above-ground water holding and settling tanks. Water was pumped from one of the tanks to the cooling tower, and then pumped to a series of spray nozzles (showers) in the cooling tower. Water collecting on the floor of the cooling tower area was discharged into a floor drain, and was then collected in a sump and pumped back to one of the above-ground water holding and settling tanks (Columbia Aluminum Corporation 1991). In 1991, several automated controls, alarms and overflow pipes were added to the system to prevent further spills (Columbia Aluminum Corporation 1991). The area was reportedly bermed, preventing migration of spills beyond the pavement (Goldendale Aluminum 1996d).

6.2.4.3 Environmental Investigation History

No environmental investigations have been performed that directly characterized the Paste Plant Recycle Water System. The Paste Plant spill (SWMU 30) was investigated and an associated soil removal action was performed (Technico Environmental Services 1991a,c) and is summarized in Section 6.2.17.

6.2.4.4 Data Gaps Evaluation and Data Needs

Data gaps and data needs with respect to the Paste Plant Recycle Water System include the following:

- Inspection of the Recycle Water System Sump and facilities that are part of Paste Plant Recycle Water System with targeted sludge and soil sampling to characterize current PAH concentrations.
- Shallow groundwater characterization in the sump vicinity to be addressed under the Groundwater in the Uppermost Aquifer AOC.

Other facilities related to manufacture, handling, and storage of carbon materials at the plant will be summarized and addressed as part of the Plant Area AOC in Section 7.5. These facilities include the Coke and Pitch Unloading Structure, the Hard Pitch Building, the Pitch Building, the area of three petroleum coke silos, the area of the anthracite silo, and the area of the Former Briquette Storage Slab east of the Paste Plant.

6.2.5 North and South Pot Liner Soaking Stations (SWMUs 10 and 11)

The North and South Pot Liner Soaking Stations are located along the east end of the former main plant Production Buildings A and B, respectively (refer to Figures 2-2 and 6.1-1). Although identified as individual SWMUs, they have been investigated together and are therefore addressed together in this Work Plan. The Pot Liner Soaking Stations reportedly operated between 1971 and 1990, and were composed of two concrete basins in which steel Hall Cells (i.e., aluminum smelting pots) were soaked with water (i.e., "quench water") to remove refractory SPL material. The SPL was generated as residue from the linings of Hall Cells during the electrolytic reduction of alumina to produce aluminum metal. This residue represents a listed hazardous waste (K088) because it can contain cyanide (URS 2008e).

Because of the potential for leaching cyanide from the pot liners, quench water was treated with hypochlorite to oxidize the cyanide. Any excess quench water that overflowed the cathode or leaked through holes in the steel shell was collected and directed back to the recycle sump. No documented historic spills or leaks have been reported for these SWMUs, and in 1990 the concrete basins were removed (URS 2008e).

6.2.5.1 Environmental Investigation History

In 2008, Lockheed Martin performed an RI/FS at North and South Pot Liner Soaking Stations (URS 2008e). This work was conducted as an independent action with informal Ecology review and concurrence regarding the Work Plan at that time.

Eight shallow soil borings [1.5 to 4.5 feet below ground surface (bgs)] and two deeper borings (20 feet bgs) were drilled during the investigation. Groundwater was encountered in one of the two deeper borings at about 19 feet bgs, and a single monitoring well was installed (MW-E7) at this location to a depth of 27.5 feet bgs. In addition, one shallow (2 feet bgs) test pit was excavated to bedrock in an area where runoff from the soaking stations likely accumulated. Figure 6.2.5-1 shows the sample station locations. The environmental sample results from this investigation are summarized below.

6.2.5.2 Previous Environmental Data

During the 2008 RI, a soil sample was collected at each soil boring location (except location MW-E7), and two soil samples were collected from the shallow test pit and analyzed for total

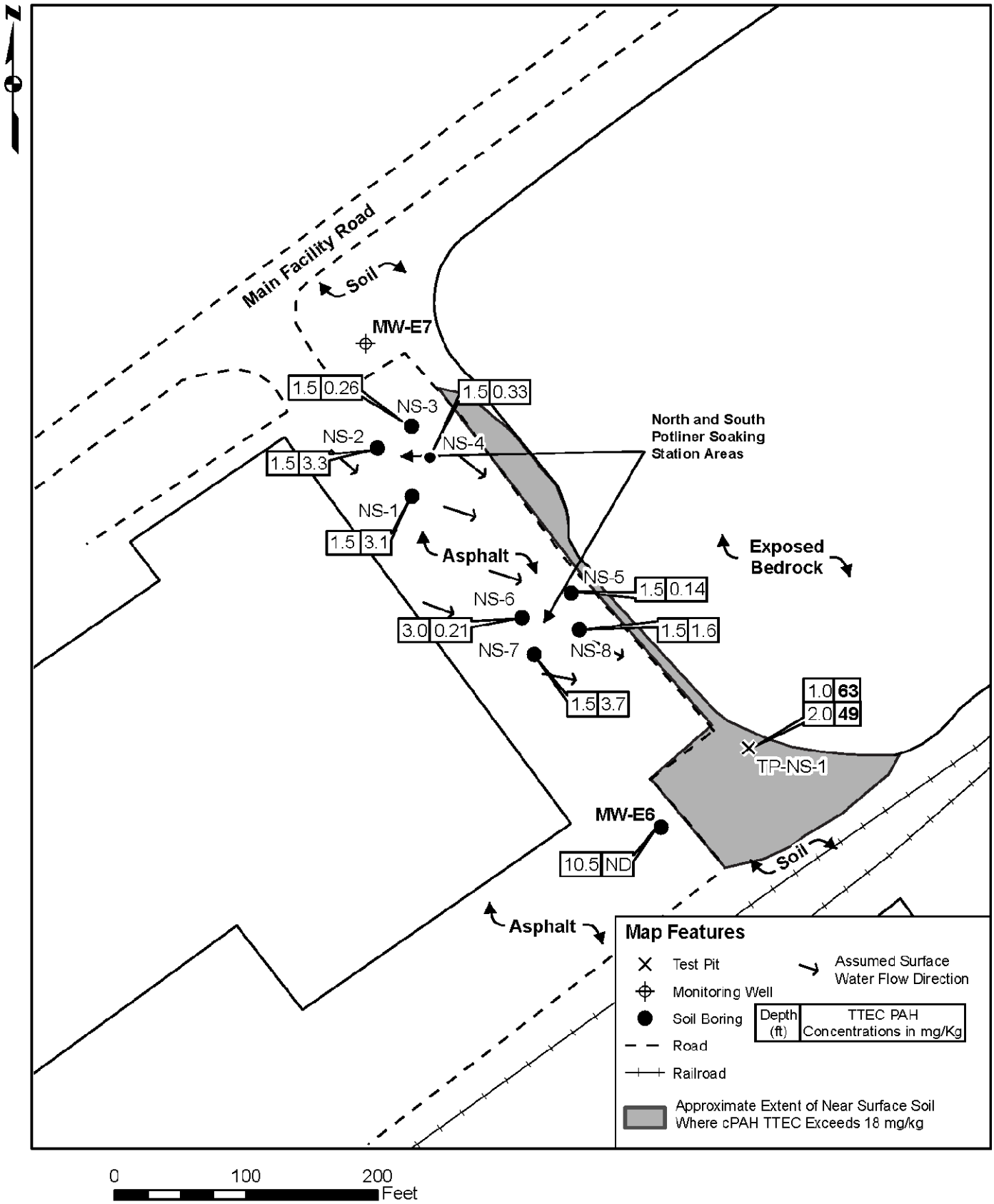


Figure 6.2.5-1

North and South Potliner Soaking Stations
Near Surface Soil Sample Results

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Source: URS 2008e

cyanide, fluoride, sulfate, PAHs, PCBs, and RCRA Metals. One groundwater sample was collected from well MW-E7 and analyzed for total and WAD cyanide, fluoride, sulfate, petroleum hydrocarbons, VOCs, PCBs, and PAHs. A tabulated summary of soil and groundwater analytical results and accompanying figures for this investigation are included in Appendix A-10.

For comparative purposes, the analytical data were evaluated in the RI relative to Method C cleanup levels (ingestion) for soils, and both Method C cleanup levels and MCLs for groundwater. For groundwater, no TPH constituents, VOCs, PAHs, PCBs, or cyanide were detected in the one well. Sulfate was detected but has no MTCA cleanup level and was well below the MCL secondary standard. Fluoride was detected at a concentration of 2.23 milligrams per liter (mg/L), which is less than the State MCL of 4.0 mg/L but slightly exceeded the 2008 MTCA Method C level of 2.1 mg/L (current Method C and Method B groundwater cleanup levels for fluoride are 1.4 mg/L and 0.64 mg/L, respectively).

For soil, with the exception of PAHs from the test pit, none of the analytes were detected at concentrations above MTCA Method C cleanup levels (ingestion). No PCBs were detected in soil (URS 2008e).

Carcinogenic PAH compounds (cPAHs) detected in samples were assessed using the total toxicity equivalent concentration (TTEC) methodology. The MTCA Method C (ingestion) cleanup level established for cPAHs TTEC was 18 milligrams per kilogram (mg/kg). PAHs were detected in 10 soil samples with TTEC concentrations ranging from 0.14 to 63 mg/kg. However, only the two samples from test pit TP-NS-1 (at 1.0 and 2.0 feet bgs) exceeded the MTCA Method C cleanup levels (refer to Figure 6.2.5-1).

An exposure assessment was conducted in accordance with MTCA, with the primary exposure pathway including ingestion of surface soil. The lateral extent of PAHs in exceedance of MTCA Method C cleanup levels was reportedly not fully delineated (URS 2008e) because it is based on results from one test pit that was located in an unpaved low area where runoff from paved areas around the soaking stations appeared to have drained. The area of PAH-impacted soil was estimated by URS to represent about 14,400 square feet with a conservative average depth of about 3 feet bgs, or about 1,600 cubic feet (refer to Figure 6.2.5-1). The estimated area of contamination is bounded

by: 1) the 8 borings within the asphalt that meet MTCA industrial soil screening levels, 2) the topographic bedrock high to the east, and 3) runoff areas near the edge of the asphalt.

Potential soil remedial technologies were screened and two potential remedial alternatives (in addition to the "No Action Alternative") were evaluated, including 1) containment (soil or asphalt cover), and 2) excavation and off-site disposal. Alternative 2, soil excavation and off-site disposal, was identified as the preferred remedial alternative (URS 2008e).

6.2.5.3 Data Gaps Evaluation and Data Needs

The findings of the 2008 RI/FS indicate PAHs in soil represent the primary environmental concern at the North and South Pot Liner Soaking Stations site. The lateral extent of PAH-impacted soils into the southeast was reportedly not fully delineated (see above). As such, collection of additional soil chemical data is needed to fully define the extent and volume of PAH-impacted soils in this area. This supplemental data collection activity can be conducted during the RI or during remedial action as appropriate.

6.2.6 East Spent Pot Liner Storage Area (SWMU 12)

The East SPL Storage Area is located east of the former facility buildings (refer to Figures 2-2 and 6.1-1). The East SPL Storage Area received SPL generated at the smelter from 1971 to 1984. SPL was initially stored on a 100-foot wide by 160-foot long concrete pad. At some point during the period of operation, the area of the concrete pad was exceeded and SPL storage expanded onto adjacent unpaved areas, primarily the rocky area to the northeast of the pad. A railroad spur is present north of the site trending northeast-southwest. A review of historic aerial photograph and the facility's history indicate these tracks were present and in use during the period when SPL was stored at this site (URS 2008c).

In 1984, storage of SPL was discontinued at the East SPL Storage Area, and approximately 105,000 tons of SPL was removed and transferred to the West SPL Storage Area (SWMU 13).

Prior to 1988 (during the period of operations of the East SPL Storage Area), SPL was not listed as a hazardous or dangerous waste either by EPA or Ecology. SPL was listed by the EPA on September 13, 1988 (53 Federal Register 35412) as hazardous waste K088 under 40 CFR, Part 261, Subpart D, four years after SPL was removed from the East SPL Storage Area.

A building was constructed in the footprint of the East SPL Storage Area after operations ceased. The building was used for storage of cryolite bath material and is still present.

6.2.6.1 Environmental Investigation History

In 2008, Lockheed Martin performed an RI/FS of the East SPL Storage Area (URS 2008c). This work was conducted as an independent action with informal review and concurrence regarding the Work Plan by Ecology at that time.

Investigation activities included completion of seventeen shallow soil test pits, one shallow soil boring, and three deeper soil borings in the East SPL Storage Area. One groundwater monitoring well (well MW-E8) was installed in one of the three deeper borings (at about 23 feet bgs) but was not subsequently developed and/or sampled as no groundwater was present at the time of investigation. Figure 6.2.6-1 shows the sample station locations. The environmental sample results from this investigation are summarized below.

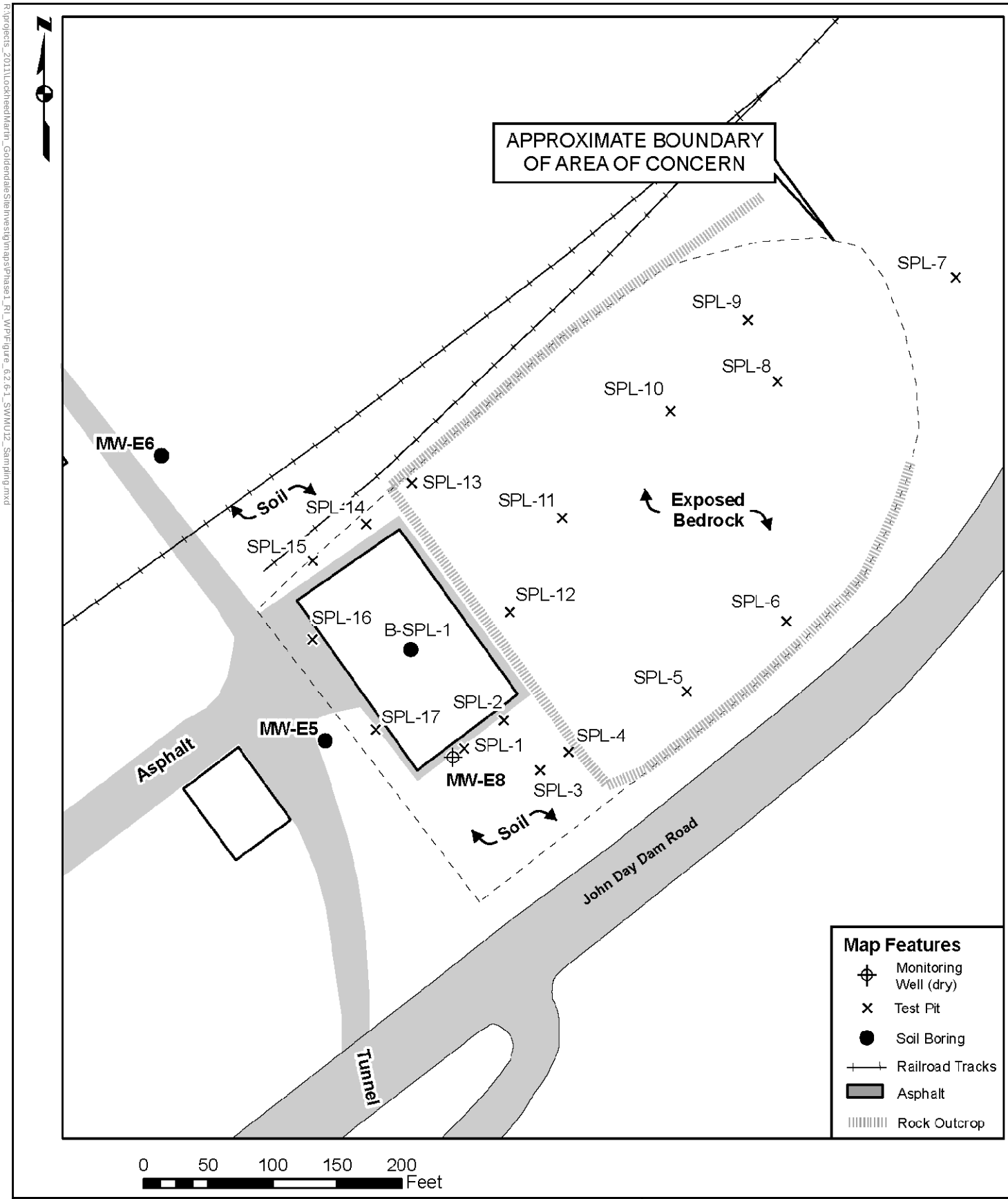


Figure 6.2.6-1

East Spent Potliner (SPL) Storage Area Sampling Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Source: URS 2008c

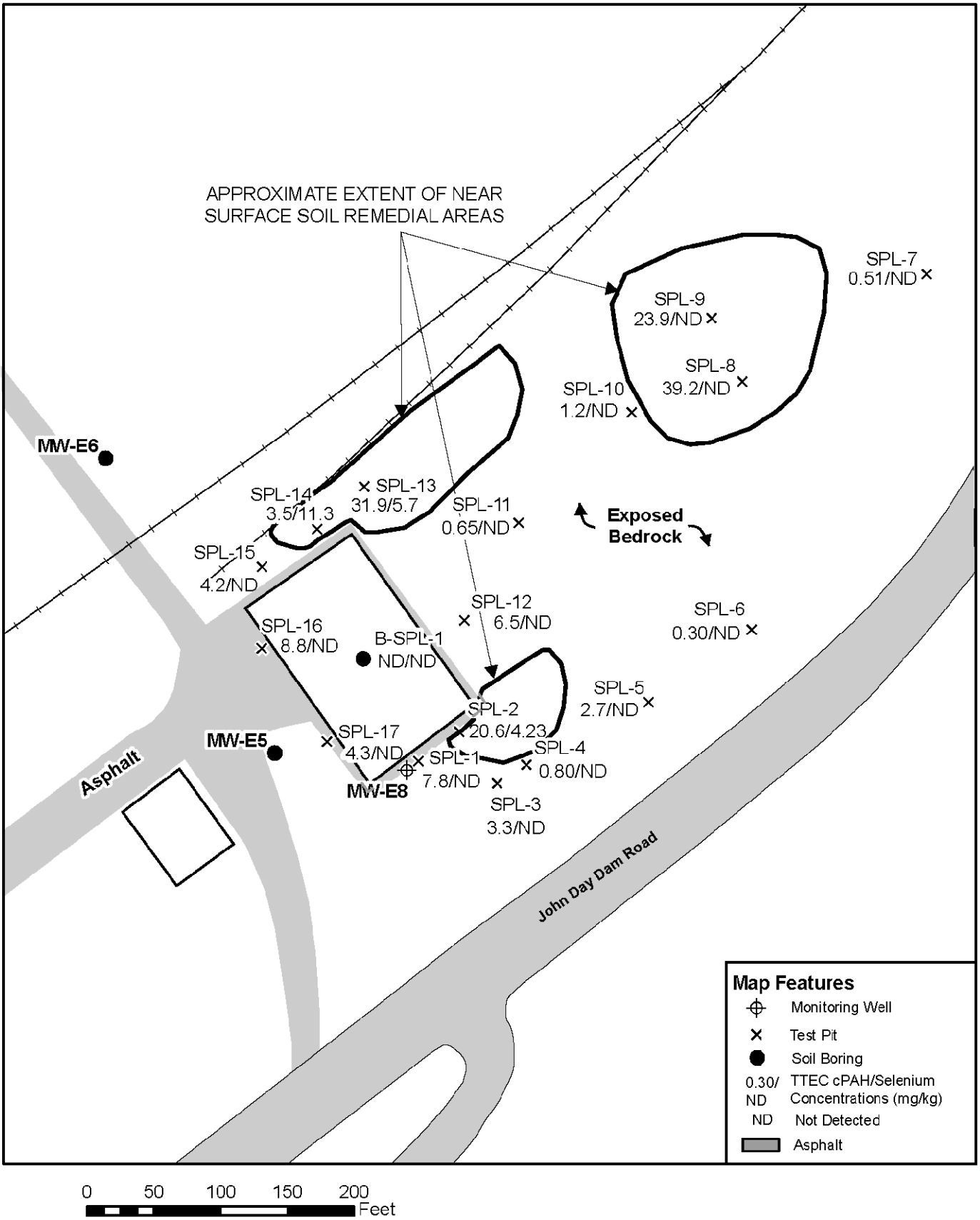
6.2.6.2 Previous Environmental Data

During the 2008 RI, 19 soil samples collected from test pits and borings were submitted for laboratory analysis including PAHs, PCBs, RCRA metals, total cyanide, fluoride, and sulfate. No evidence of VOC impacts were noted during field screening and as such were not included in the analytical suite of analyses (URS 2008c). A tabulated summary of soil analytical results for this investigation are included in Appendix A-12.

For comparative purposes, the analytical data were evaluated in the RI relative to both MTCA Method C cleanup levels (ingestion) and, when available, MTCA terrestrial ecological screening level values. No PCBs were detected in soil. Cyanide was detected in nine samples, but at concentrations below both MTCA Method C and B cleanup levels. Fluoride and sulfate were detected in soil at concentrations below the MTCA Method C level. No metals were detected above associated MTCA Method C levels.

Selenium from three test pit soil samples were detected above the associated MTCA ecological screening level of 0.8 mg/kg. PAHs were detected in four soil samples exceeding The MTCA Method C (ingestion) cleanup level for cPAHs TTEC of 18 mg/kg. The distribution of soil exceeding MTCA Method C cleanup levels and ecological screening levels for PAHs and selenium, respectively, appears to be limited to three areas east and near the building (refer to Figure 6.2.6-2). These near surface soil sample results are shown on Figure 6.2.6-2. The volume of impacted soil was estimated to be 2,400 cubic yards.

The lateral extent of PAHs above MTCA Method Industrial Cleanup Levels is bounded to the east, west, and south by samples with PAH concentrations below MTCA Method C formula values. The area of impacted soils is bounded to the north by the railroad tracks, which were already present and in use at the time of SPL storage at the East SPL Storage Area. Based on review of historical aerial photographs, the railroad spur was built during the initial construction of the plant. Ecology's (2015a) comment that one has to assume that the soil is continuously contaminated under the railroad tracks and in the area between the East SPL Storage Area (SWMU 12) and the North and South Potliner Soaking Stations (SWMUs 10 and 11) is not supported by the date of construction of the tracks, or the available historical soil contaminant data. To the northwest, the area of



Source: URS 2008c

Figure 6.2.6-2

East Spent Potliner (SPL) Storage Area
Near Surface Soil Sample Results

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

potentially impacted soil is bounded by bedrock outcrops. The vertical extent of PAHs and selenium above MTCA Method C cleanup levels in areas north, southeast, and northeast of the building was reportedly not fully characterized (URS 2008c). However, bedrock in most of these areas is exposed at the ground surface or is present less than 3 feet bgs, thus limiting the potential vertical extent of contamination in these areas.

Potential soil remedial technologies were screened and two potential remedial alternatives (in addition to the "No Action alternative") were evaluated, including 1) containment (soil or asphalt cover), and 2) excavation and off-site disposal. Alternative 2, soil excavation and off-site disposal, was identified as the preferred remedial alternative (URS 2008c).

6.2.6.3 Data Gaps Evaluation and Data Needs

The findings of the 2008 RI/FS indicate that PAHs in soil represent the primary environmental concern, with selenium considered a secondary terrestrial ecological concern at the East SPL Storage Area (URS 2008c). Although constrained by site features and the shallow depth to bedrock in this area, the horizontal and vertical extent of PAH-impacted soil was not fully characterized in areas north, southeast, and northeast of the existing Bath Building. Collection of additional soil chemical data is needed to fully define the extent and volume of PAH-impacted soils in this area. This supplemental data collection activity can be conducted during the RI or during remedial action as appropriate.

6.2.7 North SPL Containment Building (SWMU 14)

The North SPL Storage Building is located at the northeastern end of the former production area (Figures 2-1 and 6.1-1). The North Storage Building was placed in service in 1987 and was used for the storage and handling of SPL. The building was full of SPL by 1988 and sealed shut (Ecology 2014a, ENSR 1991).

The walls included 4-foot concrete perimeter walls with aluminum sheeting forming the upper part of the wall. The building was covered with a pitched aluminum roof. The floor area for the North SPL Containment Building was about 20,000 square feet. The building's floor was originally constructed to include a compacted gravel base material, 30 mil PVC liner, sand layer, and 6-inch, reinforced concrete slab (Golder 1995, ENSR 1991).

SPL was removed from the North SPL Storage Building in mid-1995 for off-site disposal pending the outcome of federal and state land disposal restriction regulations for SPL. The North SPL Storage Building was upgraded in 1996 to meet the requirements of 40 CFR 24.1101 and became certified as a Containment Building. (Golder 1996c, Ecology 1997b) The North SPL Storage Building was cleaned and inspected prior to the upgrade (Golder 1996b,c) and the following conditions were noted: wet areas at the base of the concrete walls on the north and west sides and in the interior of the building, extensive cracks and jointing in the concrete slab and perimeter concrete wall, concrete slab height 1 to 2 feet lower than the surrounding grade, and gaps between the aluminum sheeting and concrete wall (Golder 1996b).

The following modifications and evaluations were made at the North SPL Containment Building (Golder 1996c) including: assessment of slab structural integrity, sealing of floor slab joints and cracks, sealing of holes in the walls and roof, modification in operational procedures for storage and equipment staging/decontamination, installation of outer and inner doors, and exterior drainage improvements.

The upgraded North SPL Containment Building was operated from 1996 until the plant ceased operations in 2003 and was closed under RCRA during 2008 and 2009 (Ecology 2009b, CH2MHill 2009).

6.2.7.1 Closure Plan for SPL Units

Clean closure of the North SPL Containment Building (SWMU 14), South SPL Containment Building and Annex (SWMU 15), and SPL Handling Containment Building (SWMU 16) was performed under the same Ecology-approved closure plan (Golder 1995; Ecology 1995c,e). The closure plan required sampling of dust, concrete, the sand layer beneath the concrete and above the liner, and surface soils adjacent to the buildings.

For the closure sampling, screening levels specified in the Golder (1995) closure plan included the following:

- **Dust and concrete.** The screening levels for dust and concrete were 1,600 mg/kg for free cyanide, and 4,800 mg/kg for water-soluble fluoride. For the North SPL Handling Building and South SPL Handling Building, the water-soluble fluoride level was converted to a 240 mg/L fluoride screening level for the synthetic precipitation leaching procedure (SPLP) that was used for testing (CH2MHill 2009, Golder 1996c).

- **Sand and soil**. The screening levels for sand and soil included 32 mg/kg for free and total cyanide, and 4,800 mg/kg for water-soluble fluoride. For the North SPL Handling Building and South SPL Handling Building, the water-soluble fluoride level was converted to a 240 mg/L fluoride screening level for the SPLP that was used for testing (CH2MHill 2009, Golder 1996c).

The cyanide screening levels for the sand layer and soils were based on 100 times the free cyanide MTCA Method B groundwater standard at that time (100 X 0.32 mg/L for free cyanide) (Ecology 1995a,b). Note that this 100 times the groundwater protection standard screening criteria for soil is no longer used in the current revision of MTCA. Based on review of the closure plan and associated Ecology correspondence (Golder 1995; Ecology 1995a,b), the screening levels for fluoride in the sand layer and soils were based on the MTCA Method B soil screening levels and protection of groundwater was not specifically addressed for fluoride.

6.2.7.2 Environmental Investigation and Closure History

The North SPL Containment Building was investigated as part of closure activities during 2008 and 2009 (CH2MHill 2009). Closure of the North SPL Containment Building was certified by CH2MHill in 2009 (CH2MHill 2009). Closure sampling included:

- Sampling of dust at 1) concrete support posts on the east and west side of the building 2) rafters in the central, west, and eastern portion of the building, and 3) all external walls.
- Sampling of concrete at five locations.
- Sampling of sand under the concrete (initial six samples with follow-on sampling at five locations).
- Sampling of surface soils on the exterior of building (four samples, one per wall).

Based on review of the closure certification report (CH2MHill 2009), decontamination of the building structures and surfaces was not documented. The 1995 closure plan (Golder 1995) only required decontamination of the building surfaces based on sample results.

6.2.7.3 Previous Environmental Data

Analytical results for the concrete, dust, sand, and soil samples are included in Appendix A-14. The concrete samples contained free cyanide (maximum of 0.97 mg/kg), total cyanide (maximum of 416 mg/kg), total fluoride (maximum of 19,800 mg/kg), and water-soluble fluoride by SPLP (maximum of 83.8 mg/L) at concentrations below screening levels.

Three of the dust samples collected from the walls and concrete supports exceeded the fluoride SPLP screening level of 240 mg/L, but the average concentration was below the screening level. Total fluoride concentrations ranged from 117,000 mg/kg to 176,000 mg/kg in the dust samples. Detected concentrations of total cyanide ranged from 21.5 mg/kg to 190 mg/kg and free cyanide concentrations varied from 0.095 mg/kg to 1.4 mg/kg, and were below screening levels.

For the sand layer (below the concrete flooring and above the PVC liner), total cyanide exceeded the screening level in one sample (35.5 mg/kg), and low levels of free cyanide (0.44 mg/kg) were also detected in this same sample. Total fluoride concentrations in the sand layer varied from 506 to 2,890 mg/kg and water-soluble fluoride concentrations as measured through SPLP analyses ranged from 0.264 mg/L to 19 mg/L. The detected fluoride concentrations were below the closure screening levels. Based on the initial cyanide results, supplemental sampling of the sand layer was performed and the supplemental sample results were characterized by lower concentrations.

Total cyanide and free cyanide were not detected in the four soil samples collected from the outside of the building and adjacent to the building walls. Total fluoride was detected in the soil samples

below the screening levels at concentrations ranging between 805 mg/kg and 12,000 mg/kg and water-soluble fluoride as determined through SPLP analyses was detected at concentrations ranging between 4.96 mg/L and 30 mg/L. The maximum total fluoride concentrations exceed the current MTCA Method B soil formula value of 3,200 mg/kg. The SPLP leachate concentrations exceed the groundwater MCL for fluoride of 4.0 mg/L.

At the request of Ecology, results for the cyanide sand samples were evaluated with respect to the MTCA soil cleanup requirements (three-fold rule) specified in WAC 173-340-740(7). The results showed that 1) the upper 95 percent confidence limit on the mean of the data set was below the screening level, 2) all of the results were less than twice the screening level, and 3) less than 10 percent of the samples exceeded the screening level.

Based on these results, Ecology provided notification that the results were in general conformance with the approved closure plan and that financial assurance for final closure of the North SPL Containment Building was no longer required to be maintained (Ecology 2009b).

6.2.7.4 Identified Data Gaps and Data Needs

The Agreed Order states that based on the design of the building, characteristics of the SPL stored within the building, and sampling data collected during closure, no releases of hazardous or toxic constituents to the soil or groundwater are anticipated from this unit.

The following data gaps and data needs have been identified:

- **Determination of a fluoride and cyanide-containing waste and soil screening level that is protective of groundwater consistent with MTCA requirements.** It is unclear if the soil screening levels used for closure for water-soluble fluoride (4,800 mg/kg, or 240 mg/L SPLP fluoride) and cyanide are protective of leaching to groundwater. This is particularly true given the recently lowered MTCA Method B formula values for fluoride (0.640 mg/L) and free cyanide (0.0096 mg/L) in groundwater. For example, note that the water-soluble fluoride (SPLP) screening level of 240 mg/L is 60 times the drinking water MCL of 4.0 mg/L and 375 times the MTCA Method B formula value for fluoride in groundwater. While the SPLP fluoride results are below the screening level used for closure, they are fairly consistently above the groundwater screening levels, suggesting a potential for leaching.

- **Current chemical concentrations of PAHs and selected metals in soil**. The sampling program was limited to cyanide and fluoride. PAHs and selected metals represent COPC commonly associated with SPL and were not analyzed for during site closure.

- **Collection of subsurface soil samples beneath the liner.** Results for the **s**and layer above the liner show presence of fluoride in SPLP samples at concentrations ranging to 19 mg/L, which is above the fluoride MCL of 4 mg/L and suggest a potential for leaching. In addition to fluoride, subsurface soils below the liner should be characterized for COPC commonly associated with SPL.

- **Investigation of shallow groundwater.** Given the high levels of fluoride detected in soils and the evidence of drainage problems noted in 1996, shallow groundwater should be investigated to determine if a release to groundwater has occurred. This data gap and data need will be addressed as part of Groundwater in the Uppermost Aquifer AOC.

6.2.8 South SPL Storage Building (SWMU 15)

The South SPL Storage Building was constructed in 1988 and is located south of the Cast House (Figures 2-2 and 6.1-1). The building had a 21,000 ton capacity and consisted of a 22,000-square foot structure with similar construction to the North SPL Storage Building (SWMU 14). The walls included 4-foot concrete perimeter walls with aluminum sheeting forming the upper part of the wall. The building was covered with a pitched aluminum roof. The building's floor was reportedly originally constructed with a compacted gravel base material, 60-mil PVC liner, sand layer, and reinforced 6-inch concrete slab (Golder 1995, Goldendale Aluminum Company 1997b).

The South Annex Building was constructed in 1991 and was put into service in 1992. The South Annex was co-located with the South SPL Containment Building and was created by extending the foundation walls of the original building about 100 feet to the west (Golder 1995, Goldendale Aluminum Company 1997b). It was an 11,000 square foot building of similar construction to the South SPL Containment Building with a 9,800 ton capacity.

As noted previously in Section 6.2.7.1 Closure Plan for SPL Units, closure of the South SPL Containment Building and Annex (SWMU 15), North SPL Containment Building (SWMU 14) and SPL Handling Containment Building (SWMU 16) was performed under the same Ecology-approved closure plan (Golder 1995; Ecology 1995c,e). The closure plan required sampling of dust, concrete, the sand layer beneath the concrete slab, and surface soils adjacent to the buildings at these SWMUs. Refer to Section 6.2.7.1 for a summary of the screening levels used to certify closure of the unit.

6.2.8.1 Environmental Investigation and Closure History

All SPL was removed from the buildings and shipped to Chemical Waste Management's hazardous waste landfill in Arlington Oregon in 1994 and 1995 and the South SPL Storage Building and South SPL Building Annex were clean closed under RCRA in 1996 (Golder 1996a) All interior surfaces were decontaminated by Chemical Waste Management prior to sampling, and 800 pounds of swept residue were shipped to the Chemical Waste Management facility (Golder 1996a).

The South and South Annex SPL Storage Building were sampled as part of closure certification activities during December 1995 (Golder 1996a). Five concrete core samples, one sweep (dust sample), five sand layer samples, two asphalt, and two soil samples were collected.

6.2.8.2 Previous Environmental Data

Environmental data associated with clean closure of the unit is included in Appendix A-15. The detected concentration of total cyanide and total fluoride was significantly lower at this SWMU than at the North SPL Containment Building (SWMU 14) and the SPL Handling Containment Building (SWMU 16).

For concrete, total cyanide (maximum of 5.7 mg/kg) and total fluoride concentrations (maximum of 15 mg/kg) were significantly below the 1,600 mg/kg cyanide and 4,800 mg/kg water-soluble fluoride screening levels, respectively. Based on these results, analysis of free cyanide and soluble fluoride was not performed. The dust (sweep) sample contained 7.6 mg/kg total cyanide and 750 mg/kg of fluoride, which were both significantly below screening levels.

Sand layer samples collected from below the concrete slab contained low concentrations of total cyanide (maximum of 1.94 mg/kg) and total fluoride (maximum of 750 mg/kg) at concentrations significantly below screening levels. Similarly, asphalt chip samples from the north and west side of the building contained very low levels of total cyanide (0.17 mg/kg) and total fluoride (maximum of 63 mg/kg). Soil samples collected form the south and east side of the building also contained relatively low levels of total cyanide (maximum of 7.2 mg/kg) and total fluoride (maximum of 1,030 mg/kg) that were below the screening levels in the closure plan.

6.2.8.3 Identified Data Gaps and Data Needs

The Agreed Order states that based on the design of the building, characteristics of the SPL stored within the building, and sampling data collected during closure, no releases of hazardous or toxic constituent to the soil or groundwater are anticipated. Based on review of the closure report, the detected concentrations were significantly lower than the screening levels in the closure plan, as well as detected concentrations at the North SPL Containment Building or SPL Handling Containment Building. This may be due in part to the building decontamination that was employed

during closure and/or due to the shorter period of active operations at the South SPL Storage Building than other SPL SWMUs.

Data gaps and data needs include the following:

- **Current chemical characterization of PAHs and selected metals in soil.** The closure sampling program was limited to cyanide and fluoride. PAHs and selected metals represent COPC commonly associated with SPL and were not analyzed for during site closure.

- **Verification of the presence and condition of the PVC liner.** The sand layer between the concrete slab and PVC liner was reported as absent during the demolition and closure of the SPL Handling Containment Building (refer to Section 6.2.9) and the presence of a PVC liner was not noted (PGG 2011). Because of the similarity in the reported construction of the South SPL Storage Building concrete slab, sand layer, and liner with these same features at the SPL Handling Containment Building (SWMU 16) (Golder 1995, ENSR 1991), the presence and condition of the liner beneath the South SPL Storage Building concrete slab should be further assessed. If the liner is not present or is in poor condition, the need for additional sub-slab soil sampling should be further evaluated.

- **Determination of a fluoride and cyanide-containing waste and soil screening level that is protective of groundwater consistent with MTCA requirements.** As stated previously in Section 6.2.7.4. It is unclear if the soil screening levels used for closure for water-soluble fluoride (4,800 mg/kg, or 240 mg/L SPLP fluoride) and cyanide are protective of groundwater.

6.2.9 SPL Handling Containment Building (SWMU 16)

The SPL Handling Containment Building was constructed in 1990 and is located at the eastern end of Production Building D (refer to Figures 2-1 and 6.1-1). This unit is also referred to as the 90-day SPL Containment Building in the closure plan (Golder 1995), the Cathode Digging (CRRUD) Room (Golder Associates 1996b), and the Cathode Dismantling and Recovery Building (PGG 2011).

The walls included 4-foot concrete perimeter walls with aluminum sheeting forming the upper part of the wall. The building was covered with a pitched aluminum roof. The floor area for SPL Handling Building was about 20,000 square feet. The building's floor was reportedly originally constructed to include a compacted gravel base material, 60-mil PVC liner, sand layer, and 6-inch, reinforced concrete slab (Golder 1995).

The SPL Handling Containment Building was used for the disassembly of pots and the recovery of SPL from the cathode cells. SPL was temporarily stored at this location before being transferred to other onsite locations (e.g., the North SPL Containment Building) or offsite for disposal.

The SPL Handling Containment Building was also used for removal and separation of the cathode portion of pots and the recovery of recyclable metals and other materials during plant demolition activities. This activity was subject to Ecology Administrative Order Number 6350 (Ecology 2009a). Administrative Order Number 6350 specified submittal of a Work Plan (Envirocon 2007), schedule requirements, containment engineering controls, stockpiling requirements, inventory and inspection requirements, and record keeping and reporting requirements. Administrative Order Number 6350 was later amended for additional dismantlement of cells to become Ecology Administrative Order Number 7205 (Ecology 2009c).

The building was clean closed consistent with the closure plan (Golder 1995) and demolished during 2011 and 2012/.

6.2.9.1 Environmental Investigation and Closure History

A visual inspection was performed in 1995 to determine recommendation for converting the building to a containment building (Golder 1996b). The concretes slab was noted to be in relatively good condition with relatively few cracks. The walls roof and entryways were observed to have

cracks and pinholes that would allow fugitive dust emissions during operations (Golder 1996b) if the negative pressure ventilation fan system and dust scrubbers were not operational. A track hoe ram used to break down the SPL was observed outside the building and potential for tracking of materials was noted (Golder 1996b). The following modifications were made during the conversion: sealing of floor slab joints and cracks, sealing of holes in metal walls and roof, changes in operational procedures (dedication of equipment to the building to prevent off-tracking, and door closure during operations). Certification of the SPL Handling Building compliance with the requirements for containment buildings was made by Golder Associates in 1996 (Golder 1996c). Ecology approved the conversion in early 1997 (Ecology 1997b).

During demolition and concurrent closure activities, which occurred in 2011, the entire building (including 18 inches of soil from beneath the floor slab) was intended for disposal. The interior of the building was cleaned prior to sampling activities and demolition activities.

The closure sampling was conducted consistent with the 1995 closure plan (Golder 1995). Dust, surface wipe, and soil sampling was conducted. In addition to cyanide and fluoride, subsets of each sampled media (surface wipes, concrete, and soil) were analyzed for RCRA metals and PAHs. Soils and crushed concrete were also analyzed for PCBs. Nine samples of crushed concrete were collected for materials planned for site reuse. The additional chemical analyses for soil were compared against MTCA Method B formula values. As part of sampling during site closure (PGG 2011) and demolition, the following samples were collected:

- Eighteen wipe samples and two duplicates from the wall and floor of the building.
- Three samples of the concrete floor and footings.
- Seventeen soil samples from beneath the concrete slab (five initial samples and 12 confirmation samples).
- Six soil samples from outside the building (including four initial samples and two confirmation samples).

During February 2011, the western portion of the floor slab was removed and two samples were collected from depth of 3 to 6 inches and two were collected from depth of 24 to 30 inches. Twelve additional soil samples were collected from a depth of 30 inches during April 2011 after the entire floor slab and a thickness of 18 inches of soil below the slab had been removed. The sand layer that

was reportedly (Golder 1995) below the concrete slab and above the PVC liner was not encountered (PGG 2011). During closure activities, the PVC liner that was below the sand layer based on the design drawings was not reported to the total depth of 30 inches below the concrete slab (PGG 2011). The 1996 RCRA Part B Permit Application states that the sand layer was only 3-inches thick and underlain by the PVC liner (Goldendale Aluminum Company 1997b).

During May 2011, four soil samples were collected from outside the building walls. Following excavation near the eastern wall, based on comparison of chemical data with MTCA Method B screening levels, two additional soil confirmation samples were collected.

6.2.9.2 Previous Environmental Data

Environmental data collected during closure (PGG 2011) are included in Appendix A-16. Analytical results for the building wipe samples and concrete samples are summarized as follows:

- The building wipe samples contained total cyanide [maximum of 33.6 micrograms (µg)/100 square-centimeters (cm^2)], free cyanide (maximum of 117 µg/100 cm^2), and fluoride (maximum of 8.6 mg/100 cm^2). PGG (2011) states that these results indicate that these constituents were present at relatively low concentrations. No screening values for wipe samples were provided in the PGG (2011) report or closure plan. Toxic Characteristic Leaching Procedure (TCLP) analyses for metals were conducted on the wipe and concrete floor samples. TCLP metals concentrations indicated that the wipe sample were below RCRA regulatory criteria for D-Listed wastes (40 CFR, Subpart C, 261.24). PAHs were also detected at low concentrations in the wipe samples.

- Concrete samples contained low concentrations of total cyanide (maximum 4.1 mg/kg), free cyanide (maximum of 1 mg/kg), and fluoride (maximum of 35 mg/kg) at concentrations significantly below the closure plan screening levels. Low levels of PAHs and metals were detected in the concrete at concentrations below MTCA Method A and Method B screening levels for Unrestricted Land Use. PCBs and TPH were not detected.

Sample results for the 5 soil samples initially collected contained low levels of total cyanide (maximum of 0.28 mg/kg) and fluoride (maximum of 230 mg/kg); free cyanide was not detected. Two of the 5 initial sub-slab soil samples contained low levels of carcinogenic PAHs including benzo(a)pyrene (0.4 to 1.1 mg/kg), benzo(b)fluoranthene (1.5 mg/kg, one sample), and dibenz(a,h)anthracene (0.4 mg/kg, one sample) above MTCA Method B formula values, but significantly below MTCA Method C Industrial formula values. Metals were detected at concentrations below MTCA Method A and B formula values for unrestricted land use.

The confirmation samples (12) collected at a depth of 30 inches (after the concrete slab and 18 inches of soil were removed) contained low levels of fluoride (maximum of 420 mg/kg) below the post-closure screening level; total and free cyanide were not detected. Detected concentrations of metals did not exceed MTCA Method A and B formula values for unrestricted land use. Eight of the 12 sub-slab soil samples contained low-levels carcinogenic PAHs [including predominately benzo(a)pyrene (maximum of 1.3 mg/kg), dibenz(a,h)anthracene (one sample, 0.37 mg/kg), and benzo(b)fluoranthene (one sample, 1.7 mg/kg)] above MTCA Method B formula values, but significantly below MTCA Method C Industrial formula values. One of the 12 samples contained cadmium (3 mg/kg) above the Method A soil cleanup level for unrestricted land use that is based on protection of groundwater. PCBs were not detected.

The four soil samples collected from the building exterior contained low levels of total cyanide (maximum of 0.24 mg/kg) significantly below the closure screening level of 32 mg/kg and free cyanide was not detected. Fluoride concentrations ranged from 130 to 2,000 mg/kg, which is below the closure level of 4,800 mg/kg water-soluble fluoride and below the current MTCA Method B formula value of 3,200 mg/kg. Cadmium was detected in one sample (8 mg/kg) above the Method A soil cleanup level for unrestricted land use that is based on protection of groundwater. Carcinogenic PAHs were detected in all four samples at concentrations exceeding MTCA Method B formula values. Maximum concentrations for benzo(a)pyrene (13 mg/kg) in one of the samples approached the MTCA Method C formula value for this chemical. PCBs were not detected.

Based on soil concentrations that exceeded MTCA Method B formula values, a soil removal action was performed along the east wall of the building (PGG 2011). Following excavation, two soil samples were collected. Total cyanide and free cyanide were not detected in the two confirmation samples. Fluoride concentrations ranged from 360 to 490 mg/kg, which is significantly below the closure screening level. For PAHs, benzo(a)pyrene was detected in both confirmation samples at concentrations (0.45 to 0.61 mg/kg) at concentration above MTCA Method B formula values, but significantly below Method C formula values. Metals were detected in the two confirmation samples at concentrations below MTCA Method A and Method B screening levels for unrestricted land use. PCBs were not detected.

6.2.9.3 Identified Data Gaps and Data Needs

The Agreed Order states that based on the design of the building, characteristics of the SPL stored within the building and the results of samples collected during closure, no releases of hazardous or toxic constituents to soil or groundwater are anticipated in association with this unit. Based on review of the sample results (additional soil samples were collected beyond closure requirements), expanded analytical program, the soil removal already performed at this SWMU, and recent Ecology concurrence regarding the closure certification (Ecology 2011), no remaining data gaps or data needs have been identified.

6.2.10 East End Landfill (SWMU 17)

The East End Landfill is located in the southeastern portion of the facility operations area (refer to Figures 2-2 and 6.1-1). According to the Agreed Order and the 2004 RCRA Permit Application (Parametrix 2004a), the East End Landfill (EELF) represents an unlined landfill located south of the Paste Plant that was operated from 1971 to 1982. The Agreed Order also states the Landfill was closed by covering it with native soil. According to the Agreed Order, the landfill received all smelter wastes except food waste, SPL, waste oil, and spent solvents. Material disposed of in the East End Landfill included wood, demolition waste, carbon waste, contaminated alumina, and general trash.

Based on review of historical aerial photographs (refer to Appendix A-17 for historical aerial photographs), it appears the landfill was being used to deposit solid waste materials as early as 1972. Based on review of historical aerial photographs and past environmental investigations (URS 2008a, Technico Environmental Services 1991a), the main portion of the EELF is located east-southeast of the Paste Plant, rather than directly to the south.

An engineering drawing of Paving and Roads for the Alumina Storage Area (Harvey Aluminum, Drawing A01099, Revision 3, 1971c) shows that SPL storage may have occurred at the EELF (refer to Appendix A-17 for the drawing). Partially for this reason, a supplemental investigation of the EELF was planned (Tetra Tech 2011a).

A buried drum of pitch and friable asbestos was reportedly observed within the landfill during a test pit investigation in 1991 (URS 2008a, Technico Environmental Services 1991a).

Aerial photograph review indicates that between 1982 and 1989 the John Day Dam Road was built over part of the landfill (URS 2008a). The ground surface of the East End Landfill is irregular. Portions of the landfill are covered with pavement and concrete, including John Day Dam Road.

Historic aerial photographs reveal a surficial drainage feature naturally eroded into the basalt beneath the east side of the facility. This feature trends north to south toward the Columbia River and appears to be a continuation of an erosional feature draining south from the Columbia Hills (refer to Figures 2-1 and 2-2). Along the northeast corner of the facility, this drainage feature has been filled, paved, and built over. Within the East End Landfill, this topographic low appears to run along the eastern side the area where landfill waste was placed (URS 2008a).

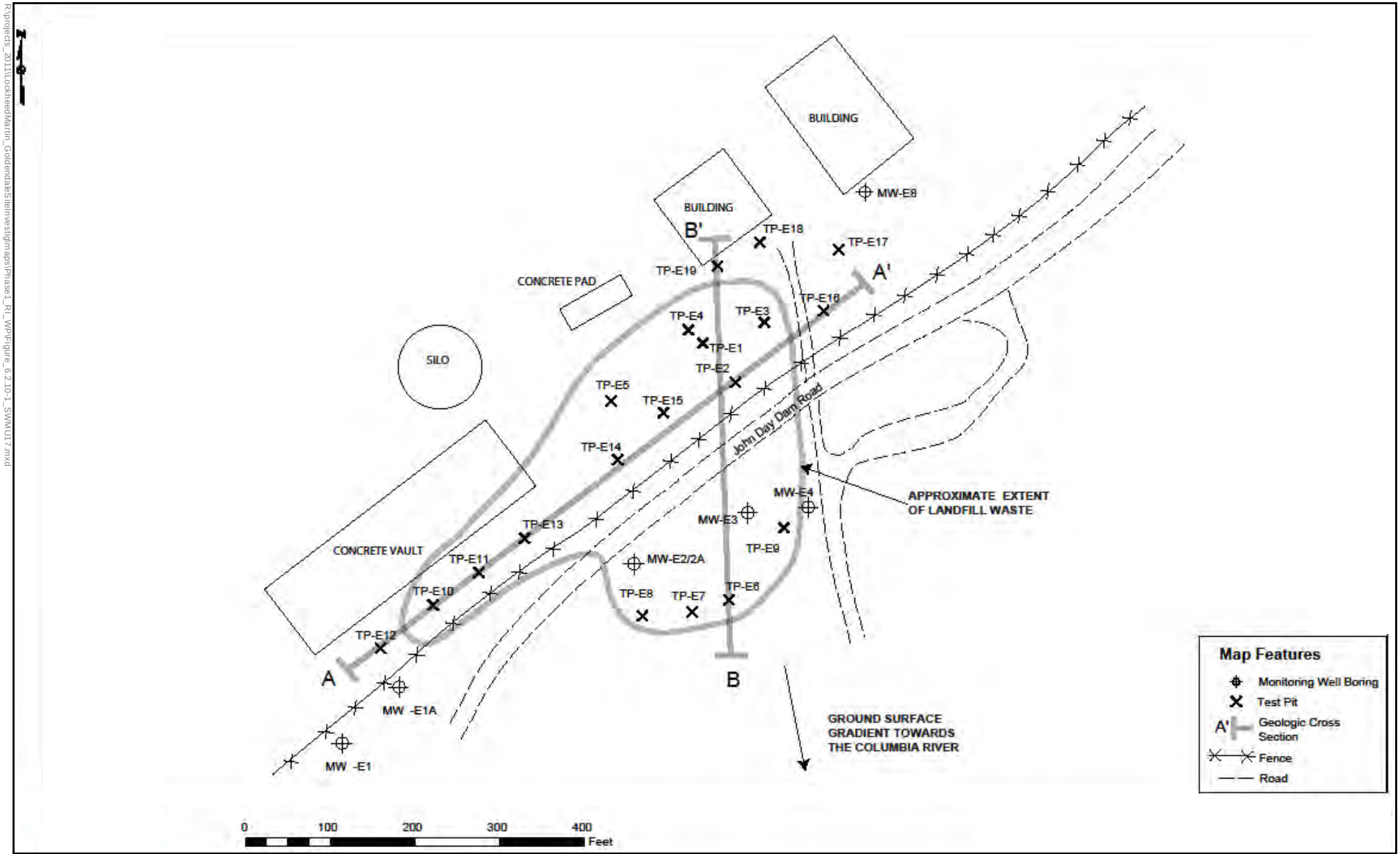
A brief discussion of the environmental investigation history and summary of associated findings for the East End Landfill site is provided below.

6.2.10.1 Environmental Investigation History

In 1991, 33 test pits were excavated throughout the East End landfill to evaluate the extent of and content of landfilled materials (Technico Environmental Services 1991a). Depth of fill encountered during test pit excavation reportedly ranged from 0.5 to 12 feet bgs. Landfill materials, where encountered, were described as general waste materials associated with the smelter. Two of the 33 test pits contained other materials, including one where a buried drum was encountered. The drum was reported in excellent condition and when opened was determined contain a pitch material. Another single test pit encountered a fibrous material at the base of the excavation believed to potentially represent friable asbestos insulation. No environmental samples were reportedly collected during the test pit excavation work effort (Technico Environmental Services 1991a). The handling and final disposal of the drum of pitch is not documented in the report. Based on review of the report, it appears the potential asbestos-containing material was returned to the excavation.

In 2008, Lockheed Martin performed an RI/FS at the East End Landfill site (URS 2008a). This work was conducted as an independent action and with informal Ecology review and concurrence of the Work Plan. The RI/FS included excavation of 19 test pits, five soil borings, and installation of four monitoring wells (designated as MW-E1A, MW-E3, MW-E4, and MW-E8), as shown in Figure 6.2.10-1. The depth of the test pits ranged from 6 to 20 feet bgs.

Bedrock was encountered from about 5 to greater than 20 feet bgs in the landfill area. Groundwater was not consistently encountered beneath the landfill within the soils overlying the basalt bedrock, but may be perched on top of the basalt bedrock seasonally in localized areas. Only one of the four wells (well MW-E1A) contained sufficient water for sampling in support of the RI. Well MW-E1A is screened in fractured, weathered, basalt about from 8 to 15 feet bgs (URS 2008a).



Source: URS 2008a

Figure 6.2.10-1

East End Landfill
Test Pit/Sample Location Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Test pits and borings were not completed within the John Day Dam Road. However, waste was reportedly suspected to be present beneath the road at depth, because landfill waste was encountered on either sides of the road and because of evidence of minor settling in the vicinity of road. The thickness of waste beneath the road and area of affected roadway will be estimated based on adjacent test pit and sample results for the purposes of the RI/FS; sampling directly beneath the road is not planned. The areal extent of the landfill was estimated at about 321,000 square feet area and is shown on Figure 6.2.10-1.

Landfill waste ranged in thickness from 2 to 19 feet and was encountered in the majority of the test pits at the site (a cross-section view of the landfill based on the findings of the 2008 RI is included in Appendix A-17). The volume of landfill waste was estimated to be 35,380 cubic yards. Waste material encountered during the RI/FS consisted of construction debris (metal pipes, fiberglass siding, brick, plastic sheeting, asphalt, and concrete), smelter wastes (reportedly carbon briquettes), potential asbestos-containing material (siding, insulation), crushed metal drums, tires, and both gray and black fine-grained material that comprised about 60 to 70 percent of the waste encountered. The RI/FS report indicates that the gray waste material may be cryolite bath material and the black waste material may be carbon waste material (URS 2008a).

As part of the 2008 RI, an exposure assessment was conducted in accordance with MTCA and included evaluation of potential receptors, points of compliance, and exposure pathways. The FS (URS 2008a) evaluation included screening of remedial technologies, and development and evaluation of three potential remedial alternatives including: 1) Containment and Infiltration Control, 2) Remedial Excavation and Disposal, and 3) the "No Action" alternative. Alternative 2, remedial excavation and disposal, was identified as the preferred remedial alternative despite its greater cost as it was deemed the more protective and effective alternative.

6.2.10.2 Previous Environmental Data

The East End Landfill RI report (URS 2008a) serves as the primary source for the available environmental data for this SWMU. A brief summary of soil and groundwater data collected in support of the RI is provided below. Tabulated summaries of soil and groundwater analytical results, and applicable cross-section diagrams are provided for this SWMU in Appendix A-17.

For comparative purposes, the analytical data were evaluated in the RI relative to Method C cleanup levels (ingestion) for landfill waste and soils, and both Method C cleanup levels and MCLs for groundwater.

Soil and Landfill Materials

Soil samples collected during the RI included one (1) landfill waste sample, 11 test pit soil samples, and 2 boring samples. Soils were analyzed for a comprehensive suite of analyses, including TPH constituents, VOCs, SVOCs, PAHs, PCBs, RCRA Metals, asbestos, cyanide, fluoride, and sulfate. A summary of the RI soil sample results is provided in Appendix A-17.

One waste sample was collected in support of the RI/FS from the black waste material. The total PAH concentrations (4,057 mg/kg TTEC) for the waste sample exceeded MTCA Method C Cleanup Level for ingestion of 18 mg/kg TTEC. Barium, cadmium, chromium, and lead were not detected above industrial screening levels; arsenic, mercury, and silver were not detected.

Results for soils collected beneath landfill wastes are summarized as follows. Oil-range petroleum hydrocarbons were detected in one soil sample (2,620 mg/kg) above the MTCA Method A Cleanup Level for Industrial Land Use of 2,000 mg/kg; low concentrations of oil-range petroleum hydrocarbons and diesel-range petroleum hydrocarbons were detected in a few other samples at low concentrations below this screening level. PAHs were detected in soils underlying the wastes in 4 of 12 samples. PAH concentrations for one sample (130 mg/kg TTEC) exceeded MTCA Method C screening levels for ingestion. Low levels of WAD cyanide (maximum of 0.895 mg/kg) and total cyanide (0.563 mg/kg) were detected below screening levels in two separate soil samples. VOCs, PCBs, gasoline-range petroleum hydrocarbons, and asbestos were not detected in soil beneath the landfill. Arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver were either not detected or were detected at concentrations below screening levels (URS 2008a).

Groundwater

Groundwater was reportedly not encountered in three of the four monitoring wells (MW-E3, MW-E4, MW-E8) installed during the RI (URS 2008a). Groundwater from well MW-E1A was sampled for petroleum hydrocarbons, VOCs, SVOCs, PCBs, RCRA metals, total and WAD

cyanide, fluoride, and sulfate. A summary of groundwater analytical results and associated figure are included in Appendix A-17.

No petroleum hydrocarbons, VOCs, SVOCs, PCBs were detected in groundwater. Arsenic, barium, and selenium were detected at concentrations below screening levels. Total cyanide was not detected. WAD cyanide was detected at low concentrations (e.g., 0.020 mg/L) below the MCL of 0.2 mg/L. The detection of WAD cyanide is slightly above the MTCA Method B cleanup level (0.0096 mg/L) and equal to the Method C cleanup level (0.021 mg/L) established for cyanide in groundwater. Fluoride was detected (15.3 mg/L) above the MCL of 4.0 mg/L. Sulfate was detected at a concentration of 52.2 mg/L, which is well below the federal secondary standard screening level (URS 2008a).

6.2.10.3 Data Gaps Evaluation and Data Needs

Historical aerial photographs have indicated that there may be additional landfill material present to the north of the area as originally characterized in the 2008 draft RI/FS report (URS 2008a). Additionally, a plant construction drawing that was found (Harvey Aluminum 1971c, Tetra Tech 2011a) that labeled the north edge of the East End Landfill as "spent cathode storage area." Aside from this construction drawing, there is no documentary evidence that SPL disposal occurred in this area.

In early February 2011, Lockheed Martin performed an inspection at the East End Landfill to better understand site conditions and to help address additional site investigation requirements. During the inspection, additional portions of the landfill area were identified for supplemental investigation, including a rectangular 4-inch to 6-inch-thick concrete pad that represents the former briquette storage area, and locations both north and south of the John Day Dam Road.

A supplemental investigation Work Plan was prepared in April 2011 (Tetra Tech 2011a). The objective of the supplemental investigation was to: 1) characterize the nature and extent of wastes including the identification and location of potential RCRA hazardous wastes or Washington State Dangerous Wastes north of the landfill area previously characterized during the 2008 RI/FS, 2) determine if spent pot liner wastes are present within the previously investigated and newly characterized areas, and 3) determine the nature and extent of soil contamination beneath

encountered wastes. A test pit sampling program and associated waste and soil sampling program was planned to address these objectives (Tetra Tech 2011a).

The current plan for supplemental investigation of the East End Landfill will be considered as part of this RI work effort. Although the soil to groundwater pathway was not considered to be significant at this SWMU (URS 2008a), groundwater characterization monitoring considerations for this area are evaluated and discussed in Section 7.2, Groundwater in the Upper Most Aquifer AOC.

6.2.11 Reduction Cell Skirt Storage Area (SWMU 23)

The Agreed Order states that an area between Line D and the Drum Storage Area (SWMU 20) was used for the storage of failed skirts from the reduction cells from 1988 to 1995 (refer to Figure 6.1-1). The steel skirts reportedly had soil bath (cryolite salts) attached to the steel skirts and the skirts were stored in the area until the steel was recycled off-site (Ecology 2014a). According to Ecology (2014a), the skirts and residual bath material in soils were removed in 1995. After 1995, the skirts were stored on a concrete pad next to the Paste Plant before recycling. The 2004 RCRA Part B Permit Application states that the unit was "clean closed" (Parametrix 2004a), however, no documentation has been found of Ecology or other regulatory agency approval of the closure activities.

According to facility personnel (BMEC, personal communication, May 22, 2014), there's no available documentation of soil removal or soil sampling in this area (refer to Appendix A-23). Current concentrations of COPC in surface and subsurface soils represent a data gap and data need for SWMU 23.

6.2.12 Carbon Waste Roll-Off Areas (SWMU 24)

A 20 cubic yard roll-off bin was used to collect, store, and transport various RCRA wastes to an off-site landfill beginning in 1987 (Ecology 2014a). According to the Agreed Order, the carbon waste roll-off areas were located between the pot rooms. However, the specific waste management area(s) are not well defined. From this description, the area may include the courtyards between the production buildings. Materials managed in the Carbon Waste Roll-off Area included: fume system carbon, waste briquettes, production room floor sweepings, silo top paste, and waste stud-hole paste. The 2004 RCRA Part B Application (Parametrix 2004a) states that the wastes managed included waste carbon, floor sweepings, and waste paste.

PAHs represent the main COPC associated with the carbon waste. The carbon waste roll-off bin was shown on historical SWMU maps as located on the south side of Production Building A near its eastern end (refer to Appendix A-24).

No environmental data has been collected specifically related to the Carbon Waste Roll-Off Bins. However, an initial soil investigation has been performed of the production area courtyards (PGG 2010). PAHs were detected in courtyard soils above MTCA Method C screening levels in some locations (PGG 2010). Historical carbon handling, manufacturing, storage, and waste handling facilities of the production area including the Carbon Waste Roll-Off Areas are summarized and addressed in the Plant Area AOC.

6.2.13 Solid Waste Collection Bins and Dumpsters(SWMU 25)

According to the Agreed Order, the Solid Waste Collection Bin and Dumpsters (SWMU 25) was defined to include the storage and management of miscellaneous, non-hazardous solid waste from all departments of the smelter placed in small dumpsters or roll-off bins located at various collection points throughout the smelter. Wastes reportedly included: transite, empty cans, floor sweepings, PVC/glass pipe, and secondary treatment plant screening (Ecology 2014a). These wastes were reportedly picked up by a local waste hauler and transported to the Rabanco landfill near Roosevelt, Washington.

The number and specific locations of the roll-off bins have not been completely documented and may have changed over the period of plant operations. SWMU figures from 1991 and 1997 (ENSR 1991, Goldendale Aluminum 1997b) show that a solid waste collection bin was located at the east end of the plant and west of the East SPL Storage Area (SWMU 12). Refer to Appendix A-25 for these historical SWMU Maps.

A 1990 inspection (Ecology 1990a) noted the presence of a solid waste storage area at the east end of Production Building A. A 1995 Ecology inspection (Ecology 1995d) noted the presence of a large roll-off box labelled “industrial trash” located on a paved slab west of the Paste Plant and east of the South SPL Building that was reportedly the accumulation container for small roll-offs in the Maintenance, the Cast House and Auto Shop. A second empty industrial trash roll-off box was observed on the north side of Production Building B across from the Industrial Wastewater Treatment Facility.

The Agreed Order states that “because of the small volume and characteristics of the wastes, the possibility of a release from these collection points is very low.” No environmental data has been collected with respect to the solid waste roll-off bins and dumpsters and no data gaps or data needs have been identified with respect to this SWMU in this Phase 1 Work Plan.

6.2.14 HEAF Filter Roll-Off Bin (SWMU 26)

The paste plant emission control was upgraded from a wet scrubber to a HEAF system around 1990 (Ecology 2014a). During operation of the HEAF system, particulates containing high concentrations of PAHs were removed from the off gases on fabric filters. A 20 cubic yard roll-off bin was located near the Paste Plant for storage of the spent HEAF filters before transportation to the ChemWaste facility in Arlington, Oregon. SWMU maps (Dames & Moore 1996, 1998) show that the roll-off bin was located east and north of the Paste Plant near the northern edge of the Briquette Storage Slab (refer to Figure 6.1-1 and Figure 6.2.4-1). The Agreed Order states that because of the nature of the storage operation, a release of hazardous constituents from the roll-off bin to soil or groundwater is unlikely.

No environmental investigations have been performed regarding the HEAF Filter Roll-Off Bin. No data needs have been identified in this Phase 1 Work Plan with respect to the HEAF Filter Roll-off Bin.

Note that there was a HEAF Building that housed the air pollution filtration equipment for the Paste Plant that is not a SWMU or AOC at the facility. According to a 1995 Ecology inspection report (Ecology 1995d), a small amount of oil was observed in containment troughs and on the floor of the building. Two drums of used oil were observed. Identified data needs related to potential sources that are not represented as specific SWMUs (such as the HEAF Building) are summarized in the Plant Area AOC.

6.2.15 90-Day Drum Storage Area (SWMU 28)

The 90-Day Drum Storage Area (SWMU 28) was established in 1987, when the Drum Storage Area was closed under RCRA (Ecology 2014a). This storage area was located on a concrete pad at the end of the Maintenance Shop/Cast House near the Capacitor Yard (refer to Figure 6.1-1). Both hazardous and non-hazardous wastes were handled at the 90-Day Drum Storage Area. Drums received from different departments and satellite accumulation areas of the plant were catalogued and dated. The storage area was inspected and inventoried on a weekly basis by the facility to ensure that drums were not leaking and that regulated wastes were not stored longer than 90 days. In 1990, an 800-square foot metal building was constructed over the concrete pad and a 6-inch concrete berm was added at the edge of the concrete pad to retain spills. An epoxy was also applied to the concrete pad to seal cracks. Access to the 90-Day Drum Storage Area was restricted.

According to an Ecology 1995 inspection (Ecology 1995d), this waste accumulation area was located in a building west of the maintenance shop and central stores area. The area around the building was reportedly paved, fenced, and locked in 1995. Dangerous wastes, recyclable oil, waste batteries, rattle cans supplies, and some products were stored in this area at the time of the 1995 inspection.

At the time of the 1995 inspection, the use of 1,1,1-TCA products was in the final phase of being discontinued. Based on the 1995 Ecology inspection, 1,1,1-TCA was used in the crane bays and for cleaning containers prior to shipment. Waste oil was reportedly stored at the southern portion of the building (Ecology 1995d). In 1995, at the 90-Day Drum Storage Area, all drums were properly closed, in reasonably good condition, had acceptable labeling, and no problems were observed (Ecology 1995d). A prior 1993 (Ecology 1995d) inspection of the 90-Day Drum Storage Area also did not show evidence of spills or other physical problems. In 1990 (Ecology 1990a), two of 10 drums of waste oil (including one drum of 1,1,1-TCA contaminated oil) were observed to be leaking with leakage restricted to the immediate area of the drums (Ecology 1995d).

No environmental investigations have been performed at the 90-Day Drum Storage Area. According to the Agreed Order, the design and operation of this unit together with the frequent inspections, makes it unlikely that there was a release of hazardous or toxics constituents from this building to the environment. The relatively recent period of operations with associated regulatory oversight,

and the documented lack of soil contamination at the Drum Storage Area (SWMU 20) (URS 2008d) (refer to Section 6.3.3) that represents an older and similar waste management unit at the site also suggest a low likelihood of a release. No data gaps or data needs have been identified with respect to the 90-Day Drum Storage Area in this Phase 1 Work Plan.

6.2.16 Caustic Spill (SWMU 29)

The caustic spill was associated with operations of the Line A Secondary Scrubber Recycle System (SWMU 5). The spill occurred on the north side of the railway lines and south of the two above-ground storage tanks used for the storage of NAOH that were located near the southern wall of Line A in the eastern portion of the former production area (Ecology 1990e,f) (refer to Figure 6.1-1 and Figure 6.2.16-1). This indicates that the spill area occurred at a different location than indicated on historical SWMU maps (Goldendale Aluminum Company 1997b, Parametrix 2014a), but is consistent with the location of Production Building A stored caustics in the 2002 spill control plan (Goldendale Aluminum Company 2002b).

About 5,000 gallons of 20 percent caustic solution (NAOH) was spilled on the ground near the A-Room Line recycle water system during a transfer between tanks on October 3, 1990 (Ecology 2014a, Ecology 1990e,f). Appendix A-29 includes a map and description of the spill area. Reportedly, other smaller spills had occurred previously and the high-level alarms on the storage tanks had not been functioning properly for an undetermined period (Ecology 1990e).

In response to the spill, the caustic solution was flushed into the nearest storm drain and the NPDES treatment system was monitored. The NPDES permit limits were not exceeded during or in the aftermath of the spill. Some of the contaminated soils were reportedly excavated by the facility because of their highly elevated pH (Ecology 1990e). A portion of the spill area was freshly asphalted at the time of the Ecology inspection following the spill (Ecology 1990e) and an asphalt covered diversion/drainage ditch to a nearby storm water grate had been constructed. The initial Ecology inspection report noted a concern that groundwater may have been impacted (Ecology 1990e).

Ecology collected four soil samples and determined that the pH ranged from 9.3 to 11.1, which was below the dangerous waste criteria for corrosivity at that time of 12.5 pH units (Ecology 1990e,f). Based on these results, no additional cleanup of the spill was required by Ecology (Ecology 1990f).

Current chemical concentrations in subsurface soil and shallow groundwater in the vicinity of the Caustic Spill (SWMU 29) represents a data need.

N
W E
S

0 125 250 500
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 6.2.16-1
Approximate Location of Caustic Spill
SWMU 29

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_GoldendaleSite\investigmaps\Phase1_RI_WP\Report\Figure_6.2.16-1_SWMU_29.mxd

6.2.17 Paste Plant Spill (SWMU 30)

This section summarizes the Paste Plant Spill that resulted from spills associated with the Paste Plant Recycle Water System (SWMU 9) and adjacent Briquette Slab Storage Area. The Paste Plant Recycle Water System (SWMU 9) is summarized in Section 6.2.4. Ecology inspections and administrative actions related to the Paste Plant Recycle Water System are also described in Section 6.2.4. The investigation area for the Paste Plant Spill as well as other nearby related site features is shown in Figure 6.2.4-1.

In addition to the Paste Plant Recycle Water System (SWMU 9), other features related to carbon handling, manufacturing and storage features in the area of the Paste Plant include: a Coke and Pitch Unloading Structure, a Pitch Building, Hard Pitch Building, three petroleum coke silos, an Anthracite Silo, and a Briquette Storage Area. These areas will be summarized under the Plant Area AOC.

6.2.17.1 Environmental Investigation and Cleanup History

During a May 1990 inspection (Ecology 1990a), an overflow event was observed at the cooling tower on the east side of the Paste Plant. The cooling tower and associated sump are part of the Paste Plant Recycle Water System. The overflow event reportedly reached the fence on the south side of the Paste Plant facility. According to the inspection report (Ecology 1990a), overflow events had occurred previously and had resulted in at least one previous soil cleanup during 1989 in which about 150 tons of state-designated EHW had been removed from the same area as the spill (interpreted as the area south of the fence line).

During July 1990 (Ecology 1990b), Ecology inspectors observed surface runoff of cooling water that was used to keep anode briquettes from fusing together. According to the Ecology inspector, the facility did not have adequate briquette building storage at that time and stored the briquettes on an uncovered concrete slab. During periods of hot weather, a series of water spray nozzles located above the concrete slab and briquette pile were used to cool the briquettes. Runoff was observed flowing across a paved area in the same general vicinity as the first overflow event, under a chain link fence, and onto a grassy area south of the Paste Plant. From the description, this spray area was likely located at the western portion of the Briquette Storage Slab.

In 1990, Columbia Aluminum was ordered by Ecology (Order No. 90-1050) to remove all PAH-contaminated soils resulting from the Paste Plant including soils south of the chain link fence located between the Paste Plant facility and John Dam Road (Ecology 1990c).

During the May 1990 inspection when the spill was noted, Ecology collected four soil/sediment samples from the spill area (Ecology 1990a). Ecology noted that the soils would designate as either a state designated DW or EHW based on the detected concentrations of carcinogenic PAHs.

Surface soils were sampled, excavated, and removed from inside and outside of the fence south of the Paste Plant (Technico Environmental Services 1991c). About 1,140 cubic yards of PAH-contaminated soil were excavated from inside of the fence and 1,690 cubic yards of PAH-contaminated soil were excavated from outside of the fence. The excavated soils were transported to and disposed of at the WSI, because they contained less than one percent PAHs, and were not designated as an extremely hazardous waste under the Washington State Dangerous Waste Regulations (Chapter 173-303 WAC) (Technico Environmental Services 1991c).

During the 1991 investigation (Technico Environmental Services 1991c), total PAH concentrations were compared against an industrial screening level of 20 mg/kg total PAHs. Concentrations of individual PAHs were not reported and the TTEC soil cleanup approach currently specified in the MTCA regulation [WAC 173-340-708(8)] was not adopted.

During excavation of the surface soils inside the fence, it was discovered that there was a landfill containing plant waste from previous operations (the East End Landfill) present to the east and along the fence line and the soil cleanup of Paste Plant spill was not completed for this reason (Technico Environmental Services 1991a,c). A former discharge line for the Paste Plant located along the fenceline was also noted as a likely historical source of contaminants (Technico Environmental Services 1991c). Capping of affected soils above the 20 mg/kg total PAH industrial screening level was recommended (Technico Environmental Services 1991a,c).

From review of the East End Landfill characterization information, site topography, and historical information, it appears unlikely that the area along the fenceline near the Paste Plant is part of the East End Landfill. This area appears to have been impacted by spills and historical runoff from operations near the Paste Plant and/or other undocumented backfilling activities. A topographic

depression was present south of the coke silos and just east of the drainage line that discharged along the fence line. This topographic depression is seen as a pond on some historical aerial photos from the 1960s and 1970s and is also shown on the original stormwater drainage map for the facility (Harvey Aluminum 1981) that shows the topography, as well as in a county road relocation plan and profile map (R.A. Edwards & Associates 1979) for this area. Based on review of a 1972 aerial photo, this area had been mostly backfilled prior to construction of the County road (i.e., John Day Dam Road) (refer to Appendix A-17). A smaller depression still remaining south of the Coke silos and north of the road may have been further backfilled later in the operational history of the plant.

Investigation of subsurface soil concentrations beneath asphalt and concrete in the Paste Plant Spill Area was not performed.

6.2.17.2 Previous Environmental Data

Appendix A-30 includes selected figures and tables from Ecology (1990a) and Technico Environmental Services (1991c) that summarize the sampling results. Results for the initial soil/sediment samples collected by Ecology during the May 1990 inspection show that concentrations of carcinogenic PAHs exceeded the one percent EHW waste designation criteria in some of the samples. Benzo(a)pyrene was consistently detected at concentrations ranging from 330 mg/kg to 1,800 mg/kg as were other carcinogenic PAHs.

During the soil removal action, a single composite sample was collected from outside the fenceline prior to soil removal action. The result was 829 mg/kg total PAHs, which is above the 20 mg/kg total PAH screening level adopted at that time.

Post-removal confirmation samples were collected at one station inside the fenceline (Post-cleanup 1) and outside the fenceline (Postcleanup 2). At each station, samples were collected from 0 to 1 feet bgs and 1 to 2 feet bgs. In addition, a sample was collected from 2 to 3 feet bgs at the Postcleanup 2 station. The results showed that PAH concentrations in soil remained above the 20 mg/kg total PAH screening level in the 0 to 1 foot bgs sample interval. Because individual carcinogenic PAH concentrations were not reported, and the current MTCA TTEC approach for carcinogenic PAHs was not used, the historical data can't be compared with current MTCA Method C or Method B formula values.

6.2.17.3 Data Gaps Evaluation and Data Needs

Characterization of current PAH soil concentrations in the Paste Plant soil investigation area with the soil data evaluation consistent with current MTCA requirements represents a data gap and data need for the Paste Plant SWMU area. The soil investigation boundaries should be planned taking into consideration investigation activities at the Paste Plant Recycle Water System (SWMU 9), East End Landfill (SWMU 17), and other nearby plant carbon manufacturing, handling, and storage facilities that will be addressed as part of the Plant Area AOC. Chemical characterization of data for subsurface soil from beneath the paved surface in the Paste Plant spill area as well as the backfilled topographic depression south of Coke silos also represents a data gap and data need.

Characterization of shallow groundwater quality also represents a data gap and data need for the Paste Plant Spill Area that will be address as part of the Groundwater in the Uppermost Aquifer AOC.

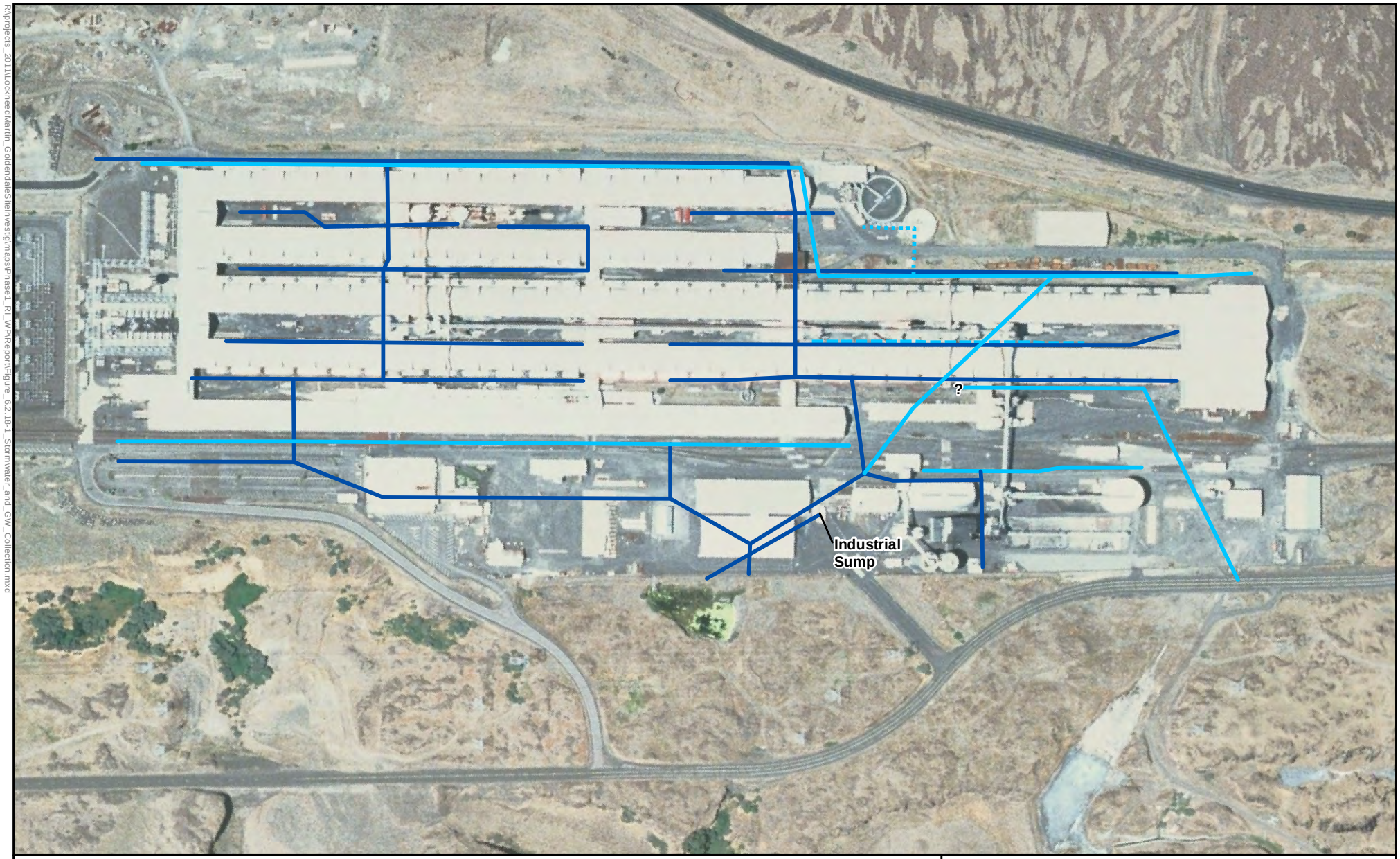
6.2.18 Storm Water Pond and Appurtenant Facilities (SWMU 32)

This section summarizes available information about the storm water pond and appurtenant facilities. Storm water is collected in a series of catch basins that drain to the storm water pond, which is located in the southern portion of the main production area (refer to Figure 6.2.18-1). Storm water collected in the pond is pumped to the industrial sump where it was historically commingled with process water prior to discharge to the NPDES ponds under the NPDES permit. In 2010, a bypass line was constructed and discharge to the NPDES ponds subsequently ceased because water from the industrial sump was redirected to the bypass line (NPDES permit discharge line) (Columbia Gorge Aluminum 2011).

SWMU 32 is defined as the storm water pond and associated storm water catch basin drainage system and associated piping. It also includes lines along the northern edge of the former plant that convey shallow groundwater to the storm water pond. The line that conveys the water from the storm water pond to the industrial sump is also included. Figure 6.2.18-1 shows the current layout of the storm water system. Appendix A-32 includes various historical design drawings of the storm water pond as well as the storm water and shallow groundwater collection systems that drain into the storm water pond.

The storm water pond has been excavated into basalt bedrock and is used to temporarily store and settle out solids prior to discharge. The storm water pond was also used as an emergency supply of water for fire suppression. The storm water pond is unlined and therefore appears to locally recharge the shallow basalt aquifer zone.

A design was prepared for expansion of the storm water pond during 1999 (Lockwood Green et al. 1999). The grading plan design (Lockwood Green et al. 1999) shows that the pond was planned to be expanded to the southeast (refer to Appendix A-32). The pond expansion occurred during the early 2000s based on the date of the plans and review of historical aerial photographs. The degree to which existing pond sediments were removed during pond expansion is undocumented based on review at the time of this plan.



Legend

- Groundwater Collection Network
- Groundwater Collection Network (Inferred from Original Groundwater Drainage Plan)
- Line location based on design plans. Line has likely been modified because of construction in this area, but the modification is undocumented.
- Storm Drain Network

Source: Harvey Aluminum (1971)

N W E S

0 125 250 500

Feet

Figure 6.2.18-1
Stormwater and Groundwater Collection System Layout

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

The shallow groundwater collection system was originally constructed of two east-west trending lines of 18-inch perforated pipe (Figure 6.2.18-2). These connected to a larger 24-inch NE-SW trending perforated pipe that drained into the stormwater system (Harvey Aluminum 1971a). This system was later expanded to include additional groundwater collection lines at the northern edge of the plant when Production Buildings C and D were added (Goldendale Aluminum Company 1996e, Martin Marietta 1980). The northern groundwater collection lines consisted of 18-inch diameter, perforated, corrugated metal pipes (Martin Marietta 1980).

In addition, a series of east-west trending 8-inch perforated pipe segments and associated catch basin are present on the south side of the railroad tracks (on the south side of the Cast House in the western part of the site and the north side of the Pitch Building east of the Coke and Pitch Unloading Structure (Goldendale Aluminum Company 1996e) (refer to Figure 6.2.18-1). This portion of the system is labelled as a storm drain on the construction drawings; however, its overall design and construction appear to be similar to the groundwater collection lines in other areas of the plant. This collection system may affect shallow groundwater flow beneath the Former Plant and may provide a transport pathway for shallow groundwater (and associated contaminants) into the storm water system (or vice versa).

A stormwater line extends in a north-south orientation from the fence line south of the Paste Plant and intersects the east-west oriented perforated groundwater collection line (described in the previous paragraph) east of the Coke and Pitch Unloading Structure (refer to Figure 6.2.16-1). The Briquette Cooling Sump at the Paste Plant was originally connected to this north-south trending storm water drainage line (refer to Section 6.2.4 and Section 6.2.17). This line appears to have historically discharged stormwater, groundwater, and briquette cooling sump water at the fence line south of the Paste Plant (within the Paste Plant Spill investigation area) and the discharge point of the system will be addressed as part of the Paste Plant Spill (SWMU 30).

The industrial sump and industrial piping system are included in discussion of the Plant Area AOC. The separate shallow groundwater collection and conveyance system at the eastern end of the plant that discharges to the NPDES Pond A is also discussed as part of the Plant Area AOC.

R:\projects_2011\LockheedMartin_GoldendaleSiteInvestig\maps\Phase1_RI_WP\Report\Figure_6.2.18-2_Original_GW_Drainage_Plan.mxd

Legend

Groundwater Collection Network

Storm Drain Network

Note: The rest of the original stormwater drainage system is not shown on this figure.

N W E S

0 125 250 500

Feet

Source: Harvey Aluminum (1971)

Figure 6.2.18-2
Original Groundwater Drainage Plan

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

6.2.18.1 Environmental Investigation and Cleanup History

Sediments within the storm water pond were sampled and characterized during 1991 (Technico Environmental Services 1990, 1991b). Most of the pond sediment samples were determined to represent state-designated EHW based on PAH concentrations exceeding the one percent EHW PAH criteria.

Some of the stormwater catch basins as well as catch basins for other drainage systems were sampled as part of investigations related to plant demolition activities (PGG 2012b). About 80 catch basins and about 3,420 linear feet of sewer line (of various types) were cleaned (PGG 2012b). Water from the cleaning process was pumped to the large clarifier located near the water treatment plant for evaporation. All solids were transported to the Bath House located southeast of the east end of Production Building A for temporary storage. About 21 tons of solids from the catch basins were transported to Columbia Ridge Landfill for disposal. Several line segments could not be accessed during the 2012 investigation and were not cleaned (PGG 2012b).

6.2.18.2 Previous Environmental Data

Appendix A-32 contains data summary tables and associated figures for investigation of the stormwater pond (Technico Environmental Services 1991b) and stormwater catch basins (PGG 2012b).

Two rounds of sampling were conducted at the stormwater pond in 1991 (Technico Environmental Services 1991b). The first round of sampling included collection of solid (i.e., sediment/ soil/sludge) samples from three locations within the stormwater pond (inlet, middle, and west end) with chemical analyses of total PAH. Total PAH concentrations ranged from 0.66 to 1.13 percent. The most contaminated sample collected from the middle of the pond (1.13 percent) exceeded the State–designated extremely hazardous waste criterion of one percent. All three samples exceeded the 20 mg/kg total PAH industrial soil screening level used at that time. The second round of sampling included collection of 13 randomly located sediment samples from the pond with measurement of individual and total PAHs. Total PAH concentrations ranged from 0.845 to 2.371 percent with 11 of the 13 samples exceeding the one percent State designation criteria for extremely hazardous waste. Concentrations of individual carcinogenic PAHs also consistently exceeded the current MTCA Method C Industrial formula values used in this Phase 1 Work Plan. For example,

benzo(a)pyrene was found at concentrations ranging between 61,000 µg/kg and 1,600,000 µg/kg in all thirteen samples, which is significantly above the current MTCA Method C Industrial formula value of 18,000 µg/kg.

Forty-seven sediment samples were collected from accessible stormwater system catch basins during 2011 and analyzed for metals (Al, As, Ba, Cd, Cr, Pb, Hg, Se, and Ag), fluoride, total cyanide, PAHs, PCBs, and petroleum hydrocarbons. Data summaries and an accompanying figure showing the catch basin locations are included in Appendix A-32. It should be noted that the catch basin samples represent solids that are contained within an engineered system and that soil and sediment screening levels may not representative for these materials from a risk-pathway perspective. Soil screening levels for protection of groundwater for drinking water use are also potentially relevant. While soil screening levels for protection of groundwater for the site-wide RI have not yet been systematically determined, some of the MTCA Method A Cleanup Levels for specific chemicals cited in this section address groundwater protection. Also, many of the catch basins already have been cleaned. Sample results have been conservatively compared against MTCA Method A, B, and C soil formula values for screening purposes in this Work Plan.

Table 6.2.18-1 summarizes the results of the storm water catch basin sampling program and includes those samples that have exceeded one or more screening levels. The results are summarized as follows:

- For metals, aluminum, arsenic, cadmium, lead and mercury were detected at concentrations above MTCA Method A or B screening levels for unrestricted land use. Of these metals, only arsenic was detected above Method C Industrial formula value in one catch basin sample. Arsenic was detected in 28 of 47 samples above the MTCA Method B formula value with several samples above the 20 mg/kg MTCA Method A screening level of 20 mg/kg based on groundwater protection. Cadmium was detected in 41 of 47 samples above the MTCA Method A soil cleanup level based on groundwater protection of 2 mg/kg, but below the MTCA Method B formula value of 80 mg/kg based on residential exposure. Lead and mercury were both infrequently detected above the screening levels (both were detected above screening levels in one of 47 samples). Aluminum concentrations exceeded the MTCA Method B soil screening level in 2 of 47 catch basin samples.

Table 6.2.18-1
Summary of Chemical Concentrations in Stormwater Catch Basin Soils/Sediment

Chemical	MTCA Method A or B Soil Screening Level	MTCA Method A or C Industrial Soil Screening Level	Number of Samples Exceeding One or More Screening Levels/Total sample number	Maximum Detected Concentration	Catch Basin or Manhole with Maximum Concentration
Aluminum	80,000	3,500,000	2/47	**150,000**	CB2L4
Arsenic	20 (Method A)[a] 0.667 (Method B)	87	28/47	**89**	CB-11
Cadmium	2 (Method A)[a] 80 (Method B)	3,500	41/47	**16**	CB2L11
Lead	250	1,000	1/47	**820**	CB-11
Mercury	2 (Method A)[a]	2 (Method A)[a]	1/47	**29**	CB2L4
Fluoride	3,200	140,000	4/47	**3,900**	CB2L11
Benzo(a)anthracene	1.37	180	47/47	**1,300**	CB2L13
Benzo(b)fluoranthene	1.37	180	47/47	**2,100**	CB2L13
Benzo(k)fluoranthene	13.7	1,800	38/47	**1,700**	CB2L13
Benzo(a)pyrene	0.137	18	46/47	**2,200**	CB2L13
Chrysene	137	18,000	24/47	**1,600**	CB2L13
Indeno(1,2,3-c,d)pyrene	1.37	180	47/47	**1,200**	CB2L13
Dibenz(a,h)anthracene	0.137	18	39/47	**480**	CB2L13
Aroclor 1254 or 1260	0.5	63.5	2/47	**1.7**	CB2L1
Naphthalene and/or Methyl naphthalene	5 (Method A)[b]	5 (Method A)[b]	4/47	**7.8**	CB-19
Mineral-Oil Range	2,000 (Method A)	2,000[b]	1/47	**18,000**	CB4L6
Diesel-Range	2,000 (Method A)	2,000[c]	16/47	**83,000**	CB1L23 (CB1L20)
Lube Oil Range	2,000 (Method A)	2,000[b]	38/47	**76,000**	CB2L13

a Screening level represents MTCA Method A soil screening level for protection of groundwater for drinking water use.

b Screening level represents MTCA Method A soil screening level for protection of groundwater for drinking water use. It represents the total value for naphthalene, 1-methyl naphthalene and 2-methyl naphthalene.

c Screening level represents MTCA Method A Industrial soil screening level, which is based on prevention of free product accumulation on groundwater. MTCA Method C for TPH is determined through a site specific evaluation and calculation process and specific values are not listed in the MTCA regulation.

All concentrations in milligrams per kilogram (mg/kg).

Bold/shaded values denote positive detections that exceed one or more screening levels.

- Fluoride was detected in all of the catch basin samples at concentrations ranging between 52 mg/kg and 3,900 mg/kg. Fluoride exceeded the MTCA Method B formula value of 3,200 mg/kg in 4 of 47 catch basin samples.

- Carcinogenic PAHs were detected in all 47 samples at concentration above MTCA Method B formula values. Some individual PAHs including benzo(a)pyrene and dibenz(a,h)anthracene were detected above MTCA Method C Industrial formula values in several catch basin samples.

- Aroclor 1254 was detected in 6 of 47 samples at concentrations ranging between 0.2 mg/kg to 1.7 mg/kg. Aroclor 1254 was detected at concentrations above MTCA Method B formula values in two samples. All detected concentrations were below MTCA Method C Industrial formula values.

- Diesel-range and lube oil range petroleum hydrocarbons were detected above the MTCA Method A Industrial Soil screening level of 2,000 mg/kg in 16 or 47 samples and 38 of 47 samples, respectively. Naphthalenes were detected above the MTCA Method A Industrial Soil screening level based on groundwater protection in 4 of 47 catch basin samples.

Total cyanide (detected in 17 of 47 samples) and free cyanide (detected in 6 of 47 samples) were detected infrequently and at low concentrations (generally below 1 mg/kg) below MTCA Method B screening levels in the catch basin samples.

6.2.18.3 Data Gaps Evaluation and Data Needs

The following data gaps and data needs have been identified with respect to the storm water retention pond and associated storm water drainage system:

- Characterization of current chemical concentrations of PAHs and other site COPC in the storm water retention pond sediments.
- Characterization of the current vertical and horizontal extent of PAH contamination (and other contaminants) in the pond sediments. Estimation of the volume of contaminated sediments in the pond and the anticipated waste designation (proportion of EHW versus non-hazardous waste in the pond sediments).
- Further information regarding the construction details of groundwater collection system (e.g., pipe elevations, pipe diameters, elevation with respect to the bedrock contact).
- Confirmation of the current layout of groundwater collection system and its tie-in with the storm water drainage system.
- Hydrologic evaluation of the groundwater collection system including estimation of the amount of groundwater conveyed by the system to the storm water pond.
- Evaluation of the effects of the groundwater collection system on shallow groundwater occurrence and flow.
- Evaluation of the hydrologic relationship between the stormwater pond and shallow groundwater.
- Verification that catch basin and storm water line cleaning has been accomplished to the maximum extent practical now that demolition activities, which previously limited access, have been completed.

6.2.19 Other Potential Sources

Other potential sources identified in the Production Area will be addressed as part of the Plant Area AOC in Section 7.5 as explained in a recent letter to Ecology (Lockheed Martin and BMEC 2014).

6.3 NORTHWESTERN AREA

The northwestern area of the site includes the SWMUs located primarily northwest of the Production Area including: the West Surface Impoundment (SWMU 4), the West SPL Storage Area (SWMU 13), the Drum Storage Area (SWMU 20), the Construction Rubble Storage Area (SWMU 21), the Wood Pallet Storage Area (SWMU 22), and the Tire and Wheel Storage Area (SWMU 27). The operational history, environmental investigation and cleanup history, previous environmental data, and identified data gaps are described for each SWMU in the following sections. Refer to Figure 6.1-1 for the locations of these SWMUs.

6.3.1 West Surface Impoundment (SWMU 4)

The West Surface Impoundment (WSI) was constructed in 1981 and began operations in 1982 as part of a major smelter expansion and modernization (refer to Figure 2-2 and 6.1-1). The WSI was initially an approximate 10 acre earthen impoundment that has a maximum depth of about 18 feet and is lined with a bottom 30-mil Hypalon geomembrane liner covered by about 6 inches of protective soil (Ecology 2014a, Parametrix 2004c).

The WSI was designed to concentrate emission control wastewater through evaporation and for storage/disposal of air emission control sludge. In 1982, the WSI began receiving waste from the North SO_2 scrubber and the Tertiary Treatment Plant (refer to Figure 2-2 and 6-1) (Ecology 2014a, Parametrix 2004a). In 1985, the East Surface Impoundment (SWMU 2) was closed and South SO_2 scrubber water was diverted to the WSI. In 1995, Ecology revised WAC 173-303 including a change to the bioassay criteria that resulted in reclassification of the WSI waste materials from state-dangerous to non-dangerous waste (Ecology 2014a, Parametrix 2004c).

In September 2004, the WSI was closed under RCRA (Parametrix 2004d). Closure was conducted through consolidation and grading of the sludges and the placement of an engineered RCRA cap consisting of a sand layer, a geosynthetic clay layer, 30-mill PVC geomembrane liner, a geotextile drainage layer, and soil cover (Parametrix 2004c, Ecology 2014a). At the time of closure, about 89,000 cubic yards of sludge material was estimated within the WSI. A Closure and Post-Closure Plan was prepared in November 2004, including provisions for long-term maintenance and groundwater monitoring (Parametrix 2004c). In November 2005, Ecology accepted certification for closure of the WSI (Ecology 2005). Site access is restricted by security fencing and signage installed around the entire perimeter of the impoundment.

The WSI closure engineering plans and record drawings are provided in Appendix A-4. The following section provides a summary of the closure and post-closure environmental history for the WSI.

6.3.1.1 Environmental Investigation History

An inspection and conformance testing program was implemented during grading and cap construction (Parametrix 2004d) to document the closure action and provide record drawings (refer to Appendix A-4). The WSI groundwater monitoring well system was originally installed in early 1984, and consisted of nine monitoring wells installed at various depths (from 22 to 150 feet bgs) and water bearing zones. A groundwater monitoring program evaluation was performed in 1988, which included assessment of site hydrogeology, groundwater quality, and monitoring well design and placement (Golder 1988). This assessment suggested that the existing well network did not adequately monitor the uppermost aquifer as represented by the unconsolidated alluvium and colluvium deposits overlying the basalt. In 1989, two existing monitoring wells were abandoned and eight additional monitoring wells were installed at depths ranging from 30 to 60 feet bgs.

From 1991 to 2003, the existing 15 well network (consisting of wells MW-2A/2B, MW-3A/3B, MW-4A, MW-6B, MW-7B, and MW-8A, MW-9A, MW-10A, MW-11A, MW-12A, MW-13A, MW-14A, and MW-15A) was monitored on a quarterly basis. Sampling activities included water level measurements, field parameter measurements (i.e., pH, temperature, and conductivity), and laboratory analysis including total organic carbon, sulfate, fluoride, chloride, sodium, iron,

manganese, free cyanide, total cyanide, and total phenols (Parametrix 2004c). Figure 6.3.1-1 shows the WSI site features including associated monitoring well locations.

An additional monitoring well, well MW-18, was installed in 2004 approximately 2,500 feet southwest of the WSI to monitor post-closure concentrations near the downgradient property boundary (refer to Figure 6.3.1-1). In late 2004, a Groundwater Sampling Data Analysis and Evaluation Plan was prepared as part of post-closure planning for the WSI (Parametrix 2004b). This sampling plan designated select upgradient and downgradient wells for long-term monitoring, as well as established the analytical program and sampling frequency as summarized in Table 6.3.1-1. Selected groundwater protection standards used to evaluate groundwater quality data include MTCA Method B and MCLs.

In accordance with the post-closure Groundwater Sampling Data Analysis and Evaluation Plan (Parametrix 2004b), a two-year post-closure groundwater evaluation was completed in 2007 (Parametrix 2007). Post-closure data included nine quarterly events between February 2005 and March 2007, with evaluation including time-series plots and Mann-Kendall statistical tests. Evaluation findings indicated that downgradient wells exceeded protection standards for sulfate and fluoride, and for total cyanide in well MW-14A. Significant decreasing trends were observed for all parameters except for fluoride. Increasing fluoride concentration trends were noted in wells MW12A, MW-14A, MW-3B, and MW-18 (Parametrix 2007).

Table 6.3.1-1
WSI Post-Closure 2004 Groundwater Monitoring Program

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Well Designation	Monitoring Activity/ Sample Analyses	Monitoring Frequency
MW-8A Upgradient MW-3B Downgradient MW-10A Downgradient MW-12A Downgradient MW-14A Downgradient MW-18 Downgradient	• Water level measurement • Field parameter measurement (pH, conductivity, temperature) • Laboratory analyses (fluoride, chloride, sulfate, and total cyanide)	• Quarterly for first 2 years • Semiannual for years 3 through 7 • Annually after year 7 until concentrations drop below the protective standard, or for a maximum of 30 years

Source: Groundwater Sampling Data Analysis and Evaluation Plan for Goldendale Aluminum West Surface Impoundment Facility (Parametrix 2004b).

Legend

Groundwater Monitoring Well

N
W E
S

0 125 250 500

Feet

Figure 6.3.1-1

West Surface Impoundment (WSI)
Location Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Routine groundwater monitoring in accordance with the WSI post-closure Groundwater Sampling Data Analysis and Evaluation Plan (Parametrix 2004b) was most recently completed in April 2014 (GeoPro 2014). The findings of the recent sampling effort and a summary of post-closure groundwater monitoring results for the WSI are provided in Section 6.3.1.2 below.

6.3.1.2 Previous Environmental Data

Routine post-closure groundwater monitoring at the WSI is currently conducted on an annual basis (refer to Table 6.3.1-1), and most recently completed in April 2014 (GeoPro 2014). Post-closure data has been collected during 12 quarterly events between February 2005 and November 2007, six semiannual events between May 2008 and October 2010, and four annual events in July 2011, April 2012, June 2013, and April 2014. The data summarized in Table 6.3.1-2 are compared against the post-closure plan-specified MTCA Method B and MCL groundwater criteria, as applicable. It should be noted that the MTCA Method B formula values for fluoride and cyanide in groundwater have recently been lowered by Ecology, including fluoride at 0.640 mg/L and cyanide at 0.0096 mg/L (refer to Section 3.3.2).

A summary and evaluation of the WSI post-closure data, including time-series plots, Mann-Kendall statistical tests, and use of Upper Confidence Limits (UCLs) for evaluation of sulfate, fluoride, chloride, and total cyanide concentrations in groundwater are provided in the WSI 2014 Annual Groundwater Monitoring Report (GeoPro 2014). A summary of finding for the 2014 annual groundwater monitoring work effort include the following:

- Groundwater flow is consistent with historical data, with an overall flow direction downgradient of the WSI toward the southwest.
- Total cyanide concentrations are below groundwater protection standards based on calculated UCLs since the last reporting period. A significant decreasing trend continues since the last reporting period for cyanide in wells MW-10A and MW-14A.
- Sulfate and fluoride concentrations in downgradient wells are above groundwater protection standards based on calculated UCLs. Fluoride in the upgradient well also exceeds groundwater protection standards. Based on Mann-Kendall trend tests, sulfate levels are increasing in downgradient wells MW-10A and MW-18, but are significantly decreasing in downgradient well MW-3B. There is no significant trend in observed fluoride concentrations.

Table 6.3.1-2
Summary WSI Post-Closure Groundwater Sample Analyses (mg/L)

Lowest Groundwater Protection Standard[a]	Upgradient Well MW-8A				Downgradient Well MW-3B				Downgradient Well MW-10A				Downgradient Well MW-14A				Downgradient Well MW-18			
	Sulfate	Fluoride	Chloride	CN[b] (total)	Sulfate	Fluoride	Chloride	CN (total)	Sulfate	Fluoride	Chloride	CN (total)	Sulfate	Fluoride	Chloride	CN (total)	Sulfate	Fluoride	Chloride	CN (total)
	250	0.96	250	0.2	250	0.96	250	0.2	250	0.96	250	0.2	250	0.96	250	0.20	250	0.96	250.00	0.20
Sample Date																				
2/16/2005	10	0.9	5.6	<0.01	**2,300**	0.6	130	<0.01	**940**	**1.8**	29	0.04	**4,000**	**9.6**	110	**0.35**	**1,500**	0.6	86	<0.01
5/11/2005	9.8	0.3	4.6	<0.01	**2,500**	0.4	140	<0.01	**910**	**1.5**	31	0.05	**3,500**	**8.6**	90	**0.24**	**1,300**	0.4	91	<0.01
8/29/2005	8.9	0.4	4.2	<0.01	**2,700**	0.6	120	<0.01	**670**	**1.2**	28	0.04	**3,600**	**30**	71	**0.27**	**1,500**	0.4	75	<0.01
11/1/2005	9.6	0.9	4.7	<0.01	**2,600**	0.9	130	<0.01	**670**	**2.7**	28	0.03	**2,800**	**25**	75	0.19	**1,300**	**1.8**	84	<0.01
2/27/2006	9.27	**2.8**	4.2	<0.01	**2,610**	0.7	118	<0.01	**1,570**	**2.3**	43	0.03	**2,170**	**31**	53	0.19	**1,520**	0.9	83	<0.01
6/5/2006	9.8	0.2	4.9	<0.05	**2,220**	0.2	113	<0.01	**1,650**	**3.2**	48	0.03	**2,380**	**27**	63	**0.20**	**1,490**	0.0	91	<0.01
7/31/2006	9.8	0.1	4.6	<0.01	**2,000**	**3.7**	110	<0.01	**860**	**2.3**	35	0.08	**3,300**	**30**	98	0.17	**1,500**	**2.6**	89	<0.01
10/9/2006	9.7	<0.2	4.5	<0.01	**2,500**	**3.8**	110	<0.01	**850**	**1.9**	30	0.03	**3,900**	**24**	130	0.01	**1,600**	**2.4**	80	<0.01
3/13/2007	10	<0.1	6.6	<0.01	**2,500**	**3.8**	110	<0.01	**1,100**	**3.4**	45	0.04	**4,400**	**16**	140	0.12	**1,600**	**2.6**	93	<0.01
6/22/2007	1	**<10**	4.89	<0.01	**2,500**	**<10**	97	<0.01	**1,100**	**<10**	36	<0.01	**7,900**	**19**	170	<0.01	**1,700**	**<1**	77	<0.01
9/24/2007	10	**<1**	4.2	<0.01	**2,200**	**<1**	124.79	<0.01	**760**	**1.2**	30	0.04	**6,400**	**<50**	200	0.03	**1,400**	**<50**	100	<0.01
11/14/2007	-	-	-	<0.01	-	-	-	<0.01	-	-	-	0.04	-	-	-	<0.01	-	-	-	<0.01
5/8/2008	10	**<1**	4	<0.01	**2,200**	**<50**	100	<0.01	**2,700**	**<50**	100	0.05	**5,500**	**<50**	100	0.19	**1,300**	**<50**	70	<0.01
10/14/2008	10	0.1	4.5	<0.01	**2,600**	**<10**	100	<0.01	**860**	**<10**	30	0.04	**6,500**	**20**	180	0.12	**1,600**	**<1**	80	<0.01
5/29/2009	9	**<1**	3	<0.02	**2,200**	**<1**	96	<0.02	**2,000**	**2**	68	0.03	**7,000**	**30**	210	0.14	**1,500**	**1**	81	<0.01
10/27/2009	10	**<1**	5.5	<0.02	**2,606**	**<1**	110	<0.02	**760**	**<1**	79	<0.02	**5,900**	**24**	160	0.044	**1,200**	**<1**	70	<0.01
5/26/2010	9.3	**<1**	4.4	<0.02	**2,300**	**2.3**	120	<0.02	**2,200**	**4.4**	83	0.03	**5,200**	**32**	170	0.14	**1,500**	**2**	100	<0.02
10/6/2010	8.9	**<1**	3.6	<0.02	**2,400**	**<1**	110	<0.02	**710**	**1**	23	0.02	**4,000**	**18**	120	0.086	**1,600**	**<1**	84	<0.02
7/26/2011	7.8	**<1**	3.6	<0.02	**2,000**	**<1**	98	<0.02	**1,800**	**3.3**	62	0.03	**3,900**	**23**	130	0.066	**1,600**	**<1**	89	<0.02
4/19/2012	10	0.18	3.8	<0.005	**2,200**	0.16	90	<0.005	**5,800**	**1.9**	180	0.01	Dry	Dry	Dry	Dry	**1,700**	0.2	79	<0.005
6/20/2013	9.4	0.16	4.8	<0.005	**1,900**	0.16	91	0.01	**4,700**	**3.1**	99	0.01	**2,300**	**17**	66	0.028	**1,500**	0.13	84	<0.005
4/25/2014	9.5	0.19	4.9	<0.005	**2,000**	0.18	91	<0.006	**6,100**	**2**	190	ND <0.005	**2,100**	**18**	61	0.037	**1,700**	0.12	79	<0.005

Source: WSI Annual Groundwater Monitoring Report (GeoPro 2014).

a Groundwater Protection Standards: MTCA Method B and Maximum Contaminant Levels (MCLs) cited in Post-Closure Monitoring Plan (Parametrix 2004b).

b CN Cyanide.

Bold/shading indicates exceedance of groundwater protection standard.

Note: Downgradient Well MW-12A was Dry, with one exception for 3/13/2007: Sulfate = 1,800; Fluoride = 6.3; Chloride = 150; and CN (Total) = <0.01.

Based on the most recent sample results, use of the current lowered MTCA Method B Formula Values for fluoride and cyanide, does not change the pattern of exceedances of screening levels for the current well network.

6.3.1.3 Data Gaps Evaluation and Data Needs

No data gaps or data needs are currently identified for the WSI based on this review, since an ongoing groundwater monitoring program is in place. Post-closure fluoride and sulfate concentrations in groundwater are much lower than pre-closure levels, although concentrations remain above groundwater protection standards with no significant overall reduction during the post-closure period to date. The next WSI annual sampling event is scheduled to occur in mid-2015. Groundwater characterization and monitoring needs are summarized on a site-wide basis as part of the Groundwater in the Uppermost Aquifer AOC in Section 7.2.

Monitoring well MW-12A has been reported dry and not sampled during 21 of the 22 post-closure monitoring periods completed since 2005. The single sample result from this well location collected in March 2007 showed sulfate concentration at 1,800 mg/L and fluoride at 6.3 mg/L, each above their associated groundwater protection standard. The status of this well as it relates to site-wide groundwater conditions will be assessed as part of the Groundwater in the Uppermost Aquifer AOC presented in Section 7.2 of this plan.

6.3.2 West SPL Storage Area (SWMU 13)

The West SPL Storage Area is located immediately east of the WSI (refer to Figures 6.1-1 and 6.3.2-1). This storage area operated from 1984 to 1988 for storage of SPL and then was closed as a solid waste landfill consistent with the Washington Solid Waste Regulations (WAC 173-304) that were applicable at that time. The unit was operated, closed, and monitored by Commonwealth Aluminum and its successor, Aleris International Limited (Aleris). Aleris filed for Chapter 11 bankruptcy in 2009 (Aleris 2010).

The West SPL Storage Area was initially constructed during summer 1984 as a concrete pad with containment walls and a drainage system installed at the pad's southern edge. Initially, 105,000 tons of SPL material from the east end of the plant was transported to this new storage area, and then the storage area was used as a repository for all SPL-generated by the facility from November and December 1984 until the plant sale to Commonwealth on January 8, 1985 (Bradford 1991).

6.3.2.1 Concrete Pad Construction Details

The construction details of the concrete pad are described in the closure plan (CH2MHill 1988a) as well as in a description by a Commonwealth Aluminum employee (Bradford 1991). Selected figures from the closure plan are included in Appendix A-13. According to the closure plan, the northern, eastern and western sides of the concrete slab were originally constructed in 1984 with 6-foot high retaining walls to allow stacking of SPL. The southern side of the stockpile had an 8-inch curb (CH2MHill 1988a,b). The dimensions of the concrete slab were approximately 480 feet by 200 feet and 6 inches thick (CH2MHill 1988a). The slab was reportedly sloped 0.5 percent from the north to south (Bradford 1991).

A grated leachate collection/drainage trench reportedly ran the length of the concrete slab just inside the south curb (Bradford 1991, CH2MHill 1988a) with the trench also sloped to drain east to west towards the WSI. A collection sump and pre-treatment chamber was reportedly present just west of the SPL slab and connected with the piping exiting from the slab drainage trench (Bradford 1991).

Legend

Existing Monitoring Well

N
W E
S

0 50 100 200
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2010.

Figure 6.3.2-1
West SPL Storage Area

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_GoldendaleSite\investigmaps\Phase1_RI_WP\ReportFigure_6.3.2-1_West_SPL.mxd

The closure plan (CH2MHill 1988a) shows the drainage of the original pad and stockpile that includes a 1.8-foot grated drain along the southern edge of the pot liner pile and concrete pad. The line appears to have drained through an 8-inch PVC drain line located near the southwest corner of the concrete pad into the fenced area of the WSI. No drain line is currently present in this area.

6.3.2.2 Cap Construction Details

Cap design details are provided in design drawings that were intended for construction bidding (CH2MHill 1988b). These design drawings are included in Appendix A-13. As-built construction drawings have not been found.

The existing SPL stockpile was to be re-graded with side slopes not to exceed 3:1. The flattest grade for any cover portion of the re-graded SPL Pile (i.e., the top) was 2 percent. The 3:1 slopes required that the footprint of the stockpile extend past the existing pad on the northern side. For the areas extending outside of the footprint of the concrete pad, a bottom liner system was designed that included from bottom to top: a bedding material layer, a 50 mil HDPE liner geomembrane liner, and protection soil layer. The SPL wastes would be placed on top of the bottom liner system for areas outside of the concrete pad. The designed top liner system included from bottom to top: a bedding material layer, a 50-mil HDPE cover geomembrane liner, strip drains, drain material, and a crushed rock final cover. A trench-anchor system was designed to secure the liners. The unlined ditches were designed and graded to convey water away from the capped area and into existing drainage systems near the site (CH2MHill 1988a). Vents were included in the design to allow equilibration of gas pressure; significant gas generation was not expected to occur within the waste pile (CH2MHill 1988a).

6.3.2.3 Environmental Investigation History

Environmental investigation and sampling of this area are related to characterization of groundwater and routine groundwater monitoring (Bakemeier 2009, Aleris 2010).

6.3.2.4 Previous Environmental Data

Soils were not investigated because the SPL waste was originally stored on a walled and curbed concrete pad. Test pits were excavated and logged for geotechnical purposes prior to design of the cap, but chemical samples were not collected. (CH2MHill 1988a,b).

Groundwater quality monitoring associated with the West SPL Storage Area has been conducted at wells MW-6B, MW-11A (used to represent upgradient or background conditions), MW-16A, and MW-17A. Wells MW-6B and MW-11A were also used as monitoring locations for the adjacent WSI. At the request of Ecology in 1989, groundwater monitoring was performed from 1990 through 2008 (Bakemeier 2009, Aleris 2010). Results are provided in Appendix A-13. The analytical program included: free cyanide, total cyanide, fluoride, sulfate, chloride, and sodium. Total cyanide, free cyanide, fluoride and/or sulfate have historically been detected at concentrations above MTCA Method B formula values and MCLs in the wells. Refer to Section 7.2 for a presentation of site-wide groundwater monitoring results.

A spike of total cyanide, fluoride, and sulfate in groundwater monitoring wells near the capped area was found in 1996 in wells associated with the West Pot Liner Storage Area (Goldendale Aluminum Company 1996a,b; CH2MHill 1996a,b). The 1996 observed spike in the groundwater concentrations was attributed by CH2MHill to the increase in ponded water and potential leaching of salts in the shallow soil near the ditch on the south side of the capped SPL pile, and not the capped SPL wastes. In 1996, during the wet winter season, precipitation caused slumping and cracking of the south and west slopes outside of the fenced area and topographically below the capped waste pile and above the southern ditch. Some of the slumped soils partially blocked the culvert under the access road to the SPL pile and resulted in ponding upstream of culvert in the vicinity of wells MW-16A and MW-17A. CH2MHill (1996a,b) reported that there were "increases in surface water percolation rates and possible increases in the leaching of soluble salts from shallow soil into the shallow groundwater."

In reference to March 1996 sampling event when the drainage problems were found, CH2MHill (1996a) notes the presence of a "SPL pile leak detection pipe that was observed to be dry and operating normally, so it does not appear to have been affected by slope instability or heavy rainfall." This pipe may represent the original concrete pad drainage line discussed in the previous section. The CH2MHill observations suggest that no leachate was generated by the capped SPL pile even during this high precipitation event.

The ditch on the southern side of the SPL pile has historically contained the scrubber slurry line leading to the WSI and there's some evidence of releases to this historically unlined drainage.

Because the WSI slurry lines were historically located in the ditch over a sustained period (WSI was operated from 1982 to 2005), there's potential for the sludge lines (or other potential sources, e.g., other miscellaneous drainage lines) to have released contaminants to the unlined ditch. Examples include the following:

- A pipe of unknown origin was observed during March 1996 near the southeastern corner of the capped SPL pile that was discharging 3 to 4 gpm near well MW-17A. The pipe discharge was sampled and contained amenable cyanide (0.011 mg/L), fluoride (0.084 mg/L) and sulfate (14.4 mg/L). The source of this pipe drainage was unknown (CH2MHill 1996b).

- A September 1996 sample of a water source that was located behind the old bowling alley (near the former research and development [R&D] laboratory shown in Figure 6.3.2-1) that was reportedly "a spring that comes to the surface in the ditch that the WTP line that runs to the WSI is located in (Goldendale Aluminum Company 1996c)." This sample contained 1.91 mg/L of fluoride.

- During October 1996, water from flushing of the SO2 scrubber purge lines was accidentally discharged to the slurry lines within the southern ditch during the period when CH2MHill was performing drainage repair of the ditch (the lines had been cut as part of the drainage ditch repair) (Wayne Wooster, e-mail communication, October 7, 1996). This inadvertent release reportedly caused additional excavation and repair to the ditch.

The southern surface drainage ditch was repaired and modified in both 1996 and 1997. In 1996, in response to the slumped slopes and spike in groundwater concentrations, a slope repair grading plan was prepared and repairs were made (CH2MHill 1996c; Wayne Wooster, e-mail communication, May 5, 1997). Based on the design drawings for the proposed work (CH2MHill 1996c), the grade of the south and west slopes was reduced and the ditch along the base of the southern slope was rebuilt, lined with 30-mil PVC liner, and covered with crushed rock. The casing for well MW-16A was planned to be extended to 2.5 feet above the new fill grade. As-built drawings of the fall 1996 slope and ditch repairs were not found during review.

During winter 1997, a front end loader got stuck in the ditch during snow removal operations and damaged about 50 feet of the liner in the southern ditch (Wayne Wooster, e-mail communication, May 5, 1997). This damage was subsequently repaired. The plan was to use a 60-mil HDPE liner placed in a shingled fashion in the affected area, covering it with fabric, and installing a final crushed rock cover (CH2MHill 1997). This repair was reportedly made during summer 1997.

6.3.2.5 Data Gaps Evaluation and Data Needs

Characterization of groundwater COPC concentrations, water-level elevations, and groundwater geochemistry at the West SPL Storage Area (SWMU 13) is needed to evaluate current groundwater conditions and will be addressed under the Groundwater in the Uppermost Aquifer AOC (refer to Section 7.2).

6.3.3 Drum Storage Area (SWMU 20)

The Drum Storage Area (SWMU 20) was located on the hillside northeast of the WSI and northwest of the former facility buildings (refer to Figures 2-2 and 6.1-1). This area was reportedly the former foundation of a redi-mix concrete plant built during the original construction of the smelter (Ecology 2014a). The Drum Storage Area was used for 55-gallon drum storage from 1971 through 1987 at which point all drums were removed and disposed offsite. The drums reportedly were stored on concrete pads and contained miscellaneous oils, solvents, and other liquid wastes. No records of historic spills or leaks were identified in association with the Drum Storage Area (URS 2008d).

A brief summary of the environmental investigation history of this SWMU is provided below.

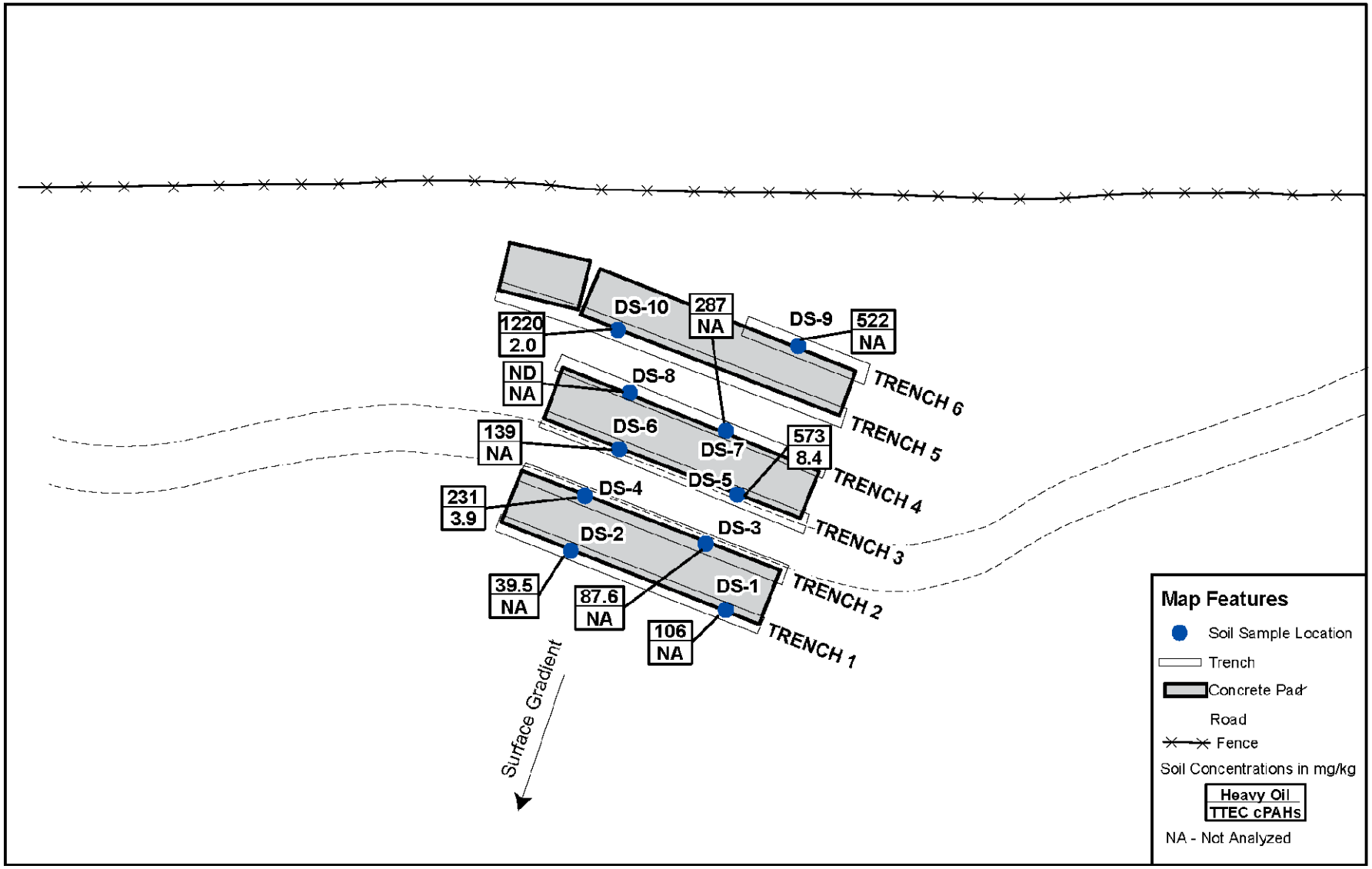
6.3.3.1 Environmental Investigation History

Lockheed Martin performed an RI of the Drum Storage Area during 2008 (URS 2008d). This work was conducted as an independent action with informal Ecology review and concurrence regarding the Work Plan. Six shallow (1 to 3 feet bgs) test trenches were completed along the sides of the concrete pads as shown on Figure 6.3.3-1. No groundwater was encountered in the six shallow trenches completed. Soil samples were collected every 5 linear feet along each trench and portions of each concrete pad were lifted to collect soil from beneath. These soils were field screened at the time of collection with little to no evidence of contamination (URS 2008d).

6.3.3.2 Previous Environmental Data

During the 2008 RI, 10 soil samples collected from test pits and beneath existing pads were submitted for laboratory analysis, including TPH constituents, VOCs, PCBs, and RCRA metals. PAHs were subsequently analyzed in those soils characterized by the highest TPH concentrations. Figure 6.3.3-1 shows the sample station locations. A tabulated summary of these soil sample results and associated figure is provided in Appendix A-20.

For comparative purposes, the analytical data were evaluated in the RI relative to Method C cleanup levels (ingestion) for soils. Method A Industrial Soil Cleanup Levels were also considered for petroleum constituents not included under Method C.



Source: URS 2008d

Figure 6.3.3-1

Drum Storage Area
Trench and Soil Sample Location Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

No PCBs or VOCs (with exception of naphthalene at low concentration in one sample) were detected in site soils. Diesel and oil-range hydrocarbons were detected in 9 of 10 samples but at concentrations below the MTCA Method A soil cleanup level of 2,000 mg/kg. Metals detected in site soil were below associated MTCA Method C soil cleanup levels (URS 2008d).

PAHs detected in soil samples were assessed using MTCA TEF methodology. The MTCA Method C (ingestion) cleanup level for cPAHs TTEC was 18 mg/kg. PAHs were detected in the three soil samples analyzed (ranging from 2.0 to 8.4 mg/kg) but did not exceed the Method C (ingestion) cPAH TTEC concentration of 18 mg/kg. Figure 6.3.3-1 includes a summary of heavy oil and TTEC cPAHs results by sample station location.

An exposure assessment performed in the RI identifies ingestion as the primary pathway of potential concern. None of the analyte concentrations exceeded the MTCA Method C cleanup levels for ingestion and the site was recommended for no further action (URS 2008d).

6.3.3.3 Data Gaps Evaluation and Data Needs

No data gaps or additional data needs are identified for the Drum Storage Area (SWMU 20) based on the findings of the 2008 RI work effort (URS 2008d), including meeting MTCA Method C soil cleanup levels. However, the appropriateness of the use of industrial cleanup levels for this SWMU based on future land use considerations should be confirmed.

6.3.4 Construction Rubble Storage Area (SWMU 21)

The Agreed Order states that construction rubble was disposed of in an area west of the Drum Storage Area (SWMU 20) following closure of the West End Landfill in 1987, and that this area was active until the smelter closed. Figure 6.3.4-1 shows the approximate location of the Construction Rubble Storage Area. A likely borrow pit can be seen on recent aerial photographs east and southeast of the West SPL Storage Area (Refer to Appendix A-21). The Construction Rubble Storage Area likely does not extend into the area of the borrow pit (PGG 2014b). Historical SWMU maps (Parametrix 2004a, Goldendale Aluminum 1997a) suggest that SWMU 21 is in close proximity and west of the Drum Storage Area. The Agreed Order states that because of the inert nature of the construction rubble, the possibility of soil or groundwater contamination is considered unlikely. No environmental investigations have been performed associated with this area. COPC concentrations in surface and subsurface soil represent a data need for the Construction Rubble Storage Area.

The Agreed Order also has included any disposal site for demolition debris in SWMU 21. Significant amounts of construction rubble (crushed concrete) remain onsite related to demolition of the plant during 2011-2013. There are four main areas where crushed concrete has been stockpiled at the site: 1) the North Access Road Stockpile located north of former Production Building B and east of the former Tertiary Treatment Plant, 2) the North Plant Stockpile located on top of the former location of Production Building D, 3) The Northwest Stockpile located between former Production Building D and SR 14, and 4) the Coke Silo Stockpiles located near the former Paste Plant on the north side of the former silo locations (see Figure 6.3.4-2).

The approximate dimensions of the North Access Road Stockpile are 30 feet wide by 15 feet tall by 250 feet long with an estimated volume of 4,200 cubic yards (PGG 2012c). The North Plant Stockpile consists of 14 piles that have been placed on the Production Building D foundation. Each of the individual piles is about 75 feet wide at the base and about 25 feet high. The total volume of the North Plant Stockpile is estimated to be about 19,000 cubic yards (PGG 2012c). The Northwest Stockpile consists of several adjacent and partially overlapping piles that cover an area of about 200,000 square feet. A rough estimation of the Northwest Stockpile volume is between 80,000 and 100,000 cubic yards. Crushed concrete from the North Access Road Stockpile was used as backfill in the footprint of the demolished SPL Handling Containment Building (SWMU 16).

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Legend

----- Approximate Location Boundary

N
W E
S

0 125 250 500
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 6.3.4-1
Approximate Location of
Construction Rubble Storage Area
SWMU 21

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_GoldendaleSite\invest\gmaps\Phase1_RI_WP\Report\Figure_6.3.4-2_Stockpiles.mxd

Legend

----- Approximate Stockpile Boundary

N
W E
S

0 125 250 500
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2013.

Figure 6.3.4-2
Crushed Concrete Stockpile Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Regulatory Closure of the SPL Handling Containment Building (SWMU 16) was approved by Ecology (Ecology 2011). The Coke Silos stockpiles are located north of the former silo foundations near the foundation of the former Paste Plant and Briquette Storage Slab and contain an undocumented volume of material (PGG 2014c).

6.3.4.1 Environmental Investigation History

Environmental data for the four crushed concrete stockpile areas is presented in two reports: the Crushed Concrete Sample Data Report (PGG 2012c) and the Coke Silos Concrete Sample Data Report (PGG 2014c). A sampling program was implemented to document the concrete crushing and stockpiling work effort as well as the sources of materials placed in the stockpiles, characterize COPC concentrations in the concrete, and evaluate whether the crushed concrete is acceptable for onsite reuse as backfill or surface paving (PGG 2012c, PGG 2014c). Monitoring of the concrete stockpiling process included periodic sampling of the crushed concrete directly from the crusher used for demolition for site COPC using both discrete and composite sampling methods. At the Coke silos, concrete cores of the silos were collected in addition to crushed concrete samples. Sample results were statistically evaluated and compared against MTCA Soil Method B and C formula values. Risk analysis was also performed to evaluate potential on-site reuse of the crushed concrete.

6.3.4.2 Previous Environmental Data

This section briefly summarizes the results of the concrete sampling program. Relevant data summary tables and associated figures are provided in Appendix A-21.

Crushed Concrete Data Report Results

A total of 77 crushed concrete samples were collected from the Northwest Stockpile, 16 samples from the North Access Road Stockpile, and 14 samples were collected from the North Plant Stockpile, respectively. The analytical program for the crushed concrete sample data report (PGG 2012c) included total metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium [total with limited hexavalent chromium analyses], lead, mercury, selenium, silver, and zinc), fluoride, total cyanide, free cyanide, PAHs, and PCBs (Aroclors). Leaching tests for metals, and cyanide were conducted on a small subset of the samples and included both TCLP and SPLP analyses. Table 6.3.4-1 provides a summary of the results.

Table 6.3.4-1
Summary of Chemical Concentrations in Crushed Concrete
North Access Road Stockpile, Northwest Stockpile, and North Plant Stockpile

Chemical	MTCA Method A or B Soil Screening Level for Unrestricted Land Use	MTCA Method A or C Industrial Soil Screening Level	Maximum Detected Concentration	Stockpile Area With Maximum Concentration
Metals				
Aluminum	80,000 (Method B)	3,500,000 (Method C)	22,000	North Plant
Arsenic	20 (Method A)[a] 0.667 (Method B)	20 (Method A)[a] 87	6.5	North Access Road
Barium	16,000 (Method B)	700,000 (Method C)	240	Northwest
Cadmium	2 (Method A)[a] 80 (Method B)	2 (Method A)[a] 3,500 (Method C)	1.9	North Plant
Chromium (total)	2,000 (Method A)[a] 120,000 (Method B)	2,0000 (Method A)[a] 5,250,000 (Method C)	46	North Access Road
Lead	250 (Method A)	1,000 (Method A)	44	Northwest
Zinc	24,000 (Method B)	1,050,000 (Method C)	690	North Access Road
Aluminum Smelting				
Total Cyanide	48	2,100	0.25	Northwest
Total Cyanide (SPLP)	NE	NE	<0.005 U	Not Applicable
Free Cyanide	48	2,100	0.5	North Access Road
Free Cyanide (SPLP)	NE	NE	<0.005 U	Not Applicable
Fluoride	3,200	140,000	290	Northwest
Polynuclear Aromatic Hydrocarbons (PAH)				
Naphthalene	5 (Method A)[b] 1,600 (Method B)	5 (Method A)[b] 70,000 (Method C)	0.47	North Access Road
2-Methylnaphthalene	5 (Method A)[b] 320 (Method B)	5 (Method A)[b] 14,000 (Method C	0.25	North Access Road
1-Methylnapthalene	5 (Method A)[b] 34.5 (Method B)	5 (Method A)[b] 4,530 (Method C	0.16	North Access Road
Acenaphthylene	NE	NE	0.074	Northwest
Acenaphthene	4,800 (Method B)	210,000 (Method C)	1.7	North Access Road
Fluorene	3,300 (Method B)	140,000 (Method C)	1.1	North Access Road
Phenanthrene	NE	NE	13	North Access Road
Anthracene	2,400 (Method B)	1,050,000 (Method C)	2.8	North Access Road
Fluoranthene	NE	NE	33	North Access Road
Pyrene	2,400 (Method B)	105,000 (Method C)	30	North Access Road
Benzo(g,h,i)perylene	NE	NE	21	North Access Road
Carcinogenic PAHs				
Benzo(a)anthracene	1.37 (Method B)	180 (Method C)	**21**	North Access Road
Benzo(b)fluoranthene	1.37 (Method B)	180 (Method C)	**40**	North Access Road
Benzo(k)fluoranthene	13.7 (Method B)	1,800 (Method C)	12	North Access Road
Benzo(a)pyrene	0.137 (Method B)	18 (Method C)	**29**	North Access Road
Chrysene	137 (Method B)	18,000 (Method C)	24	North Access Road
Indeno(1,2,3-c,d)pyrene	1.37 (Method B)	180 (Method C)	**24**	North Access Road
Dibenz(a,h)anthracene	0.137 (Method B)	18 (Method C)	**5.3**	North Access Road
Polychlorinated Biphenyls				
Aroclor 1242	1 (Method A)[c]	10 (Method A)[c]	0.9	North Plant

a Screening level represents MTCA Method A soil screening level for protection of groundwater for drinking water use.

b Screening level represents MTCA Method A soil screening level for protection of groundwater for drinking water use. It represents the total value for naphthalene, 1-methyl naphthalene, and 2-methyl naphthalene.

c Screening Level is for Total PCBs. Aroclor specific MTCA Method B and C value is not established for Aroclor 1242.

NE Not Established.

U Chemical was not detected. Associated value represents the reporting limit.

All concentrations in milligrams per kilogram (mg/kg).

Bold/shaded values denote positive detections that exceed one or more screening levels.

Results are summarized as follows:

- Carcinogenic PAHs including: benzo(a)anthracene, benzo(b)fluoranthene, benzo(a) pyrene, indeno(1,2,3-c,d)pyrene, and dibenz(a,h)anthracene were detected in several samples at concentrations above their individual MTCA Method B formula values. Benzo(a)pyrene (maximum concentration of 29 mg/kg) also exceeded the MTCA Method C formula value of 18 mg/kg in one sample.

- Total cyanide was positively detected in 19 of the crushed concrete samples (21 percent) at low concentrations (maximum of 0.25 mg/kg) below the MTCA Method B formula value of 1,600 mg/kg. Free cyanide was positively detected in four samples at a maximum concentration of 0.5 mg/kg, which is also significantly below the MTCA Method B formula value of 1,600 mg/kg. Total and free cyanide were not detected in the SPLP samples.

- Fluoride (maximum of 270 mg/kg) was consistently detected at low concentrations below the MTCA Method B formula value of 3,200 mg/kg.

- Metals were not detected at concentrations above MTCA soil screening levels. TCLP metals analyses were also low or non-detect.

Coke Silo Results

The coke silo concrete sampling program (PGG 2014c) included chemical analysis of four concrete cores for total metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, selenium, silver, and zinc), PAHs, PCBs as Aroclors, and petroleum hydrocarbons. Leaching tests (TCLP metals only) were also conducted on the four core samples. To process the cores for sampling, the cores were crushed.

Eight crushed concrete composite samples were directly collected from the crushing operation and analyzed for the same list of metals (with a subset of samples additionally analyzed for hexavalent chromium), fluoride, total and free cyanide, and PAHs. Leaching tests (TCLP metals only) were also conducted. Analytical results for the concrete samples collected from the Coke Silos are summarized in Table 6.3.4-2.

Overall, the crushed concrete demolition samples were significantly higher than the core samples that were initially collected, particularly for PAHs. This may be due to the sample collection and processing method that was employed on the respective samples.

Table 6.3.4-2
Summary of Detected Chemical Concentrations in Crushed and Concrete Core Samples

Coke Silos

Chemical	MTCA Method A or B Soil Screening Level for Unrestricted Land Use	MTCA Method A or C Industrial Soil Screening Level	Maximum Detected Concentration in Crushed Concrete Samples	Maximum Detected Concentration in Concrete Core Samples
Metals				
Aluminum	80,000 (Method B)	3,500,000 (Method C)	13,000	8,800
Arsenic	20 (Method A)[a] 0.667 (Method B)	20 (Method A)[a] 87	2.8	< 10 U
Barium	16,000 (Method B)	700,000 (Method C)	87	89
Chromium (total)	2,000 (Method A)[a] 120,000 (Method B)	2,0000 (Method A)[a] 5,250,000 (Method C)	30	31
Zinc	24,000 (Method B)	1,050,000 (Method C)	44	27
Aluminum Smelting				
Total Cyanide	48	2,100	<0.5 U	NA
Free Cyanide	48	2,100	<0.5 U	NA
Fluoride	3,200	140,000	4.8	NA
Polynuclear Aromatic Hydrocarbons (PAH)				
Naphthalene	5 (Method A)[b] 1,600 (Method B)	5 (Method A)[b] 70,000 (Method C)	0.11	< 0.067 U
2-Methylnaphthalene	5 (Method A)[b] 320 (Method B)	5 (Method A)[b] 14,000 (Method C	0.16	< 0.067 U
1-Methylnapthalene	5 (Method A)[b] 34.5 (Method B)	5 (Method A)[b] 4,530 (Method C	0.16	< 0.067 U
Acenaphthylene	NE	NE	0.014	< 0.067 U
Acenaphthene	4,800 (Method B)	210,000 (Method C)	2.1	< 0.067 U
Fluorene	3,300 (Method B)	140,000 (Method C)	1.6	0.25
Phenanthrene	NE	NE	12	0.025
Anthracene	2,400 (Method B)	1,050,000 (Method C)	3.5	0.017
Fluoranthene	NE	NE	14	0.055
Pyrene	2,400 (Method B)	105,000 (Method C)	11	0.046
Benzo(g,h,i)perylene	NE	NE	1.4	0.034
Carcinogenic PAHs				
Benzo(a)anthracene	1.37 (Method B)	180 (Method C)	**5.5**	0.023
Benzo(b)fluoranthene	1.37 (Method B)	180 (Method C)	**5**	0.034
Benzo(k)fluoranthene	13.7 (Method B)	1,800 (Method C)	1.6	0.022
Benzo(a)pyrene	0.137 (Method B)	18 (Method C)	**3.7**	0.035
Chrysene	137 (Method B)	18,000 (Method C)	4.3	0.038
Indeno(1,2,3-c,d)pyrene	1.37 (Method B)	180 (Method C)	**2.5**	0.025
Dibenz(a,h)anthracene	0.137 (Method B)	18 (Method C)	**0.65**	<0.0067 U
Petroleum Hydrocarbons				
Lube-oil range and diesel range	2,000 (Method A)[c]	2,000 (Method A)[c]	100	< 100 U

a Screening level represents MTCA Method A soil screening level for protection of groundwater for drinking water use.

b Screening level represents MTCA Method A soil screening level for protection of groundwater for drinking water use. It represents the total value for naphthalene, 1-methyl naphthalene and 2-methyl naphthalene.

c Screening level represents MTCA Method A soil screening level to reduce/eliminate accumulation of product on groundwater.

NA Not Analyzed.
NE Not Established.
U Chemical was not detected. Associated value represents the reporting limit.
All concentrations in milligrams per kilogram (mg/kg).
Bold/shaded values denote positive detections that exceed one or more screening levels.

Sample results show that carcinogenic PAHs including: benzo(a)anthracene, benzo(b)fluor-anthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, and dibenz(a,h)anthracene were detected at concentrations above MTCA Method B formula values in the majority of the crushed concrete samples. Fluoride (maximum of 4.8 mg/kg) was detected at low concentrations below the MTCA Method B formula value. Total cyanide and free cyanide were not detected in the crushed concrete samples. Petroleum hydrocarbons were detected at low concentrations in the crushed concrete samples. PCBs were not detected in the two core samples that were analyzed for this chemical suite.

6.3.4.3 Data Gaps Evaluation and Data Needs

No site characterization RI data needs have been identified with respect to the concrete sampling program. Statistical analysis and risk analysis has been presented in PGG (2012c, 2014c) in support of potential site reuse of the concrete. To support a concrete re-use determination, additional leaching test data will likely be needed, but this testing does not represent a short-term RI data need. It is particularly important to determine if the concrete will leach chemicals of concern into groundwater or alter subsurface geochemical conditions over the long-term. Concentrations of site COPC in the concrete are only one of several factors to evaluate in the determination of whether site reuse of the concrete is appropriate. Potential site reuse of the concrete materials will be further evaluated in the feasibility study and as part of cleanup action plan preparation.

6.3.5 Wood Pallet Storage Area (SWMU 22)

Following closure of the West End Landfill in 1987, wood waste was transported to a storage and burning area northeast of the smelter and north of the Rectifier Yard (Ecology 2014a) (refer to Figure 6.1-1). The excess wood at the site was burned periodically at this location under a permit from the county fire department (Ecology 2014a, Parametrix 2004a). Employees were reportedly invited to use the wood for home construction projects or fire wood. The 2004 Part B Permit Application (Parametrix 2004a) states that because of the inert nature of this material, the possibility of soil or groundwater contamination from this activity is remote.

This SWMU was visited in March 2012 (PGG 2012a) and photographs were taken (refer to Appendix A-22). A debris pile with burn residue was observed. Debris included wood, plastic, metal, and coated and uncoated wires. The dimensions of the pile were not documented at the time of the March 2012 site visit.

Due to the presence of materials other than wood in the pile, a data need is to better characterize and profile the wastes prior to excavation and proper off-site disposal. Depending on the results of the waste characterization, soil confirmation sampling beneath the pile may be appropriate after the pile is removed.

6.3.6 Tire and Wheel Storage Area (SWMU 27)

The Tire and Wheel Storage Area is located along the hillside northeast of the WSI and northwest of the former facility buildings (refer to Figures 2-2 and 6.1-1). This area was reportedly the former foundation of a redi-mix concrete plant built during the original construction of the smelter (Ecology 2014a), and is co-located with the former Drum Storage Area (SWMU 20) previously discussed in Section 6.3.3 above.

In 1987, the facility began using the concrete pad(s) in this area to store worn out rubber tires and steel wheels. This practice was reportedly continued until the summer of 1994 when a grass fire consumed the tires and wheels stored in this area. After the fire, the facility personnel reportedly cleaned up this area and the site has not been used since that time (Ecology 2014a).

No environmental investigation data was reported for this SWMU. However, in 2008 Lockheed Martin performed an RI of the co-located Drum Storage Area (SWMU 20), including soil samples collected from test pits along the sides of the existing concrete pads and from locations beneath the existing pads (refer to Section 3.3.3 and Figure 6.3.3-1 above). These soil samples were analyzed for TPH constituents, VOCs, PCBs, and RCRA metals. PAHs were subsequently analyzed in those soils characterized by the highest TPH concentrations. None of the reported concentrations from these soil samples exceeded the MTCA Method C cleanup levels used to assess the existing site conditions at the time of investigation.

No data gaps or additional data needs are identified for the Tire or Wheel Storage Area (SWMU 27) based on the findings of the 2008 Drum Storage Area RI work effort performed by Lockheed Martin (URS 2008d). However, the appropriateness for the use of industrial cleanup levels in site soils based on future land use consideration should be confirmed.

6.3.7 Other Potential Sources – Research and Development Laboratory Septic Drainfield

An environmental investigation of the septic system that serviced the former office and research and development (R&D) laboratory was performed in 2012 (PGG 2013a). The Office and R&D Laboratory was located south of the WSI and West SPL Storage Area and immediately east of the former trailer park, and the drainfield was located in the western portion of the trailer park (see Figure 6.3.7-1). The objective was to determine if a release of site-related chemicals had occurred within the septic system. The septic system layout and sample results summary tables are provided in Appendix A-33.

The area west of the plant was the site of a local community prior to the construction of the smelter (PGG 2013a). The area was referred to as the "art colony" because of the community building and trailer park where various artists and other visitors would live during part of the year. These structures were built in around 1959 and were associated with construction activities at the John Day Dam. The trailer park consisted of a tree-lined area of about 150 feet by 700 feet west of the community building with several trailer parking spots. From 1981 to 1987, the community building was re-purposed as a field office. In 1996, a pilot R&D lab was added to the west end of the field office and used for process improvement testing (PGG 2013a). This area was serviced by a septic system and Ecology had expressed concern that activities in the R&D lab may have released site-related chemicals into the septic system (PGG 2013a). The office building and R&D Lab were demolished in January 2012 (PGG 2013a). The septic system was characterized through excavation of test pits.

Two different septic systems were discovered near the western end of the trailer park and soil sampling was performed at each system. The newer septic system tanks were pumped out (with liquids and sludge appropriately disposed of offsite) and then decommissioned in place. Use of the older system likely pre-dated the operation of the R&D laboratory. The older septic system was not operational; the steel septic tank was partially exposed at the ground surface, the diffuser was filled with soil and rock, and the piping system was broken and disjointed. For these reasons, the investigation focused on the newer tank system and the older system was not decommissioned. For the old system, a single sample was collected was collected at the base of the steel diffuser.

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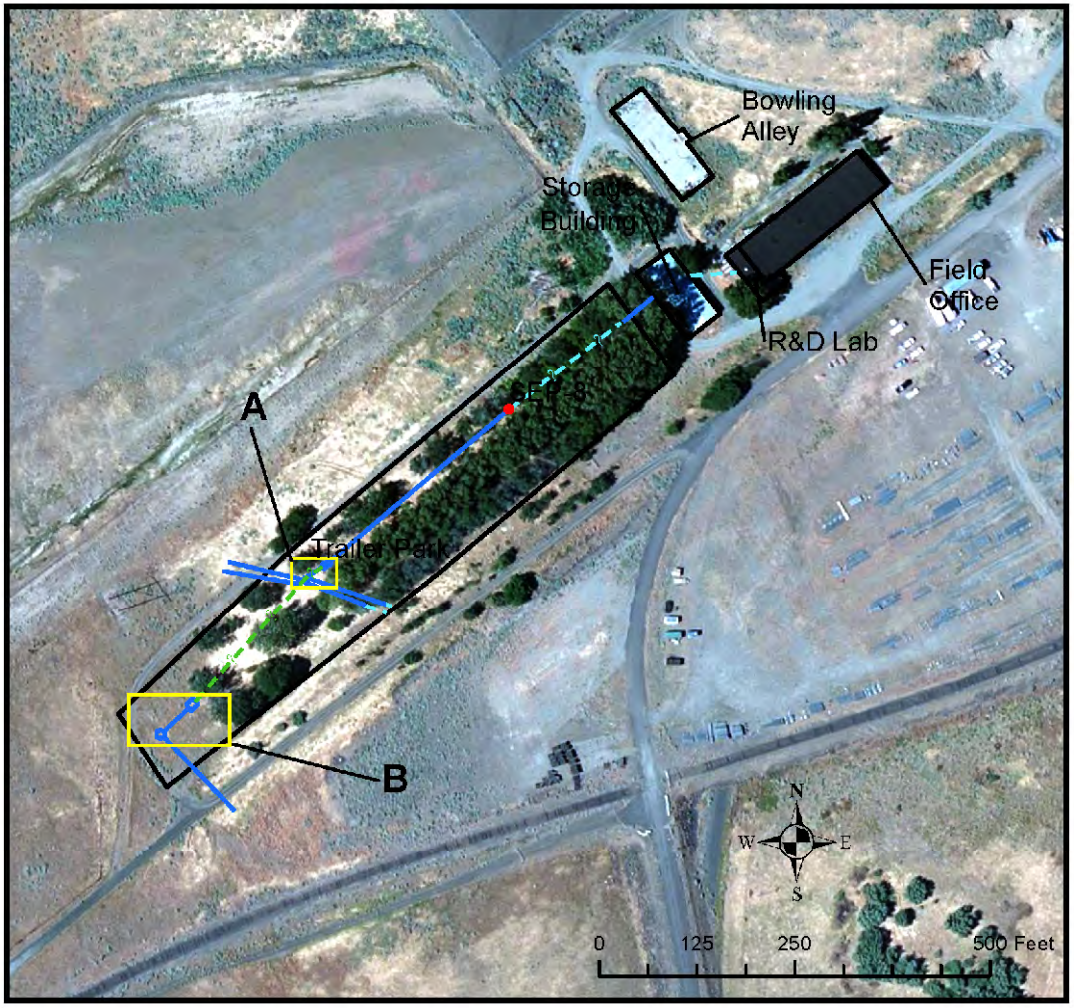
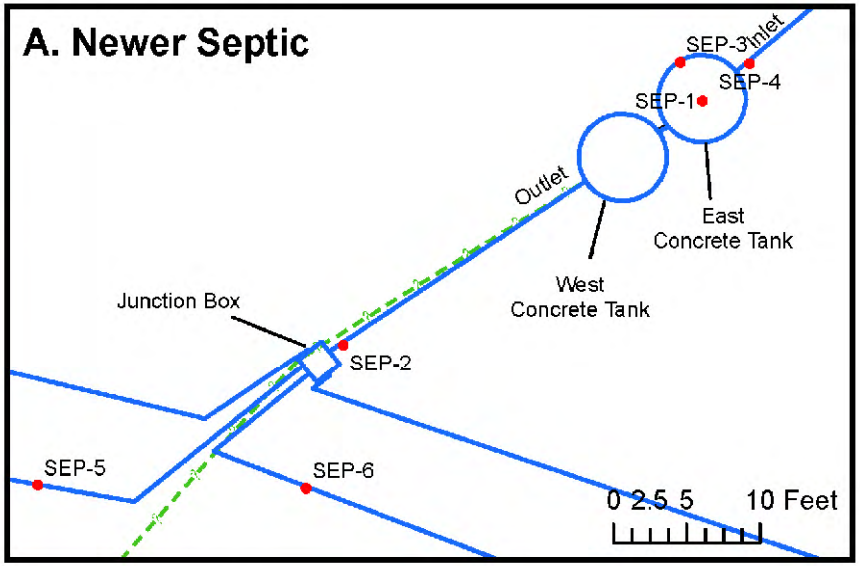
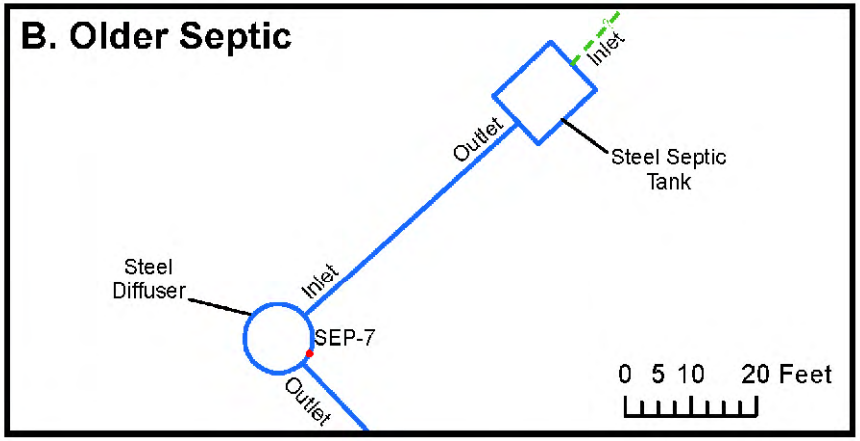






Legend

- Older Project Septic Line
- Newer Project Septic Line
- Septic Line
- Sample Points

Source: PGG (2013a).

Figure 6.3.7-1
Former Septic System Site Features
and Sampling Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

6.3.7.1 Previous Environmental Data

A total of eight discrete sludge and soil samples were collected from the septic systems: seven samples from the new system and one sample from the older system. The analytical program for the soil and sludge investigation included: total metals, fluoride, cyanide, PAHs, PCBs, petroleum hydrocarbons and VOCs. Table 6.3.7-1 summarizes the results. The detected concentrations of most chemicals were significantly higher in the tank sludge than in the soil samples collected from beneath the septic tank and associated piping system.

Results are summarized as follows:

- COPC were not detected at concentrations above MTCA screening levels in the sample collected from the older tank system.
- Arsenic (maximum of 16 mg/kg) was detected in soil above MTCA Method B formula value of 0.667 mg/kg, but below the MTCA Method A Cleanup Level for Unrestricted Land Use that is based on protection of groundwater of 20 mg/kg as well as the Method C Industrial formula value of 87.5 mg/kg. Arsenic was not positively detected in the sludge sample.
- Cadmium and mercury were detected in the sludge sample at a concentration of 4.9 mg/kg and 15 mg/kg, both of which are above the MTCA Method A Cleanup Level for Unrestricted Land Use of 2 mg/kg for both metals that is based on protection of groundwater. Cadmium and mercury concentrations detected in soil samples were less than 2 mg/kg.
- Aluminum (maximum of 11,000 mg/kg in both soil and sludge) was detected in all of the samples at concentration below the MTCA Method B formula value of 80,000 mg/kg.
- The other analyzed metals were either not detected (antimony, beryllium, selenium, and silver) or were detected at concentrations below MTCA Method B and Method C formula values for unrestricted land use (barium, chromium, lead, and zinc) in both the sludge and soil samples.
- Total cyanide was detected at a low concentration in the tank sludge (1 mg/kg) below MTCA Method B formula value, and was not detected in the soil samples.
- Fluoride was detected a low concentrations (1.6 mg/kg to a maximum of 550 mg/kg in the sludge sample) below both MTCA Method B and Method C formula values.

Table 6.3.7-1
Summary of Detected Chemical Concentrations in Sludge and Soil Samples

Research and Development Laboratory Septic Drain Field
(Page 1 of 2)

Chemical	MTCA Method A or B Soil Screening Level for Unrestricted Land Use	MTCA Method A or C Industrial Soil Screening Level	Maximum Detected Concentration in Sludge	Maximum Detected Concentration in Soil
Metals				
Aluminum	80,000 (Method B)	3,500,000 (Method C)	11,000	11,000
Arsenic	20 (Method A)[a] 0.667 (Method B)	20 (Method A)[a] 87	<10 U	**16**
Barium	16,000 (Method B)	700,000 (Method C)	520	97
Cadmium	2 (Method A)[a] 80 (Method B)	2 (Method A)[a] 3,500 (Method C)	**4.9**	<0.59 U
Chromium	2,000 (Method A)[a] 120,000 (Method B)	2,0000 (Method A)[a] 5,250,000 (Method C)	36	19
Lead	250 (Method A)	1,000(Method A)	140	19
Mercury	2 (Method A)[a]	2 Method A[a]	**15**	<2.6 U
Zinc	24,000 (Method B)	1,050,000 (Method C)	NA	56
Aluminum Smelting				
Total Cyanide	48	2,100	1	<0.05 U
Free Cyanide	48	2,100	<0.05 U	<0.05 U
Fluoride	3,200	140,000	550	21
Polynuclear Aromatic Hydrocarbons (PAH)				
Naphthalene	5 (Method A)[b] 1,600 (Method B)	5 (Method A)[b] 70,000 (Method C)	<0.55 U	0.022
Acenaphthylene	NE	NE	<0.55 U	0.017
Acenaphthene	4,800 (Method B)	210,000 (Method C)	0.99	0.083
Fluorene	3,300 (Method B)	140,000 (Method C)	1.5	0.029
Phenanthrene	NE	NE	9.9	0.17
Anthracene	2,400 (Method B)	1,050,000 (Method C)	2.6	0.044
Fluoranthene	NE	NE	12	0.25
Pyrene	2,400 (Method B)	105,000 (Method C)	9.8	0.19
Benzo(g,h,i)perylene	NE	NE	3.1	0.009
Carcinogenic PAHs				
Benzo(a)anthracene	1.37 (Method B)	180 (Method C)	**8.2**	0.13
Benzo(b)fluoranthene	1.37 (Method B)	180 (Method C)	**8.8**	0.21
Benzo(k)fluoranthene	13.7 (Method B)	1,800 (Method C)	2.8	0.059
Benzo(a)pyrene	0.137 (Method B)	18 (Method C)	**6.3**	**0.16**
Chrysene	137 (Method B)	18,000 (Method C)	6.8	0.13
Indeno(1,2,3-c,d)pyrene	1.37 (Method B)	180 (Method C)	**3.4**	0.083
Dibenz(a,h)anthracene	0.137 (Method B)	18 (Method C)	**1**	0.028
Volatile Organic Compounds				
Acetone	1,600 (Method B)	70,000 (Method C)	7.2	0.3
Carbon Disulfide	8,000 (Method B)	350,000 (Method C)	0.5	0.025
2-Butanone	48,000 (Method B)	2,100,000 (Method C)	1.4	0.023
Toluene	7 (Method A)[a] 6,400 (Method B)	7 (Method A)[a] 280,000 (Method C)	0.15	<0.0063 U
Ethylbenzene	6 (Method A)[a] 8,000 (Method B)	6 (Method A)[a] 350,000 (Method C)	0.23	<0.0013 U
Total Xylenes	9 (Method A)[a] 16,000 (Method B)	9 (Method A)[a] 280,000 (Method C)	1.34	<0.0025 U
Isopropyl benzene	8,000 (Method C)	350,000 (Method C)	0.13	<0.0013 U
1,2,4-Trimethylbenzene	NE	NE	4.2	<0.0013 U
p-Isopropyl toluene	NE	NE	11	0.017

Table 6.3.7-1
Summary of Detected Chemical Concentrations in Sludge and Soil Samples
Research and Development Laboratory Septic Drain Field
(Page 2 of 2)

a	Screening level represents MTCA Method A soil screening level for protection of groundwater for drinking water use.
b	Screening level represents MTCA Method A soil screening level for protection of groundwater for drinking water use. It represents the total value for naphthalene, 1-methyl naphthalene and 2-methyl naphthalene.
NE	Not Established.
U	Chemical was not detected. Associated value represents the reporting limit.
All concentrations in milligrams per kilogram (mg/kg).	
Bold/shaded values denote positive detections that exceed one or more screening levels.	

- Carcinogenic PAHs including benzo(a)pyrene (6.3 mg/kg), benzo(a)anthracene (8.2 mg/kg), benzo(b)fluoranthene (8.8 mg/kg), indeno(1,2,3-cd)pyrene (3.4 mg/kg) and dibenzo(a,h)anthracene (1 mg/kg) were detected in tank sludge at concentrations above MTCA Method B formula values, but below MTCA Method C formula values. Of these PAHs detected in sludge, only benzo(a)pyrene was detected in one soil sample at a concentration (0.16 mg/kg) above the MTCA Method B formula value of 0.1 mg/kg.

- Low levels of other non-carcinogenic PAHs were detected primarily in the sludge at low concentrations (less than 10 mg/kg) below MTCA Method B formula values.

- PCBs and petroleum hydrocarbons were not detected in the sludge or soils.

- For VOCs, chlorinated solvent constituents (e.g., 1,1,1-TCA, TCE, PCE, and vinyl chloride) and benzene were not detected. Several other VOCs were detected at low concentrations in the tank sludge including: acetone (7.2 mg/kg), 2-butanone (1.4 mg/kg), carbon disulfide (0.5 mg/kg), ethyl benzene (0.23 mg/kg), toluene (0.15 mg/kg), total xylenes (1.34 mg/kg), isopropyl benzene (0.13 mg/kg), 1,2,4-trimethylbenzene (4.2 mg/kg), and p-isopropyl toluene (11 mg/kg). The detected concentrations are below MTCA Method B formula values. These chemicals were either not detected or detected at very low concentrations of less than 0.1 to 1.0 mg/kg in soil.

The results suggest that the detected chemicals likely were historically released to the septic system from the R&D laboratory. Highest detected concentrations were found in tank sludges that were subsequently removed and are not representative of chemical concentrations in subsurface soil. Chemical data for the subsurface soil shows a couple of low-level exceedances of MTCA Method B formula values for benzo(a)pyrene and arsenic with no exceedances of MTCA Method C Industrial formula values.

The original report (PGG 2013a) also compared the detected sludge and soil concentrations against various screening levels for protection of groundwater (i.e., MTCA values and EPA Regional

Screening Levels) and practical quantitation limits for laboratory analyses were set to achieve screening levels for protection of groundwater for the septic drainfield investigation. The tank sludge and some of the soils exceeded these screening levels for some carcinogenic PAHs, metals, and VOCs. Note that the technical approach for developing soil screening levels protective of groundwater consistent with MTCA requirements has not yet been determined for the site-wide RI and soil screening levels for protection of groundwater in PGG (2013a) are not specifically cited with the exception of MTCA Method A Soil Cleanup Levels that incorporate protection of groundwater for drinking water use (refer to Table 6.3.7-1).

6.3.7.2 Data Gaps Evaluation and Data Needs

Based on review of the sludge and soil data, it appears relatively unlikely that past releases of chemicals to the septic drainage system has caused leaching of chemicals to shallow groundwater at concentrations above groundwater cleanup levels. However, verification of COPC concentrations in groundwater in this area represents a data gap and data need that will be addressed under the Groundwater in the Uppermost Aquifer AOC (refer to Section 7.2). The proposed approach for developing soil screening levels protective of groundwater will be presented in the Phase 2 Work Plan.

6.4 WESTERN AREA

This area includes the West End Landfill (SWMU 18) and the Plant Construction Landfill (SWMU 19) as shown in Figure 6.1-1 and described in the following sections. This area also includes a description of an additional potential source area (i.e., Upper Fluoride Area). The operational history, environmental investigation history, previous environmental data, and identified data gaps are described for each SWMU and other potential source areas in the following sections.

6.4.1 West End Landfill (SWMU 18)

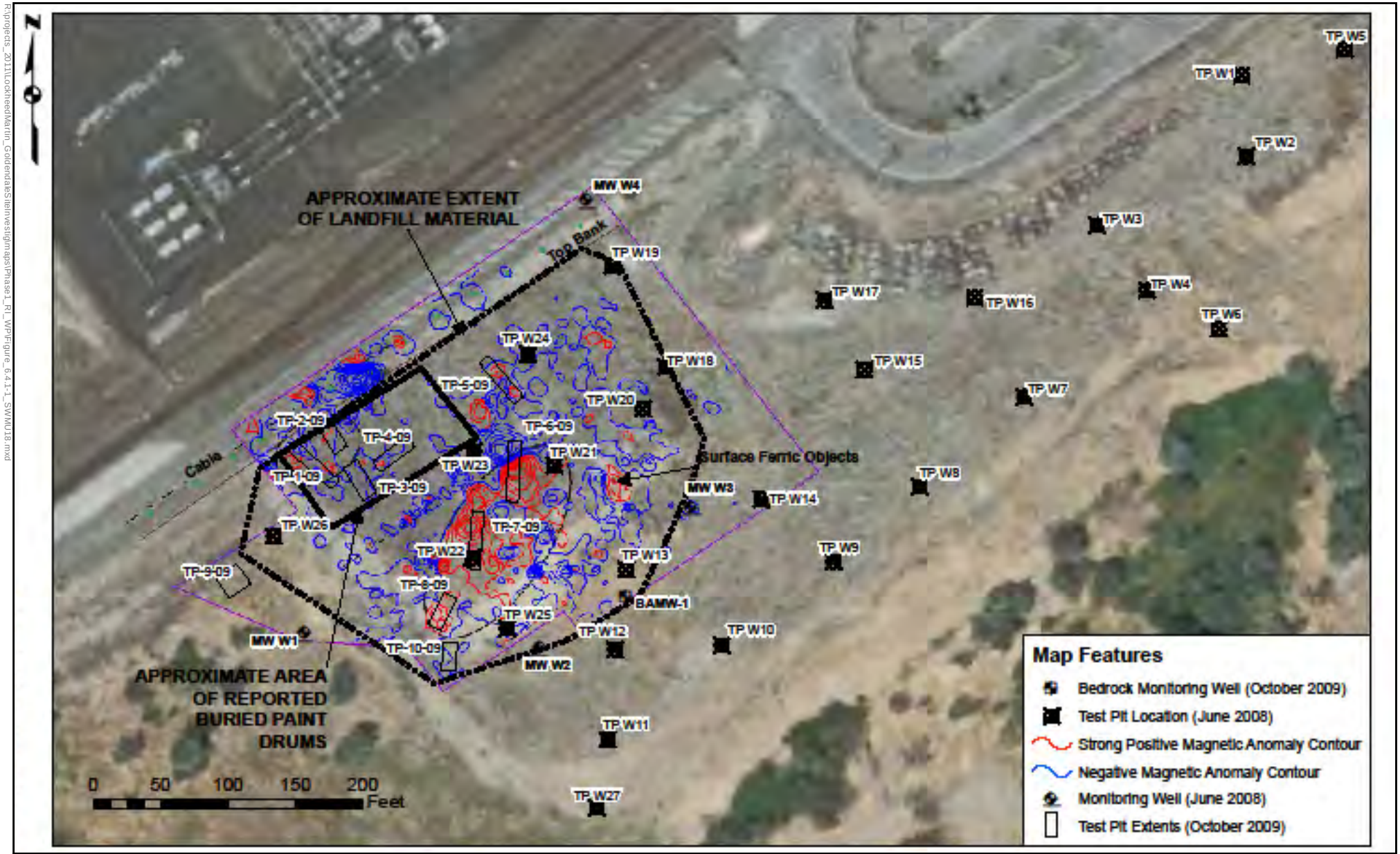
The West End Landfill is located in the western portion of the site, adjacent to the southwest corner of the Production Area (refer to Figures 2-2 and 6.1-1). Based on historical aerial photographs, it appears that the area beneath the Landfill was initially graded in 1971 during construction of the facility. The ground surface of the landfill is irregular and unpaved, and is about 10-30 feet lower in elevation than the main facility area. The area was reportedly used between 1982 and 1987 to dispose of non-hazardous construction debris, facility trash, wood waste, alumina, carbon waste, and vegetation. Some asbestos-containing building materials were reportedly disposed with demolition debris (URS 2008f). Buried paint drums were suspected in the northwestern portion of the landfill based on recollections of facility personnel (URS 2008f). The site was closed by covering it with soil material.

A discussion regarding the environmental investigation history of the West End Landfill, including proposed remedial action is provided in the following section.

6.4.1.1 Environmental Investigation History

Lockheed Martin performed an RI/FS of the West End Landfill during 2008 and 2009 (URS 2008f, 2010). This work was conducted as an independent action with informal Ecology review and concurrence regarding the Work Plan. The locations of RI explorations and monitoring wells are shown in Figure 6.4.1-1. The scope of the RI field investigation included:

- **Test pit excavations and chemical sampling.** A total of 37 test pits and five soil borings were installed to characterize the landfill area. Nine soil samples were collected for chemical analyses. Of the nine soil samples; eight were collected from below the base of the landfill materials and one sample was collected from soils adjacent to the landfill. Two additional samples of landfill materials were collected and analyzed.



Source: URS (2010)
Imagery: USGS 2006.

Figure 6.4.1-1

West End Landfill Site Plan,
Exploration Locations

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

- **Geophysical survey.** A magnetic survey and ground penetrating radar survey were performed to further assess the potential for buried paint drums. Test pits were excavated in areas of identified geophysical anomalies to confirm that drums were not present.

- **Monitoring well installation and groundwater sampling.** Four shallow groundwater monitoring wells (MW-W1 through -W4) were installed, developed, and sampled. One deeper monitoring well was later installed in bedrock (BAMW-1) and sampled as part of site-wide groundwater investigation activities.

A draft RI/FS Report (URS 2008f) and a Final RI Report (URS 2010) were prepared in support of this work effort. Based on the RI characterization activities, the area containing landfill material is delineated to be about 225 feet wide and 350 feet long. Landfill materials range in thickness from 2 feet near the periphery to a maximum thickness of about 25 feet and were generally covered with about 1 foot of soil fill. No listed hazardous wastes or State of Washington Dangerous Wastes were found during the RI (URS 2010). No evidence of landfill gases or leachate was found during the RI investigation. Landfill material consists of construction debris (metal pipes, fiberglass siding, brick, plastic sheeting, asphalt, concrete), facility bulk wastes (carbon briquettes), potential asbestos-containing material (siding, insulation), tires, and gray to black fine-grained material. A summary of the RI environmental data is provided in Section 6.4.1.1 below.

The draft RI/FS Report (URS 2008f) considered three potential cleanup alternatives: landfill closure-capping, remedial soil excavation and disposal, and no action. The draft FS concluded that the no action alternative would not achieve cleanup standards and would not be protective of human health and the environment; therefore the no action alternative was not retained. The remedial alternatives were evaluated with respect to MTCA criteria for remedy selection (WAC 173-340-360). Both alternatives were found to meet the MTCA threshold requirements for remedy selection [WAC 173-340-360(2)(a)]: protection of human health and the environment, compliance with cleanup standards, compliance with applicable state and federal laws, and provisions for compliance monitoring. The draft FS preliminarily recommended selection of the excavation and disposal alternative despite its significantly greater cost because it was evaluated as having simpler short-term implementation and having greater permanency (URS 2008f).

The first phase of RI/FS field investigation [as summarized in the draft RI/FS report (URS 2008f)] did not include the northwest corner of the landfill to avoid areas in which surplus paint drums were reportedly buried. A geophysical survey and supplemental test pit investigation were subsequently

performed to characterize the contents and the horizontal and vertical extent of the landfill material in this area. The geophysical survey and test pit investigation did not show the presence of buried paint drums or of hazardous waste. The complete results for all of the RI characterization work including the geophysical survey and supplemental test pit excavations are provided in the Final Draft Remedial Investigation Report (URS 2010).

Based on the complete remedial investigation findings that suggested there was not hazardous waste or drums present in the WELF, the recommended cleanup action alternative for the West End Landfill was changed to construction of a geosynthetic cap with associated institutional controls, long-term maintenance, and monitoring (URS 2010). A 100 percent design for the WELF cap was also prepared (Tetra Tech 2012).

6.4.1.2 Previous Environmental Data

The West End Landfill RI report (URS 2010) serves as the primary source for the available environmental data for this SWMU. A brief summary of soil and groundwater data collected in support of the RI is provided below. Tabulated summaries of soil and groundwater analytical results and applicable cross-section diagrams are provided for this SWMU in Appendix A-18.

For comparative purposes, the RI utilized MTCA Method A Industrial soil cleanup levels to screen analytes for potential remediation, when available. When MTCA Method A industrial soil values are not available for a specific compound, other screening levels were also used, including MTCA Method C soil cleanup levels (ingestion), State of Washington background concentrations (Ecology 1994), calculated Method C soil concentrations protective of groundwater, and other published criteria. Groundwater concentrations in the RI were compared to MTCA Method C groundwater cleanup levels (URS 2008f). Groundwater concentrations were subsequently also compared against MTCA Method A and B groundwater cleanup levels in the draft CAP (Tetra Tech 2010).

Soil and Landfill Materials

Based on historical aluminum reduction operations at the site, the analytical program for the RI investigation included chemical analysis of 9 soil samples. These analyses included: gasoline-, diesel-, and oil-range petroleum hydrocarbons (TPH-Gx and TPH-Dx), VOCs, SVOCs, PCBs, RCRA metals, total and WAD cyanide, fluoride, sulfate, and asbestos. Two samples of landfill material were analyzed for PAHs and RCRA metals only. A tabulated summary of the RI analytical

results for the soil and landfill materials is provided in Appendix A-18. Figures showing the cross-sectional views of the landfill, and test pits are also included in Appendix A-18.

Table 6.4.1-1 summarizes the RI screening levels and maximum detected concentrations for soil and landfill materials. The screening levels primarily represent MTCA Method A Soil Cleanup Levels for Industrial Land Use that are protective of groundwater.

Table 6.4.1-1
Summary of Soil and Landfill Material Maximum Concentrations and Screening Levels
West End Landfill, Goldendale, Washington

Chemical of Concern	Screening Level	Screening Level Type	Maximum Detected Concentration (mg/kg)/ Depth (feet bgs)/Material
Oil-range petroleum hydrocarbons	2,000 mg/kg	MTCA Method A for Industrial Land Use	**2,170**/16/soil beneath landfill or landfill material
cPAHs benzo(a)pyrene TTEC	2 mg/kg	MTCA Method A for Industrial Land Use	**75**/1.5/landfill material
Asbestos	1 percent	Washington State Department of Labor and Industries	Not detected in soils, present in landfill debris
Arsenic	20 mg/kg	MTCA Method A for Industrial Land Use	**22.5**/1.5/landfill material
Cadmium	2 mg/kg	MTCA Method A for Industrial Land Use	**3.98**/17.5/landfill material
Selenium	0.8 mg/kg	Simplified Ecological Evaluation Procedure, MTCA Table 749-2	**15.8**/1.5/landfill material
Total cyanide	2 mg/kg	EPA Region 9 Preliminary Remediation Goal; soil concentration protective of the risk-based groundwater PRG	0.970/16/soil beneath landfill or landfill material
Fluoride	330 mg/kg	EPA Region 9 Preliminary Remediation Goal; soil concentration protective of the risk-based groundwater PRG	**593**/16/soil beneath landfill or landfill material

Concentrations in bold denote exceedances of Screening Levels
cPAH Carcinogenic polynuclear aromatic hydrocarbons
mg/kg Milligrams per kilogram
MTCA Model Toxics Control Act
PRG Preliminary Remediation Goal
TTEC Total toxicity equivalent concentration

No PCBs, VOCs, SVOCs, gasoline-range TPH, mercury, selenium, or silver were detected in soils underlying the landfill. Metals including arsenic, barium, cadmium, chromium, and lead were detected in soils at low concentrations below screening levels. Similarly, diesel-range TPH, and miscellaneous non-carcinogenic PAHs were also detected at low concentrations below screening levels.

Groundwater

Shallow groundwater beneath the landfill was identified at depths ranging from about 20 feet to 55 feet bgs, which is about 15 feet below the average base of the landfill. Based on the RI (URS 2010), the shallow groundwater flow direction near the landfill is to the southwest.

There are five monitoring wells present in the landfill vicinity (refer to Figure 6.4.1-1). Four of the wells are completed within unconsolidated sediments (MW-W1, MW-W2, MW-W3, and MW-W4) and one of the wells is completed in bedrock (BAMW-1).

Groundwater samples were collected from the monitoring wells and analyzed for: TPH-Gx, TPH-Dx, VOCs, SVOCs, PCBs, RCRA metals, total and WAD cyanide, fluoride, and sulfate. A tabulated summary of the groundwater analytical results is provided in Appendix A-18 along with an accompanying groundwater flow direction map.

Well MW-W3 contained very little water during both sampling events and a grab sample was analyzed for total and WAD cyanide only. Water from this well may have been from the end cap at the bottom of the well (URS 2010) and may not be representative of groundwater in the screen interval.

No concentrations of TPH-Gx, TPH-Dx, VOCs, SVOCs, or PCBs were detected in groundwater. Other metals including barium, cadmium, mercury, selenium, and silver were either not detected or detected at low concentrations below screening levels. Low concentrations of total cyanide (maximum of 0.082 mg/L in well MW-W1) and WAD cyanide (maximum of 0.019 mg/L in well MW-W3) were detected below the MCL of 0.20 mg/L for total cyanide. Fluoride (maximum of 0.590 mg/L in MW-W1 and MW-W2) and sulfate (maximum of 91.6 mg/L in MW-W2) were consistently detected at concentrations below screening levels.

Due to the limited and low level detection of chemicals of potential concern in groundwater, additional consideration of MTCA Method A groundwater cleanup levels is provided similar to soils. For the few cases in which a Method A value was not available, MTCA Method B Cleanup Levels or MTCA MCLs protective of groundwater use were adopted. The following groundwater screening levels have been modified from the RI and summarized in Table 6.4.1-2.

Table 6.4.1-2
Summary of Groundwater Maximum Concentrations and Screening Levels
West End Landfill, Goldendale, Washington

Chemical of Concern	Screening Level (mg/L)	Screening Level Type	Maximum Concentration in Groundwater (mg/L)/ Well Location
Oil-range petroleum hydrocarbons	0.5	MTCA Method A	Not detected / All locations
cPAHs benzo(a)pyrene TTEC methodology	0.0001	MTCA Method A	Not Detected, but reporting limits are above cleanup levels / All locations
Arsenic	0.005	MTCA Method A	**0.00846** / MW-W4
Cadmium	0.005	MTCA Method A	0.00257 / MW-W4
Chromium	0.05	MTCA Method A	**0.285** / MW-W4
Lead	0.015	MTCA Method A	**0.0212** / MW-W4
Selenium	0.05	MCL, MTCA Method B formula value for carcinogen NE	0.00235 / MW-W1
Total Cyanide	0.2 / 0.009	MCL / MTCA Method B formula value	**0.082** / MW-W1
Fluoride	0.64	MTCA Method B formula value	0.590 / MW-W1

Bold concentrations denote exceedances of cleanup levels.
cPAH Carcinogenic polynuclear aromatic hydrocarbons
mg/L Milligrams per liter
MCL Maximum contaminant level
MTCA Model Toxics Control Act
NE Not Established
TTEC Total toxicity equivalent concentration

6.4.1.3 Data Gaps Evaluation and Data Needs

In December 2010, Lockheed Martin prepared a draft CAP for the West End Landfill site (Tetra Tech 2010). The main objectives of the CAP are to document and summarize the selected cleanup alternative and to present the conceptual design for the selected alternative. The conceptual design defines the design criteria and establishes the overall scope and components of the landfill cover system design. Environmental protection and post-closure maintenance and monitoring planning components were also incorporated in the 2010 CAP (Tetra Tech 2010).

Both a 60 percent design package and a 100 percent design package (Tetra Tech 2012) were prepared in support of the West End Landfill Capping Project.

The West End Landfill represents a qualifying industrial property under MTCA (WAC 173-340-200) and institutional controls and monitoring would be implemented as part of the cleanup action. The CAP and associated design packages prepared have not been reviewed by Ecology because the pending site-wide Agreed Order had not been negotiated and signed at that time.

Further evaluation regarding implementation of the capping remedy for the West End Landfill represents a data evaluation need for the RI/FS. Ongoing groundwater monitoring and groundwater characterization data needs are evaluated and discussed in Section 7.2 – Groundwater in the Upper Most Aquifer AOC.

6.4.2 Plant Construction Landfill (SWMU 19)

The plant construction landfill was reportedly created during construction of the smelter in 1969 through 1970 (Ecology 2014a, Parametrix 2004a). The general contractor reportedly disposed of general debris in the area west of the Rectifier Yard and east of the WSI. The Agreed Order states that due to the long period of time since smelter construction, little is known about the exact contents of the landfill. Figure 6.1-1 shows the approximate location and area of the Plant Construction Landfill, which is a flat open area west of the Rectifier Yard, and south of the former locations of the trailer park and R & D laboratory.

A geotechnical investigation was performed in the vicinity of the Plant Construction Landfill in 2001 (Fujitani Hilts & Associates 2001) The geotechnical investigation included 19 borings and 4 backhoe test pits, geotechnical testing of soils, and a geophysical survey.

6.4.2.1 Previous Environmental Data

The geotechnical investigation identified the following lithologic units in the vicinity of the Plant Construction Landfill: 1) a fill unit consisting of coarse gravel and cobble rock fragments with silt and sand, 2) flood deposits consisting of stratified sand and silty sand, and 3) basalt flow rock of the Grande Ronde Basalt Formation. The fill material ranges from 3 to 17 feet thick across the geotechnical investigation area. The alluvial flood deposit sequence ranged from 19 to 49 feet thick. Basalt bedrock was encountered at depths as shallow as 34.5 feet bgs. No debris or other material was reported in the boring logs or test pits, so it appears the landfill material is rock and soil from clearing and grading activities during construction of the plant.

Groundwater was encountered at a depth of about 20 feet bgs during drilling of the borings. A piezometer was constructed at one of the borings (B11). No chemical data was collected as part of the 2001 geotechnical investigation.

6.4.2.2 Data Gaps Evaluation and Data Needs

Collection of surface and subsurface soil analytical laboratory data represents a data need for this area given its size, lack of documentation, and likely future development.

Verification and inspection of the piezometer represents a data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC (refer to Section 7.2).

6.4.3 Other Potential Sources – Upper Fluoride Area

The Upper Fluoride Area was identified as a potential source area in the 1996 Phase I ESA and 1998 Phase I ESA Updates (Dames and Moore 1996, 1998). The area was characterized during 2013 through site reconnaissance and evaluation of surface drainage patterns (PGG 2013a). According to PGG (2013a), there was a previous concern that contaminants from the WELF may have migrated to the Upper Fluoride Area. The Upper Fluoride Area is located about 300 feet southwest of the WELF and has an area of about 300 feet by 700 feet. Refer to Appendix A-34 for a figure showing the Upper Fluoride Area.

Site reconnaissance and review of aerial photographs did not reveal any feature or other indications of historic roads or structures that might have been used by the plant for storage or other activities in the Upper Fluoride Area (PGG 2013a). Interviews with long-time plant employees did not identify any historic uses by the smelter facility of the Upper Fluoride Area. The topography of the Upper Fluoride Area was undulating. The investigation area was covered by sand that overlies the basalt bedrock. The investigation area was vegetated with sage and grasses. No clear surface water flow pathway was found between the Upper Fluoride Area and the WELF, and topographic highs were identified between the two features. Based on these findings, no further investigation was recommended (PGG 2013a). No data needs have been identified for this area during preparation of this Phase 1 Work Plan.

6.5 EASTERN AREA

The eastern area of the site includes the SWMUs located east of the production area including: the NPDES Ponds (SWMU 1), the East Surface Impoundment (SWMU 2), the Intermittent Sludge Ponds (SWMU 3), and the Smelter Sign Area and Area North of the East Surface Impoundment (SWMU 31). The operational history, environmental investigation history, previous environmental data, and identified data gaps are described for each SWMU in the following sections.

6.5.1 NPDES Ponds (SWMU 1)

The NPDES Ponds SWMU consists of four wastewater settling ponds and associated drainage between the ponds that were used for detention and settlement of solids in wastewater from the former aluminum reduction facility (Figure 6.5.1-1). The ponds were constructed in a natural drainage feature and gravity-discharged to the Columbia River. The ponds were located about 400 feet (Pond D) to 2,000 feet (Pond A) to the west-northwest of the Columbia River. An area that includes Ponds C and D was delineated as a wetland; however, because the ponds represent a constructed feature used as part of a treatment system under an NPDES permit, the NPDES ponds do not represent waters of United States as defined under Federal Regulation 33 CFR 328.3(a)(8) and therefore conformance with the typical wetland restoration permit conditions was not required by the U.S. Army Corps of Engineers.

Ponds A and B were constructed as part of the original smelter during 1971 to serve as settling ponds to remove wastewater solids (Ecology 2014a, ARCADIS 2011a). Ponds C and D were installed downstream from Ponds A and B during 1972 and 1973. All four ponds were constructed through installation of earthen dikes across natural drainage features.

Waste streams from the smelter's air pollution control scrubber systems were discharged under a NPDES permit into Ponds A and B and the discharge from these ponds was historically combined with plant's other industrial discharges (e.g., cooling water, storm water run-off and treated sewage) These combined discharges historically flowed down the drainage channel (labelled as the ditch excavation area in the closure report) into gravel-lined Ponds C and D. A portion of this discharge channel was concrete lined (ARCADIS 2011a).

Legend

- Concrete Lined Ditch
- Lower Ditch (Unlined)
- Side Ditch (Unlined)

NPDES = National Pollutant Discharge Elimination System

N
W E
S

0 100 200 400
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 6.5.1-1

NPDES Ponds (SWMU 1)
Site Features

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_GoldendaleSite\investigmaps\Phase1_RI_WP\Figure_6.5.1-1_NPDES_Ponds_SWMU1.mxd

The sediment loading rates to the ponds were reduced by a series of wastewater treatment improvements in the late 1970s and 1980s, in particular, the change from wet to dry air pollution scrubbers in 1978. A bypass pipeline was constructed in May 2010 to route process wastewater flows to include stormwater around the former ponds. The bypass pipeline is equipped with an automated monitoring station and flow controls.

6.5.1.1 Environmental Investigation and Cleanup History

In 1985, an investigation of the pond sludge was conducted associated with the NPDES permit to investigate the potential presence of contamination in the pond system and the Columbia River (JUB Engineers 1985, ARCADIS 2008a). Analytical results indicated that the NPDES pond sludge contained between one and two percent PAHs. The report concluded that the sludges represented EHWs under the Washington State Dangerous Waste Regulations (Chapter 173-303 WAC). However, this initial testing did not incorporate the required state analytical testing method and a later investigation found their conclusions to be unsupported for this reason (ARCADIS 2008a). A second investigation was conducted in 1990 reportedly using different state-specified analytical methods (Technico & Enviroservices Company 1990, ARCADIS 2008a). This investigation found that none of the sludges in the ponds represented EHW.

During 2007, Lockheed Martin performed a site investigation and remedial alternatives evaluation for the NPDES ponds (ARCADIS 2008a). The objective of the field investigation was to determine the horizontal and vertical extent of contamination and physical properties of the deposits, and to provide more representative waste characterization for the surface deposit areas. Both composite sub-samples as well as discrete samples were collected. All 24 samples were analyzed for PAHs with a few selected samples analyzed for chemicals potentially associated with aluminum operations including arsenic, aluminum, total cyanide, fluoride, sulfate and select VOCs.

The 2007 results showed that the deposits contained consistently elevated PAH concentrations, but below the one percent screening threshold (10,000 mg/kg) that would cause the deposits to be designated as a Washington State EHW. Aluminum (maximum of 33,700 mg/kg), arsenic (maximum of 16.9 mg/kg), fluoride (maximum of 215 mg/kg) and sulfate (maximum of 1,660 mg/kg) were detected in all of the 8 samples collected (3 from the sludge, 3 from the underlying soils, and 2 from lateral extent locations). Total cyanide was detected (0.710 mg/kg) in

one underlying soil sample. No VOCs were detected in any of the six samples analyzed for this analytical group (two from the sludge, three from the underlying soils, and one lateral extent sample). During 2008, additional supplemental sludge and soil/sediment samples were collected that showed the presence of PAHs at concentrations between 1 and 2 percent, indicating that a limited portion of the pond deposits represented state-designated EHW (ARCADIS 2011a, 2008b). Three closure remedial alternatives were evaluated for the NPDES Ponds including: 1) no action, 2) on-site consolidation and capping, and 3) complete removal with offsite landfill disposal. For the removal alternative, two scenarios were evaluated for cost evaluation purposes: 1) all solid waste, and 2) one-third solid waste and two-thirds EHW.

A draft CAP was completed in 2009 by Lockheed Martin for remediating the four ponds and associated ditch through complete sludge and contaminated soil/sediment removal with offsite disposal. Removal of the contaminated sludge with disposal in a permitted offsite facility was the recommended remedial alternative in the CAP. While the CAP was not formally approved by Ecology, Ecology representatives stated that the cleanup could proceed as an independent cleanup action with later Ecology approval of the cleanup as part of a formal order (ARCADIS 2011a).

The remedial action objectives of the 2010 NPDES Ponds cleanup action included:

- Risk reduction to human health and the environment by eliminating the potential for exposure to contaminated sludge containing PAH through excavation, removal, and offsite disposal of the sludge in the ponds and the connecting ditch.
- Minimization of potential impacts to the public and ecological receptors during remedial construction through use of appropriate engineering controls.
- Completion of the cleanup according to the requirements of MTCA (WAC 173-340-350 through WAC 173-340-390) and the Washington State Dangerous Waste Regulations (WAC 173-303).

These objectives were addressed and met through implementation of the cleanup action.

Originally, the proposed soil cleanup level for the 2010 cleanup action was 2 mg/kg cPAH, using a TTEC approach. This cleanup level represents a MTCA Method A Industrial Cleanup Level, which was deemed appropriate based on the industrial land use of the site. However, because MTCA requires institutional controls (e.g., restrictive covenants) for remedial actions using industrial

cleanup levels, the project team decided to complete the cleanup action to meet the MTCA Method B Cleanup Level for cPAH TTEC of 0.14 mg/kg, which is based on a human health scenario of concurrent ingestion and dermal contact. This standard also represents a MTCA Method B soil standard formula value in the Washington State Cleanup Levels and Risk Calculations (CLARC) database. The 0.14 mg/kg cleanup goal also was the required level for a portion of Ponds D and C that were located within Corps of Engineers property and were therefore not eligible for institutional controls under MTCA.

The remedial action was completed during 2010 (ARCADIS 2011a). A total of 55,529 tons of sludge were removed from the ponds and the associated drainage ditch. This total mass included 46,812 tons of solid waste and 8,717 tons of EHW. PAH-impacted sludge (solid waste) was removed for off-site disposal at the Waste Management, Inc. Columbia Ridge Landfill located in Arlington, Oregon, with EHW disposed at the Chemical Waste Management Subtitle C landfill in Arlington, Oregon.

Final confirmation sampling results collected at the conclusion of excavation activities show that the NPDES Ponds sediment PAH concentrations were below MTCA Method B Cleanup Levels for unrestricted land use. Confirmatory sample data were reviewed by Ecology and Ecology representatives confirmed that the data meets the statistical approach for demonstrating compliance with the cleanup level for unrestricted land use (ARCADIS 2011a).

Site restoration activities were performed as required under the federal Nationwide Permit 38 conditions and included slope stabilization, grading, drainage pathway modification, and reseeding.

6.5.1.2 Previous Environmental Data

The most recent data for the NPDES ponds represent post-removal soil confirmation sample results collected in 2010 (ARCADIS 2011a). These data represent the post-remediation and current conditions at this SWMU. The data and major findings are summarized in the following sections. Refer to the Site Closure Report (ARCADIS 2011a) for the complete documentation of site closure activities. Detailed data summary tables and figures from the Site Closure Report are provided in Appendix A-1.

NPDES Pond Stockpile and Post-Removal Confirmation Sample Results

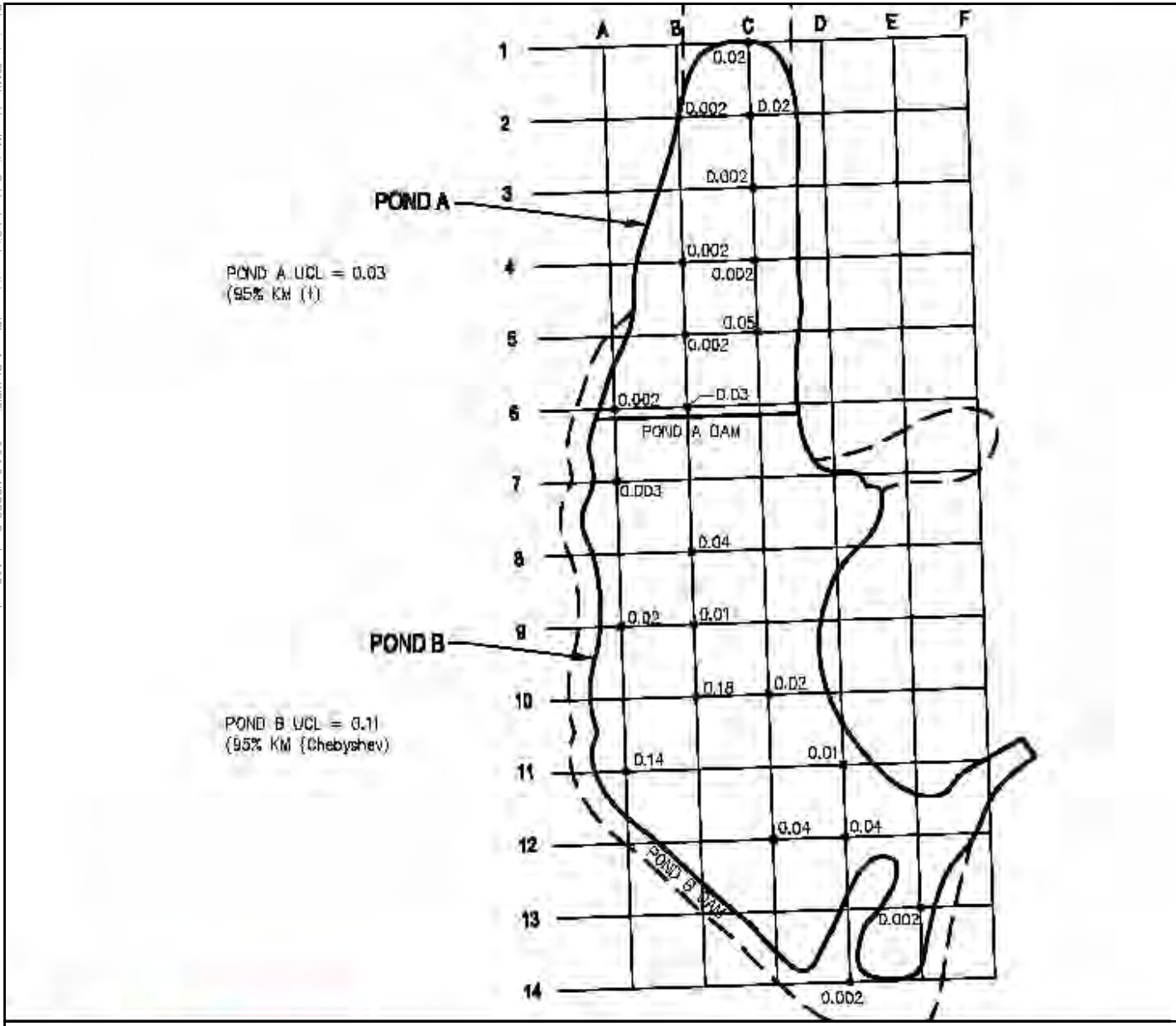
Stockpile sampling was conducted to ensure that the sludge had been properly classified as solid waste or EHW. Ten-point composite samples were collected from each stockpile to profile the sludge.

Once all the sludge was removed from each pond, the excavation extent of each pond was sampled. Ten composite soil samples were collected at each pond and eight composite soil samples were originally planned from the drainage ditch. The pond confirmation samples were 5-point composite samples that were randomly selected from a previously established 50-foot by 50-foot grid points. Refer to Figures 6.5.1-2, 6.5.1-3, and 6.5.1-4 for the confirmation sample locations and results).

The presence of bedrock caused some alterations of the sub-sampling scheme. With Ecology approval (ARCADIS 2011a), sub-sample locations on rock were considered as clean and no sub-sample was collected. This resulted in calculation of a weighted average for a given composite sample using an assumed concentration of ½ the detection limit value for the bedrock sub-sample locations that could not be sampled. In the NPDES ditch area, the entire side ditch and ditch area was excavated to concrete (lined portion) or bedrock, so final confirmation samples were not required.

Consistent with MTCA requirements, a statistical evaluation of the data was performed using ProUCL 4.0™ to calculate the 95% UCL on the mean. The statistical program Pro UCL™ was selected because it can be used with datasets that do not exhibit a normal or log-normal data distribution (ARCADIS 2011a).

Soil cleanups under MTCA must meet three criteria for the site to be in compliance with the 0.14 mg/kg cPAH TTEC MTCA Method B Cleanup Level: 1) the 95% UCL of the population mean must be below the cleanup level, 2) less than 10 percent of the samples can exceed the cleanup level, and 3) no sample can yield results that are twice the cleanup level (refer to WAC 173-340-740(7)(d) and (e).



Legend

0.02 ● PAH Total Toxicity Equivalent Concentrations (TTEC) Milligrams per Kilogram (mg/kg)

Note: Letters and numbers define grid points. For example, grid point C1 confirmation result is 0.02 (mg/kg).

Source: ARCADIS (2011), Site Closure Report, NPDES Ponds, Columbia Gorge Aluminum, Goldendale, Washington, dated January 2011.

N
W E
S

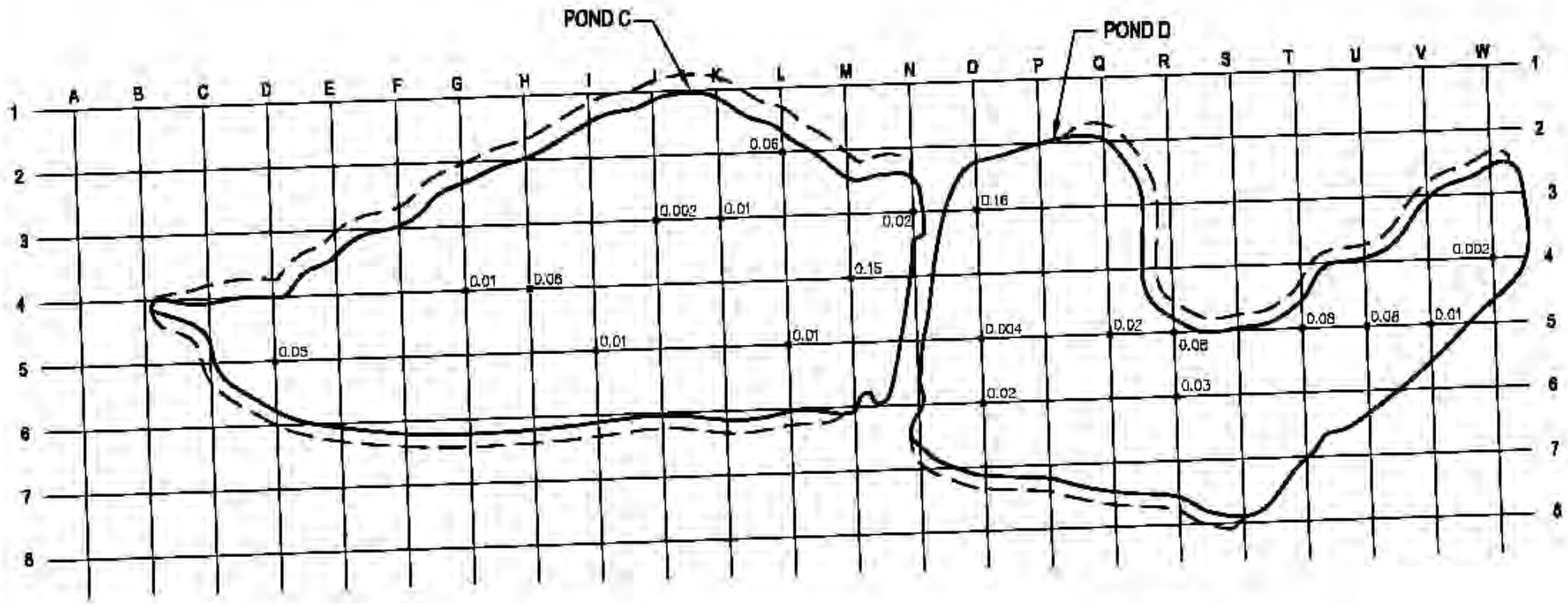
0 30' 60' 120'

Approximate Scale in Feet

Figure 6.5.1-2

NPDES Ponds A & B

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



POND C UCL = 0.10
(95% KM (Chebyshev)

POND D UCL = 0.08
(95% KM (t)

Legend

0.04 ● PAH Total Toxicity Equivalent Concentrations (TTEC)
Milligrams per Kilogram (mg/kg)

Note: Letters and numbers define grid points. For example, grid point D5 confirmation result is 0.05 (mg/kg).

Source: ARCADIS (2011), Site Closure Report, NPDES Ponds, Columbia Gorge Aluminum, Goldendale, Washington, dated January 2011.

N
W E
S

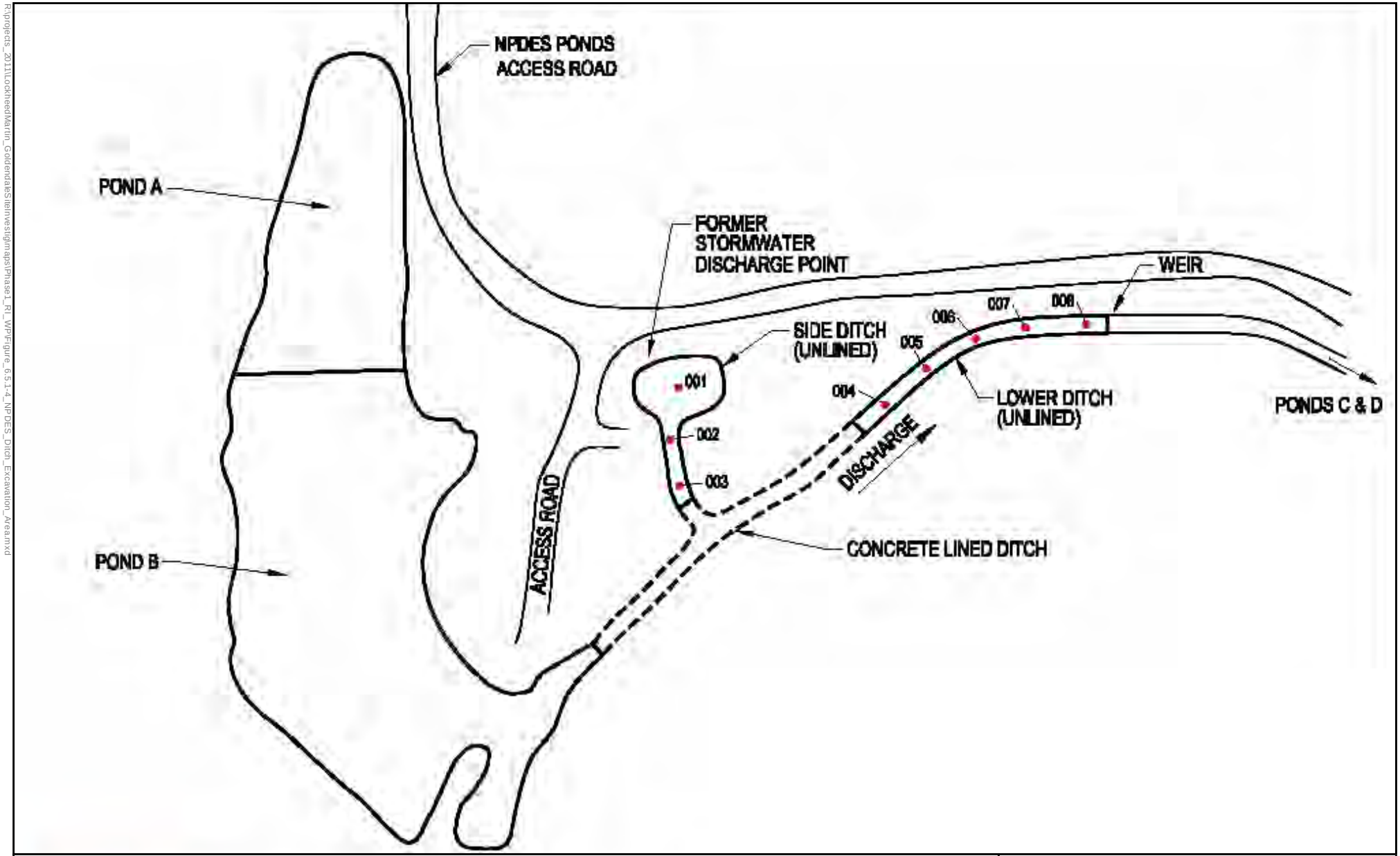
0 30' 60' 120'

Approximate Scale in Feet

Figure 6.5.1-3

NPDES Ponds C & D

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



Legend

- Unlined Ditch
- Concrete Lined Ditch
- Composite Sample Site Center Points

Notes:
Side Ditch: Samples were collected on 9/21/10 and 10/8/10. Final excavation conducted to bedrock on 10/11/10 and 10/12/10. No further sampling conducted.

Lower Ditch: Sample sites selected but no samples collected. Ditch section was excavated to bedrock during initial excavation.

Source: ARCADIS (2011), Site Closure Report, NPDES Ponds, Columbia Gorge Aluminum, Goldendale, Washington, dated January 2011.

N
W E
S

0 30' 60' 120'

Approximate Scale in Feet

Figure 6.5.1-4

NPDES Ditch Excavation Area

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

At the conclusion of the removal action, all three of these criteria had been met at each pond and the ditch area downstream of Ponds A and B (ARCADIS 2011a). Table 6.5.1-1 summarizes the confirmation sample results and UCL for each pond and the ditch.

Other Historical Environmental Investigation Data

Other historical environmental data have been collected at the NPDES Ponds as mentioned previously in the environmental investigation and cleanup history including 1985 (JUB Engineers 1985), 1990 (Technico & Enviroservices 1990), 2007 (ARCADIS 2008a), and 2008 (ARCADIS 2008b). Relevant data summary tables and accompanying figures for these older investigations are included in Appendix A-1.

6.5.1.3 Data Gaps Evaluation and Data Needs

The NPDES Ponds (SWMU 1) have been successfully remediated through removal of contaminated soil to MTCA Method B Cleanup Levels. For this reason, no further action at the NPDES Ponds is recommended.

Potential data gaps and data needs related to future impacts to the NPDES Ponds include the possibility that the ponds could re-contaminate due to ongoing, overland flow, groundwater seepage, and/or stormwater runoff. These data needs will be addressed as part of the Plant Area AOC, stormwater conveyance system (SWMU 32), and the Groundwater in the Uppermost Aquifer AOC.

Table 6.5.1-1
Final Confirmation Sample Result Summary

2011 NPDES Ponds Closure Report
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Grid Point	Total cPAH TTEC Concentration (mg/kg)	95 % UCL
Pond A		
C1	0.014[a]	0.0282
B2	0.002[a]	
C2	0.02[a]	
C3	0.002[a]	
B4	0.002[a]	
C4	0.002[a]	
B5	0.002[a]	
C5	0.05[a]	
A6	0.002[a]	
B6	0.03[a]	
Pond B		
A7	0.003[a]	0.114
B8	0.04	
A9	0.02	
B9	0.01	
B10	0.18	
C10	0.02	
A11	0.14	
D11	0.01	
C12	0.04	
D12	0.04	
D14	0.002[a]	
D13	0.002[a]	
Pond C		
D5	0.04	0.101
G4	0.01	
H4	0.06	
I5	0.02	
J3	0.002[a]	
K3	0.01	
L2	0.05	
L5	0.01	
M4	0.15	
N3	0.02	
Pond D		
O3	0.16[a]	0.0782
O5	0.004[a]	
O6	0.02	
Q5	0.02[a]	
R5	0.08	
R6	0.01[a]	
T5	0.08[a]	
U5	0.08	
V5	0.01	
W4	0.002[a]	
Ditch		
001	0.002[a]	No UCL could be calculated
002	0.002[a]	
003	0.002[a]	
004	0.002[a]	
005	0.002[a]	
006	0.002[a]	
007	0.002[a]	
008	0.002[a]	

Notes: All concentrations in milligrams per kilogram (mg/kg).

a One or more subsamples in the composite sample could not be collected due to the presence of bedrock. In these cases, the 5-point composite sample concentrations represent a weighted average in which the missing bedrock subsamples were set at one-half the detection limit for the analyses.

cPAH Carcinogenic Polynuclear Aromatic Hydrocarbon
NPDES National Pollutant Discharge Elimination System
TTEC Total toxicity equivalent concentration
UCL Upper confidence limit

6.5.2 East Surface Impoundment (SWMU 2)

The ESI is a 5.76 acre unlined, natural depression impoundment that received sludge from the plant's air emission control scrubber system from approximately 1973 through June of 1985 (refer to Figure 2-2 and 6.1-1). In July 1987 the ESI was closed in compliance with the ESI Modified Closure and Post-Closure Plans (Geraghty & Miller 1986) by stabilizing waste, placing a cap, and fencing the closed site. This closure conformed with the Washington Dangerous Waste Regulations, specifically WAC 173-303-400(3)(a), which includes, by reference, 40 CFR Part 265 Subparts F through R for interim status facilities. Post-closure requirements have been subsequently modified by Ecology.

All discharges to the ESI stopped in June 1985. At the time of closure, approximately 70,300 cubic yards of sludge material was estimated to remain within the ESI. The sludge material contained select metals, silica, PAHs, phenol, fluoride, cyanide, and sulfate. The site was formally closed in July 1987 including construction of an engineered cap. The engineered and impermeable RCRA cap consists (from bottom to top) of a one-foot sand cover, 30-mil PVC liner, and a 0.05-inch geotextile fabric, one foot of transitional material, and one foot of rip-rap. The 1986 ESI Post Closure Plan includes grading and cap designs and cross-sections that have been compiled in Appendix A-2 of this Work Plan (Geraghty & Miller 1986).

The ESI groundwater monitoring program and cap operations, maintenance and monitoring program is ongoing. A brief discussion of the environmental investigation history, including ongoing post-closure inspection and monitoring is provided in the following section.

6.5.2.1 Environmental Investigation History

In 1984, Common Wealth Aluminum initiated a groundwater monitoring program for the ESI. The initial program included installation and sampling of four groundwater monitoring wells, including one upgradient well (MW-1), and three downgradient wells (MW-8, MW-9, and MW-10) as shown in Figure 6.5.2-1. Initial groundwater sampling results indicated the ESI was impacting water quality in the uppermost water bearing zone underlying the ESI. Based on the initial results, a groundwater quality assessment program plan was prepared for the ESI in June 1985 (Century West 1985a,b).

Legend

MW-10
Monitoring Well Location

ESI Boundary

N

0 125 250 500
Feet

Figure 6.5.2-1
East Surface Impoundment
and Associated Features

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

In late 1985, 17 additional monitoring wells were installed (refer to Figure 6.5.2-1), basalt integrity tests were conducted, hydraulic conductivity "slug tests" were performed in select monitoring wells, and groundwater samples were collected from three of the four existing monitoring wells (well MW-9 was dry at the time of sampling) and from 15 of the 17 newly installed monitoring wells (wells IB-6 and IB-7 were dry at the time of sampling) in general accordance with the Ecology-approved groundwater quality assessment program plan (Century 1986). A summary of the primary findings of this investigation include:

- Identification of up to six water bearing zones underlying the ESI. General groundwater flow direction is south to southwest toward the Columbia River. A detailed discussion of the ESI conceptual hydrogeologic model is provided in Section 7.2, the Groundwater in the Uppermost Aquifer AOC.

- Two primary mechanisms, including differential hydraulic head and fluctuating groundwater table were identified as being potentially responsible for the release of ESI waste constituents to the environment. The formation of "intermittent ponds" to the east and south of the ESI were reported as surface expressions of the colluvial/first aquifer groundwater table during times of high recharge (e.g., late winter/early spring).

- Seven soil borings drilled within the temporary cover placed over the ESI defined the lateral and vertical extent of the contained sludge material.

- A comprehensive suite of indicator parameters, EPA priority pollutants, and waste constituents were analyzed for groundwater samples collected during the investigation. In general the downgradient designated wells showed an increase in concentrations for fluoride, sulfate, and to lesser extent total cyanide. Free cyanide concentrations were below the limits of detection in all wells sampled. Waste constituents were generally reported to decrease in concentration with depth. Historical groundwater sampling results for these ESI-designated monitoring wells are included in Section 7.2.

In 1991, a groundwater conditions assessment (Geraghty & Miller 1991) was performed to assess the potential for occasional groundwater contact with ESI waste materials. This evaluation was conducted in March 1991 (spring time) and included water level measurements in selected monitoring wells and from sumps installed in the three intermittent pond areas located around the ESI perimeter. The conclusions of this evaluation indicated that the existing information could not support determination as to whether a portion of the ESI sludge material may periodically be in contact with groundwater (Geraghty & Miller 1991). Further assessment was recommended including coring within the ESI to evaluate the leaching potential of existing sludge material, as well as installation of a 2-inch diameter monitoring well within the deepest portion of the ESI.

In late 1991, a single groundwater monitoring well (i.e., well ESI-1) was installed through the ESI cover at a location selected to intercept the area of deepest sludge disposal (refer to Figure 6.5.2-1). The purpose of this well was to: 1) establish whether groundwater was in contact with the sludge enclosed within the ESI, and 2) establish the leaching potential for chemicals in the remaining sludge material (Geraghty & Miller 1992). The results of this investigation include the following:

- The well was drilled to a total depth of about 16.5 feet bgs where competent basalt bedrock was encountered.
- The elevation at the base of the sludge in the borehole is about 509.4 feet msl (15.0 feet bgs). About 1.5 feet of native soil is present between the base of the sludge and bedrock.
- Groundwater was not detected in well ESI-1 at the time of installation or approximately 3-weeks later indicating no contact between groundwater and the sludge material at the lowest point within the ESI.
- Laboratory results from the sludge sample collected from the borehole indicate that detectable concentrations of leachable fluoride and sulfate, but not leachable cyanide were present.

In 1995, an evaluation of existing groundwater conditions at the ESI was performed including: 1) a geophysical field program to characterize bedrock topography and groundwater flow conditions in and around the ESI; 2) topographic surveying and mapping of site features; and 3) development of a conceptual understanding of existing hydrogeologic conditions (HartCrowser 1996). The findings of the seismic survey suggest an apparent depression in the bedrock below the ESI with a low point of depression at an elevation of about 480 to 490 feet. The bedrock surface identified on the seismic refraction profile does not correlate with the depth of "refusal" typically encountered during drilling within the ESI at an elevation of about 508 feet msl. This observation suggests that the "refusal" horizon in the boreholes within the ESI is likely not competent basalt, but rather fractured basalt or basaltic rubble (HartCrowser 1996).

In 1995, an annual groundwater monitoring summary for the ESI was prepared that included post-closure monitoring data and associated trend analysis from 1988 to 1995 (HartCrowser 1996). Quarterly groundwater monitoring, including collection of water quality and water level data has been ongoing since closure of the ESI in 1987. Monitoring during this period incorporated 12 of the existing 21 monitoring wells in the vicinity of the ESI, including wells MW-1, MW-8, MW-10, IB-

1, IB-3, IB-4, IB-5, IB-9, IB-10, IB-11, IB-13, and ESI-1 (refer to Figure 6.5.2-1). Routine physical and chemical data collected during quarterly monitoring included water levels, pH, conductivity, fluoride, total cyanide, sulfate, total organic carbon, total organic halides, and for the first quarter only: total phenols, chloride, iron, manganese, and sodium. A brief summary of the 1995 monitoring evaluation include:

- Of the list of chemical parameters included in the quarterly monitoring, sulfate and fluoride are the two primary constituents identified at elevated concentrations above background levels in the vicinity of the ESI.
- General groundwater flow direction for the shallow groundwater in the ESI is south to southwest. Seasonal variations in groundwater levels are observed, with higher levels during the wet winter months.
- Seasonally high water levels in the shallow groundwater during the winter and spring months coincide with observed increased groundwater concentrations of sulfate and fluoride in shallow downgradient wells (e.g., wells IB-9 and MW-10). In general there was an overall decreasing trend in fluoride and sulfate concentrations in these wells.
- The observed water-level rise during the wet season in the ESI monitoring well ESI-1 suggests that groundwater during these wet periods may contact with at least a portion of the sludge material within the lower base of the impoundment.

In November 2003, as approved by Ecology (Ecology 2003), the frequency of operation and maintenance inspection activities and groundwater monitoring for the ESI was reduced to three years of quarterly monitoring, including four quarterly sampling events in 2005 (completed), 2010 (completed), and 2017 (ARCADIS 2011b). Annual inspections and maintenance of the ESI cover are required annually during each of the sampling years. In addition, since 2007 ESI inspection and maintenance activities have been conducted on an annual basis to document: 1) the presence of erosional gullies, vegetative cover, cracking or settling of the cover, and burrows or other animal activities that would disturb the cover; 2) slumping; 3) the security and condition of posts and fencing; 4) the visibility and condition of warning signs; 5) the condition and functionality of gas collection vents and risers; and 6) the presence of ponding or diversions in the drainage systems on/within the ESI area.

The most recent ESI groundwater monitoring data was collected during 2010 (ARCADIS 2011b).

6.5.2.2 Previous Environmental Data

The most recent groundwater monitoring data for the ESI was collected in March, June, September, and December 2010, and included water level measurements, field parameter measurements, and groundwater samples collected from four existing monitoring wells, including one upgradient well (IB-3) and three downgradient wells (MW-10, IB-5, and IB-8) as shown in Figure 6.5.2-1. Field parameter measurements including temperature, pH, specific conductance, and dissolved oxygen were recorded at the time of sample collection. All project groundwater samples were analyzed for fluoride, sulfate, and iron in accordance with an Ecology recommendation and approval letter (Ecology 2003).

Table 6.5.2-1 provides a summary of the ESI 2010 groundwater analytical results, as well as state screening levels for comparative review. No screening levels were exceeded in the upgradient well IB-3. Fluoride was detected at or slightly above the WA MCL screening level of 4 mg/L in all four samples collected from well MW-10, and in one sample from well IB-8 (see Figure and Table 6.5.2-1). Sulfate was reported above the secondary MCL standard of 250 mg/L in samples from downgradient wells MW-10, IB-5, and IB-8. Total iron slightly exceeded the screening level of 0.3 mg/L in one sample collected from well MW-10.

6.5.2.3 Data Gaps Evaluation and Data Needs

Findings and recommendations from the 2010 ESI groundwater monitoring report, and from ongoing annual ESI cover inspections indicate conditions at the ESI remain stable (ARCADIS 2011b). Groundwater elevations, flow directions, and water quality results observed during 2010 are reportedly consistent with historical limits and generally followed previously recognized trends.

Data needs for groundwater characterization and monitoring are addressed and summarized as part of the Groundwater in the Uppermost Aquifer AOC in Section 7.2. No other data needs or data gaps have been identified.

Table 6.5.2-1
Summary of 2010 Groundwater Analytical Results

East Surface Impoundment
Columbia Gorge Aluminum Smelter Site
Goldendale, WA

Monitor Well ID	Date Sampled	Casing Elevation (ft msl)	Depth to Water (feet)	Groundwater Elevation (ft msl)	PH (S.U.)	Cond. (µhos/cm)	D.O.	Temp (°C)	Fluoride (mg/L)	Sulfate (mg/L)	Total Iron (mg/L)
Upgradient Monitoring Wells											
IB-3	Mar-10	533.15	9.63	523.52	6.81	182	7.7	14.8	<0.500	16.4	<0.100
	Jun-10		10.33	522.82	7.11	194	5.3	15.1	<0.500	15.6	<0.100
	Sep-10		12.09	521.06	7.07	178.5	6.1	16.5	0.25	16.1	<0.100
	Dec-10		11.11	522.04	7.35	202.1	5.0	14.8	0.26	16.8	<0.100
Monitoring Well Screened in Uppermost Water-Bearing Zone											
MW-10	Mar-10	514.79	8.32	506.47	6.91	750	7.3	13	**5.32**	204	<0.100
	Jun-10		9.72	505.07	7.00	1,283	5.0	14.3	**9.30**	**389**	<0.100
	Sep-10		11.91	502.88	6.94	1,993	5.07	18.5	**4.0**	**747**	**0.430**
	Dec-10		7.82	506.97	7.49	639	4.51	16.1	**7.3**	140	<0.100
IB-5	Mar-10	503.26	11.57	491.69	7.07	1,856	5.8	14.2	<0.500	**955**	<0.100
	Jun-10		11.68	491.58	7.21	1,947	4.2	16.0	<0.500	**830**	<0.100
	Sep-10		12.68	490.58	7.32	1,681	4.35	17.1	0.22	**860**	<0.100
	Dec-10		14.01	489.25	7.90	1,714	4.32	15.4	0.21	**823**	<0.100
Monitoring Well Screened in Deeper Water-Bearing Zone											
IB-8	Mar-10	462.36	195.79	266.57	6.80	1,609	7.4	20.4	**1.88**	**797**	<0.100
	Jun-10		198.37	263.99	7.07	1,685	4.3	20.5	**4.20**	**630**	<0.100
	Sep-10		198.55	263.81	7.05	1,459	5.45	20.8	**2.7**	**679**	<0.100
	Dec-10		199.00	263.36	7.35	1,640	5.8	18.1	**2.8**	**740**	<0.100
Screening Levels											
MTCA Method B									0.64	NA	NA
MTCA Method C									1.4	NA	NA
WA MCL									4	250	0.3

ft msl	feet above mean sea level
mg/L	milligrams per liter
DO	Dissolved Oxygen
COND	Specific conductance in micromhos per centimeter
µhos/cm	micromhos per centimeter
Bold/shaded	Concentration exceeds available screening levels
MCL	Maximum Concentration Limit
MTCA	Model Toxics Control Act

Source: ARCADIS 2011b.

6.5.3 Intermittent Sludge Disposal Ponds (East Surface Deposits Area) (SWMU 3)

The Intermittent Sludge Disposal Ponds (herein referred to as the "East Surface Deposits") consist of an approximately 12-acre parcel located southeast of the former smelter (refer to Figures 2-2 and 6-1.1). While the smelter was operating in the 1970s, air pollution control scrubbers removed particulate and aerosol pollutants from plant air discharges. Waste streams containing sulfate, fluoride, total cyanide, and PAHs from the plant's air pollution control scrubber systems were discharged under NPDES permit into settling ponds (i.e., NPDES ponds) located southeast of the main production plant (refer to Figure 6-1.1). From the early to late 1970s, sludge from the NPDES ponds was periodically pumped to various natural shallow depressions in the fields to the east which form the East Surface Deposits Area (ESDA).

The ESDA is comprised of 13 relatively small, relatively shallow sub-areas that have accumulated PAH-containing material as described above. The 13 ESDA sub-areas have been designated alphanumerically, including Sub-Areas A through N as shown in Figure 6.5.3-1. Sub-areas E and F have been combined into a single sub-area (EF), and sub-area M was further subdivided numerically (M1, M2, and M3). Past environmental site investigation(s) and site cleanup of the ESDA is summarized in the following sections.

6.5.3.1 Environmental Investigation and Site Cleanup History

In 1996, a preliminary assessment of the ESDA was performed by Lockheed Martin (Tetra Tech 1997). Ten surficial samples were collected from the ESDA for analysis including those constituents of concern related to wastes from the air scrubber system. One sample each was collected from the center portions of sub-areas A, B, C, E, I, J, K, and L. Two samples were collected from sub-area M. Samples were not collected from sub-areas D, F, G, or H (ARCADIS 2007a,b,c). No total cyanide was detected in these samples, and both fluoride and sulfate were reported at low concentrations below current MTCA Method C and B soil cleanup levels. Sample PAH concentrations ranged from not detected to 26,110 mg/kg, with a reported average concentration of 7,250 mg/kg.

In 2006, a more extensive site investigation and closure alternative analysis of the ESDA was undertaken by Lockheed Martin (ARCADIS 2007a). Under an Ecology-approved work plan, the study delineated the horizontal and vertical extent of PAH-impacted surface deposits, and assessed

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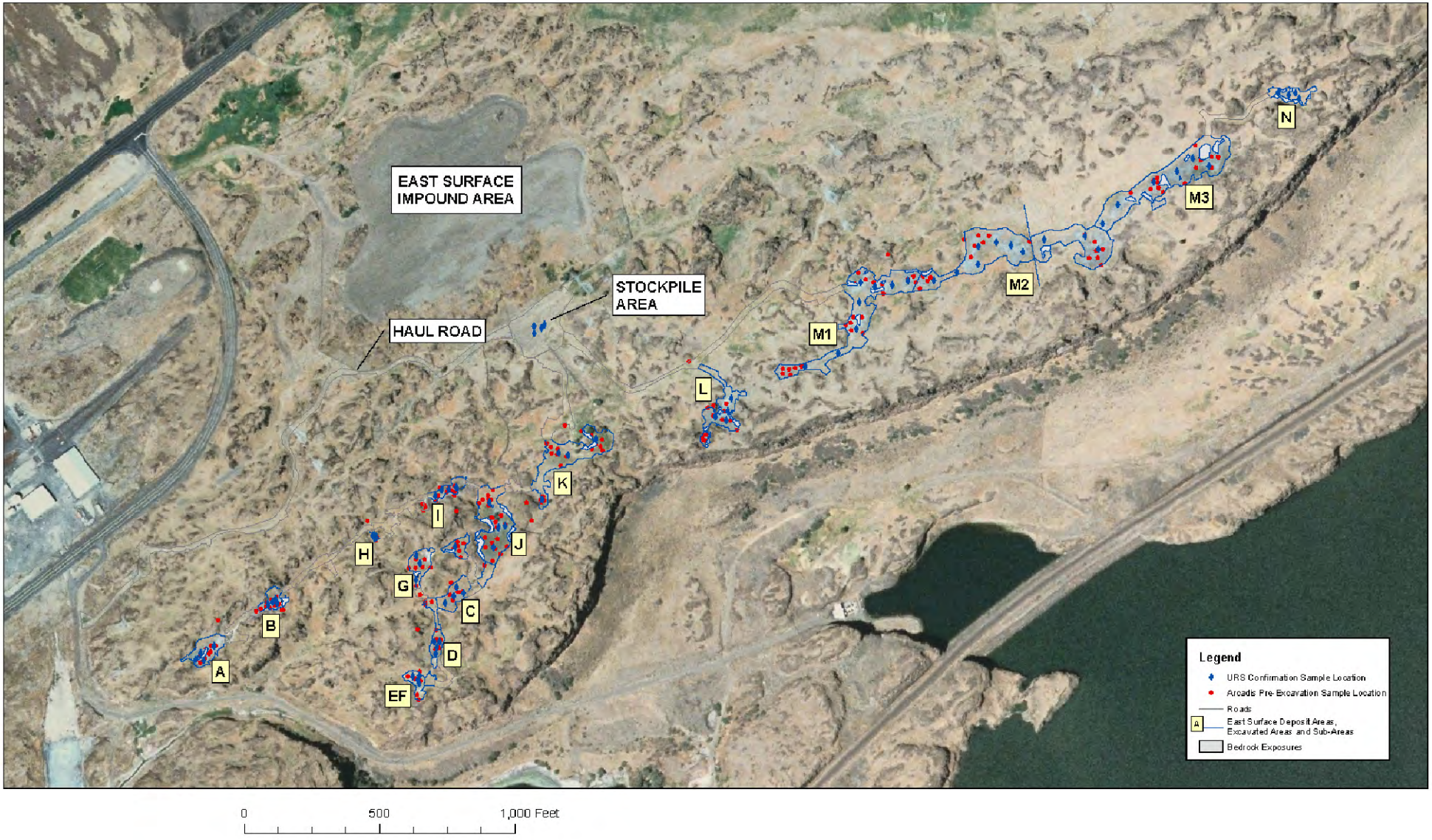

Source: URS 2008b

Figure 6.5.3-1

Intermittent Sludge Disposal Ponds
(East Surface Deposits)
Excavation and Confirmation Sample Location Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

the physical properties and established a representative waste characterization of the material. The study demonstrated that PAH-impacted material in the ESDA was readily identified as a gray to black fine-grained material easily distinguishable from native soils (ARCADIS 2007a).

A total of 80 samples were collected and submitted for PAH analysis as part of the ARCADIS (2007a) field effort: 29 PAH-impacted material composite samples; 14 samples of the underlying soils; and 37 lateral samples of surface materials and/or native soils. Results showed composite sample total cPAH concentrations ranged between 136 mg/kg in Area G to 4,169 mg/kg in Area A. Underlying soil cPAH concentrations ranged from not detected in Area M1 to 58.4 mg/kg in Area I; cPAH concentrations in lateral extent samples ranged between 0.03 mg/kg in Area M2 and 28.61 mg/kg in Area J (URS 2008b). In consultation with Ecology, Lockheed Martin evaluated cleanup alternatives for the site which included the no action alternative, capping/in-place closure, and removal with off-site landfill disposal. Removal and off-site disposal was ultimately selected as the preferred clean-up alternative (ARCADIS 2007a).

In 2007, Lockheed Martin prepared a voluntary cleanup work plan (ARCADIS 2007b) and associated sampling and analysis plan (ARCADIS 2007c) which described the cleanup measures and procedures proposed for the ESDA. The primary objectives of the removal cleanup action included:

- Remediation of ESDA material at the site to MTCA Industrial Soil Cleanup Levels and establishment of institutional controls on the property;
- Removal of ESDA material from the site to an approved solid waste landfill;
- Increased protection of environmental receptors from unacceptable risks due to ingestion or contact with ESDA material;
- Increased protection of surface water, groundwater and air quality as a result of this cleanup action;
- Maximization of long-term use of the ESDA parcel for industrial purposes and reduce the surface acreage affected by past aluminum processing operations; and
- Minimization of the effects of the cleanup on the public (human health and safety) and the environment through appropriate engineering practices and controls.

Site cleanup of the ESDA was performed in accordance with the approved work plan(s) during November and December 2007. PAH-impacted materials were excavated from sub-areas A through N (refer to Figure 6.5.2-1), stockpiled and profiled for disposal, and transported off-site to an approved solid waste landfill facility (URS 2008b). At the completion of the project, a total of about 10,342 tons (approximately 7,920 cubic yards) of ESDA material from the 13 sub-areas was excavated and properly disposed off-site (URS 2008b). Table 6.5.3-1 provides a summary of the excavated soil volumes by sub-area, and identifies the number of confirmation samples collected within each sub-area following excavation. Excavation confirmation soil sampling results and assessment of the cleanup action relative to MTCA cleanup standards is discussed in the following section.

Table 6.5.3-1
Summary of ESDA Material Excavation Areas[a]

East Surface Deposits 2007 Cleanup Action
Goldendale, Washington

Sub-Area Designation	Excavation Area (ft^2)	Approximate Volume (CY)	Average Depth (ft)	Approximate Maximum Depth (ft)	Number of Confirmation Samples
A	9,800	510	1.4	3	4
B	5,500	578	2.5	2.8	4
C	11,300	173	0.4	3	4
D	4,700	133	0.8	2	4
E/F	6,200	203	0.9	1.6	4
G	12,400	200	0.4	0.8	4
H	600	60	0.5	2.7	4
I	5,200	350	1.8	2	4
J	30,900	1,039	0.9	3	4
K	26,800	605	0.6	4	4
L	16,200	678	1.1	2	4
M1	45,100	1,077	0.6	3	8
M2	38,600	660	0.5	1	8
M3	79,500	1,248	0.4	1	8
N	6,900	132	0.5	1.5	4

a Table adopted from URS (2008b).

6.5.3.2 Previous Environmental Data

The most recent data for the East Surface Deposits represent post-removal soil confirmation sample results collected in November and December 2007 (URS 2008b). These data, along with the 37 lateral extent samples collected during the 2006 investigation represent the post-remediation and current conditions at this SWMU.

At the completion of excavation of the East Surface Deposits, a total of 72 confirmation soil samples were collected from all 13 sub-areas (samples A-1-C through N-4-W) and analyzed for PAHs using EPA Method 8270-SIM. In addition, four samples were collected and submitted for PAHs analysis from the shallow subsurface beneath the former soil stockpile area (samples SP-1-C1 through SP-4-W1). The confirmation soil sample station locations are shown for all sub-areas from west to east in Figures 6.5.3-2 and 6.5.3-3, respectively. Stockpile confirmation sample station locations are shown on Figure 6.5.3-2.

The TTEC for benzo(a)pyrene was used to evaluate compliance with MTCA cleanup standards. Compliance sample results calculated using the TTEC method resulted in levels of 0.008 mg/kg to 0.055 mg/kg. None of the 72 compliance sample TTEC values exceeded the 0.1 mg/kg MTCA Method A benzo(a)pyrene Soil Cleanup Level for Unrestricted Land Use (URS 2008b). Table 6.5.3-2 provides a summary of the calculated TTEC values for the 72 compliance samples collected in support of the ESDA cleanup action.

A reasonable maximum exposure scenario that included ESDA post-excavation compliance samples, stockpile area samples, and the 37 lateral samples (ARCADIS 2007a) collected prior to the cleanup from areas adjacent to the 13 ESDA sub-areas where soils were not removed. A 95 UCL was calculated on the combined TTEC data of 0.473 mg/kg, which is less than the MTCA Method A Industrial Soil Cleanup Level of 2.0 mg/kg. In addition, a site-specific terrestrial ecological evaluation was undertaken in accordance with MTCA. The benzo(a)pyrene 95 UCL of 0.472 mg/kg was determined well below the 12 mg/kg value protective of wildlife (URS 2008b). Tabulated analytical result summaries for PAHs and accompanying figures for confirmation, stockpile, and lateral samples collected in support of this work effort are provided in Appendix A-3.

6.5.3.3 Data Gaps Evaluation and Data Needs

The East Surface Deposits (SWMU 3) have been successfully remediated through removal of contaminated materials to MTCA Method A Soil Cleanup Levels for Unrestricted Land Use in all 13 sub-areas, and to MTCA Method A Industrial Soil Cleanup Levels in lateral or adjacent locations to this SWMU. For this reason, no further environmental investigation activities are proposed. The appropriateness of industrial cleanup levels for this SWMU based on future land use considerations should be confirmed.

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Figure 6.5.3-2

East Surface Deposits
(West Section Confirmation Sample Designation Location Map)

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Source: URS 2008b

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Source: URS 2008b

Figure 6.5.3-3

East Surface Deposits
(East Section Confirmation Sample Designation Location Map)

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Table 6.5.3-2
Confirmation/Compliance Soil Sample Results[a]

East Surface Deposits
2007 Cleanup Action
Goldendale, Washington
Page 1 of 2

Excavated Sub-Area	Sample ID1	Sample Depth (Inches Below Base of Excavation)	Date Collected	TTEC[b] (mg/kg)
A	A-1-C	0-4	11/21/2007	0.008305
	A-2-E		11/21/2007	0.008671
	A-3-S		11/21/2007	0.0079275
	A-4-W		11/21/2007	0.0082295
B	B-1-C	0-4	11/21/2007	0.0080785
	B-2-E		11/21/2007	0.0082295
	B-3-S		11/21/2007	0.0082295
	B-4-W		11/21/2007	0.0080785
C	C-1-C	0-4	11/28/2007	0.0080785
	C-2-E		11/28/2007	0.0083805
	C-3-S		11/28/2007	0.008305
	C-4-W		11/28/2007	0.008456
D	D-1-C	0-4	11/28/2007	0.0092865
	D-2-W		11/28/2007	0.009513
	D-3-E		11/28/2007	0.009815
	D-4-S		11/28/2007	0.008607
E/F	EF-1	0-4	11/19/2007	0.017652
	EF-2-S		11/21/2007	0.009433
	EF-3-W		11/21/2007	0.0098905
	EF-4-E		11/21/2007	0.0094375
G	G-1-C	0-4	11/28/2007	0.0083805
	G-2-W		11/28/2007	0.008305
	G-3-E		11/28/2007	0.008909
	G-4-S		11/28/2007	0.0083805
H	H-1-C	0-4	11/28/2007	0.05475
	H-2-E		11/28/2007	0.0083805
	H-3-W		11/28/2007	0.0085315
	H-4-N		11/28/2007	0.0083805
I	I-1-C	0-4	11/28/2007	0.009362
	I-2-E		11/28/2007	0.0094375
	I-3-W		11/28/2007	0.0079275
	I-4-N		11/28/2007	0.008607
J	J-1-C	0-4	11/28/2007	0.0149765
	J-2-E		11/28/2007	0.011766
	J-3-S		11/28/2007	0.0098905
	J-4-N		11/28/2007	0.0083805
K	K-1-C	0-4	11/28/2007	0.0097395
	K-2-E		11/28/2007	0.0089845
	K-3-S		11/28/2007	0.010419
	K-4-W		11/28/2007	0.0106455
L	L-1-C	0-4	11/29/2007	0.0082295
	L-2-E		11/29/2007	0.0083805
	L-3-S		11/29/2007	0.008456
	L-4-W		11/29/2007	0.008456

Table 6.5.3-2
Confirmation/Compliance Soil Sample Results[a]

East Surface Deposits
2007 Cleanup Action
Goldendale, Washington
Page 2 of 2

Excavated Sub-Area	Sample ID1	Sample Depth (Inches Below Base of Excavation)	Date Collected	TTEC[b] (mg/kg)
M1	M1-1-C1	0-4	12/7/2007	0.0085315
	M1-2-E1		12/7/2007	0.008607
	M1-3-W1		12/7/2007	0.008456
	M1-4-N1		12/7/2007	0.0083805
	M1-5-C2		12/7/2007	0.008456
	M1-6-W2		12/7/2007	0.0085315
	M1-7-E2		12/7/2007	0.008456
	M1-8-N2		12/7/2007	0.0083805
M2	M2-1-C1	0-4	12/6/2007	0.008305
	M2-2-E1		12/6/2007	0.0085315
	M2-3-S1		12/6/2007	0.0085315
	M2-4-W1		12/6/2007	0.008456
	M2-5-C2		12/6/2007	0.008607
	M2-6-E2		12/6/2007	0.008456
	M2-7-S2		12/6/2007	0.008456
	M2-8-W2		12/6/2007	0.008758
M3	M3-1-C1	0-4	12/6/2007	0.015256
	M3-2-NE		12/6/2007	0.0089845
	M3-3-SE		12/6/2007	0.009815
	M3-4-WC		12/6/2007	0.008003
	M3-5-C2		12/6/2007	0.008758
	M3-6-EC		12/6/2007	0.0085315
	M3-7-SW		12/6/2007	0.007852
	M3-8-NW		12/6/2007	0.0086825
N	N-1-C	0-4	12/6/2007	0.008758
	N-2-E		12/6/2007	0.0085315
	N-3-S		12/6/2007	0.008758
	N-4-W		12/6/2007	0.0086825
MTCA Soil Cleanup Levels (mg/kg)			Method A (Unrestricted Land Use)	0.1
			Method A (Industrial Land Use)	2.0
			Method C Industrial	18

a Table adopted from URS (2008b). Table was modified to include Method A Industrial Cleanup Levels.
b Total Toxicity Equivalent Concentration (TTEC) for benzo(a)pyrene.

6.5.4 Smelter Sign Area (SWMU 31)

The Smelter Sign Area actually consists of two primary areas, including the Smelter Sign Area located between the eastern edge of the Production Area and John Day Dam Road and an area located north of the East Surface Impoundment (NESI Area) (refer to Figure 6-1.1 and 6.5.4-1). According to former facility personnel, the Smelter Sign Area was a location where SPL and other wastes were disposed of in the early 1970's. The period of potential disposal associated with the Smelter Sign Area is assumed limited to the early to mid-1970's based on review of historical aerial photographs (Tetra Tech 2011c).

The NESI Area appears to have potentially been used for disposal of a variety of facility wastes based on preliminary aerial photograph review and field observations. Review of the historical aerial photographs suggests that the majority of the physical disturbance and potential disposal activities at the site occurred during the early 1970's shortly after construction of the aluminum plant (Tetra Tech 2011b). Two intermittent ponds were historically present in the southwestern portion of the NESI Area. These ponds were reportedly excavated to bedrock and backfilled as part of closure activities at the ESI Area (Geraghty & Miller 1986).

No environmental investigation has been completed in the areas associated with the Smelter Sign Area SWMU. However, site inspections have been performed to better understand site conditions and to help develop the scope for remedial investigation. A brief discussion regarding past site inspection and associated activities is provided in Section 6.5.4.1 below.

6.5.4.1 Environmental Investigation History

A site inspection of the Smelter Sign and NESI areas was conducted on January 30, 2011 through February 2, 2011 (Tetra Tech 2011a,b). A brief summary regarding the findings of this inspection is provided below.

Smelter Sign Area

The Smelter Sign Area consists of: 1) the plant sign area with associated irrigated lawn and gravel access road along the northern lawn boundary, 2) a built-up bench-area with a rough gravel roadway and two small concrete pads that is present south of the lawn, and 3) a knoll area with basalt outcrops and backfill material with some evidence of historical disposal that is located southwest of the lawn and northwest of the bench area. From the top of the bench area the topography slopes downward to the north, west, south, and east (refer to Figure 6.5.4-1).

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Legend

Smelter Sign and NESI Area Boundaries

Note: NESI Area (Area North of East Surface Impoundment)

N
W E
S

0 125 250 500
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 6.5.4-1
Smelter Sign and NESI Area (SWMU 31)

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

During inspection two concrete pads were observed present on top of bench area along with a line of small, low-lying metal supports. These supports may potentially be related to historical piping for ESI area that was closed during the late 1980's. Scattered chunks of suspected pot liner wastes and a few small piles of miscellaneous plant wastes were observed in the bench area and the knoll area southwest of the lawn. Also observed were plant-related waste that included bricks in the northeastern area adjacent to the irrigated lawn. No wastes were observed on the grassy southeast facing slope of the bench area above the railway spur (Tetra Tech 2011c).

NESI Area

The NESI Area consists of an open area that currently appears to be used as pasture land (refer to Figure 6.5.4-1). The site is characterized by hummocky topography with some outcrops of basalt bedrock. A gravel road enters the site from the west and north. A spur of the gravel road serves as an entrance to the closed ESI Area. A series of rock walls composed of basalt cobbles and boulders are present at the site. Some low-lying areas of the site were observed to have seasonal standing water and appeared to be wetland areas.

Carbon wastes, suspected SPL, and cryolite wastes were observed in several areas of the site. The wastes appeared to be distributed along the sides of gravel road, particularly in areas of low elevations. In some areas, it appears that the wastes had been graded and pushed up to the sides of depression areas. The largest accumulation of waste appeared to be present immediately west of the road in the central part of the investigation area and can be readily seen in Figure 6.5.4-1 (Tetra Tech 2011b). Based on field observations, the southwestern portion of the NESI Area appears to have been covered by gravel fill and a sump, reportedly constructed during ESI closure activities, was found in this area. Small, scattered piles of carbon wastes and other facility-related wastes were found at the bedrock edges of the gravel-covered area (Tetra Tech 2011b).

During the site inspection, a wetlands assessment was performed to ensure that the field investigation of this area can be appropriately conducted, and that necessary permits can be obtained prior to conducting previously planned investigation activities. Approximately 5.1 acres of wetland were found within the investigation area. Evidence of waste disposal was found within the wetlands in the central and eastern portion of the planned NESI Area investigation. The wetlands represent depressional Category III wetlands. Category III wetlands represent wetlands with moderate level

functions that generally have been disturbed in some ways and are often smaller, less diverse, and/or more isolated from other natural resources than other higher category function wetlands (Tetra Tech 2011b).

6.5.4.2 Data Gaps Evaluation and Data Needs

Independent site investigation work plans have been prepared for the Smelter Sign Area (Tetra Tech 2011c) and the NESI Area (Tetra Tech 2011b). The objectives of the investigation program(s) were to determine the location and potential amounts of RCRA hazardous waste (e.g., listed K088 spent pot liner waste), as well as other state and federal hazardous waste, and to determine the extent of COPC in site soils that underlie the wastes. These objectives were planned to be accomplished through implementation of a trenching and test pit sampling program and associated waste and soil sampling.

Shallow trenches and test pit excavations were proposed to qualitatively determine the type of wastes present in particular areas and to determine the lateral extent of wastes. The physical characteristics of encountered waste materials were planned to be described and these observations were going to be used to categorize the wastes. Test pit excavations were planned to determine the vertical extent of wastes, to provide characterization of smaller suspected areas of waste accumulation, and to provide characterization of the vertical extent of contamination in soil below the waste. Soil samples were planned to be collected to determine the extent of contamination in soils that underlie the waste.

As the proposed investigation includes work associated with a wetland area, the fieldwork will require permitting through the U.S. Army Corp of Engineers (ACOE) Nationwide 6 Permit, as well as the completion of a Joint Aquatic Resources Permit Application (JARPA). The JARPA application, project plans, and wetland delineation report will need to be submitted concurrently for review to the ACOE and Ecology. Klickitat County is not party to the JARPA process, but should be notified to ensure that the project complies with the Klickitat County Critical Areas Ordinance (Tetra Tech 2011b).

Data needs for the Smelter Sign Area include waste characterization and the nature and extent of soil contamination. Characterization of shallow groundwater COPC chemical concentrations and

water-level elevation in the NESI subarea near the wetlands represents a data p and data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.

6.5.5 Other Potential Sources

No other additional potential sources have been identified in the eastern area of the site.

Section 7
AOC Summaries and Evaluations

This section summarizes and evaluates the AOCs identified in the Agreed Order including Columbia River Sediments, Groundwater in the Uppermost Aquifer, Wetlands, and the Rectifier Yard. A letter was submitted that notified Ecology of the discovery and premise for the Plant Area AOC (Lockheed Martin and BMEC 2014) consistent with the requirements of the Agreed Order. The Plant Area AOC is also summarized and evaluated in this Section. Table 7.0-1 provides a brief summary description of the site AOCs.

7.1 COLUMBIA RIVER SEDIMENTS

According to Agreed Order, the NPDES outfall, sheet flow from the property near the river, and two intermittent streams have the potential to contaminate sediments in the Columbia River adjacent to the former smelter. The Agreed Order scope of work states that the following pathways will be evaluated for their potential to contaminate sediment: direct discharges, stormwater discharges, sheet flow, groundwater discharges and seeps, soil erosion, and spills, dumps, leaks and other activities at the facility (Ecology 2014a). This section identifies the data gaps and data needs associated with characterization of the Columbia River sediment adjacent to the former smelter.

The Columbia Gorge Aluminum Smelter Site and the Columbia River Sediment AOC are located in a treaty-defined usual and accustomed fishing area of the Confederated Tribes and Bands of the Yakama Nation (Ecology 2014a). The North Shore TFAS is an upland area maintained by the Yakama Nation and is located immediately upstream of the John Day Dam and west of the Boat Basin (Ecology 2014a).

The features of the Columbia River and historical sediment sampling stations near the site are shown on Figure 7.1-1. The sediment AOC includes sediments along the Washington shore near the NPDES outfall (refer to Figure 7.1-1). Potential groundwater discharges and/or seeps, wetlands, and the former smelter stormwater system will be evaluated under the relevant AOCs and SWMUs.

Table 7.0-1
Areas of Concern – Description and Investigation Status Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Areas of Concern	Geographic Area	Description and Notes	Investigation Status
Columbia River Sediments	Columbia River near NPDES outfall and Boat Basin	Since the start of plant operations, a permitted wastewater and storm water outfall has been operated at the Columbia River and there is concern that the treated wastewater and stormwater discharges have adversely affected Columbia River sediments (Ecology 2014a). In addition, sheet flow from the plant site and two intermittent rivulets leading to the Boat Basin potentially could contribute to sediment contamination (Ecology 2014a).	Limited sediment sampling for PAHs was conducted in 1985 (JUB Engineers 1985) and 1994 (ENSR 1994) in accordance with NPDES permit requirements. In addition sediment and/or surface water near the site was studied as part of 1985, 1986 and 2005 Columbia River studies (Damkaer and Dey 1986; WSDOH et al. 2005).
Groundwater in the Uppermost Aquifer at the Facility	Site-Wide	Groundwater characterization and monitoring has been performed at some of the SWMUs (the ESI and WSI, SWMUs 2 and 3, respectively) as part of long-term post-closure monitoring requirements. There are currently approximately 50 wells at the site that are completed in the shallow unconsolidated aquifer zone and within two basalt bedrock aquifer zones. The full extent of groundwater contamination in the uppermost aquifer remains uncharacterized (Ecology 2014a). There are three production wells at the facility completed in deep zones within the basalt bedrock with associated water rights.	The site hydrogeologic conceptual model was originally described in groundwater characterization documents pertaining to the ESI (Century 1986) and WSI (Golder 1988). During 2009-2011, site-wide groundwater was investigated and the hydrogeologic conceptual model was updated (URS 2009, 2011). Groundwater monitoring was conducted at the West SPL Storage Area (SWMU 13) from about 1988 to 2006 (Aleris 2010). Independent cleanup investigations that include a groundwater component have been performed at the WELF (SWMU 18) (URS 2008f, Tetra Tech 2010), EELF (SWMU 17) (URS 2008a), and the North and South Pot Liner Soaking Stations (SWMUs 10 and 11) (URS 2008e).
Wetlands	Located in depressions in areas other than the Production Area	The concern identified in the Agreed Order is for potential environmental impacts from historical smelter emissions. Evaluation of contamination and potential ecological exposures is incomplete. Hydrologic interactions and transport pathways between the wetland's surface water, storm water, and groundwater are not fully characterized. Fourteen wetlands have been delineated at the site. Most have been disturbed to at least a moderate degree by grazing, grading, or historical plant operations and represent Category III and IV wetlands.	Wetlands at the site have been delineated in PGG (2013a) and Tetra Tech (2011b). A geophysical investigation was conducted a Wetland D located in the western part of the site near the WELF and WSI (PGG 2013b).
Rectifier Yard	West of the Production Area	The rectifier yard and associated facilities were used for power generation and transmission for the former aluminum reduction plant. PCB containing transformer oils were historically used in electrical equipment at the site and PCBs may have been released.	Initial investigations of the Rectifier Yard were completed associated with plant demolition (PGG 2012b).
Plant Area	Production Area	The Plant Area AOC was identified by the project team during the course of review in preparation of this Work Plan. It includes additional features in the area of the former plant that may have released COPC. Focus categories for further assessment include: 1) Carbon Handling, Storage, and Manufacturing Features, 2) Cryolite and Bath Storage and Handling Features, and 3) Production Building, Cast House, and Ancillary Features.	Initial environmental investigation of Courtyard soils was completed associated with plant demolition (PGG 2010).

AOC Area of Concern

Figure 7.1-1
Columbia River Area Features and
Historical Sediment Sampling Location Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

7.1.1 Site Setting

The Columbia Gorge Aluminum Smelter Site is located on a topographic bench about 225 feet in elevation above the Columbia River, which is situated approximately 0.5 miles to the southeast (refer to Figure 7.1-1). Surface water flow and sediment transport in the Columbia River near the site are controlled by the presence of the John Day Dam that was constructed between 1958 and 1971. The reported harmonic mean flow of the Columbia River at John Day Dam during 1992-1994 was 123,460 cfs (ENSR 1997). Low flow conditions in the Columbia River at the John Day Dam occur during August to October (ENSR 1997). The pool elevation of Columbia River above the dam ranges from 257 to 268 feet MSL.

The John Day River flows into the Columbia River on the Oregon side on the opposite river bank about one mile upstream of the former smelter site. The John Day River is free flowing and drains a fairly large area of central Oregon high desert (5,090 square miles) and contributes sediment to the Columbia River, particularly during high water periods. The average discharge for the John Day River in the Lower John Day sub-basin (Service Creek Gauging station) is 1,937 cfs (USGS 2013). During the late spring and summer months, water temperatures of the lower John Day River are significantly warmer (up to 10ºF) than the receiving waters of the Columbia River, and increases Columbia River temperatures downstream of the confluence have been noted that extend downstream to the John Day Dam (Bryan Johnson &Associates 1972).

The reach of the Columbia River in the site vicinity is thought to be a depositional area due to the presence of the John Day Dam downstream of the site and the confluence of the John Day River with the Columbia River on the Oregon shoreline south of the site. Maintenance dredging doesn't appear to be ongoing for the reach of the Columbia River extending upstream from John Day Dam to the confluence with the John Day River based on initial conversations with the U.S. Army Corps of Engineers (Tetra Tech, personal communication, August 13, 2014).

Primary features relevant to investigation of the Columbia River Sediment AOC, includes the John Day Dam, the Boat Basin and associated drainages, and the NPDES outfall. These features are presented in further detail in the following sections.

7.1.1.1 John Day Dam

The John Day Dam is a major structure controlling surface water flow and sedimentation in the site vicinity. The John Day Dam site consists of a navigation lock, spill, powerhouse, fish passage facilities, and recreation facilities (refer to Figure 7.1-1). Construction of the John Day Dam began in 1958. The first of the 16 generators began operations in 1968 and the last generator started operations in 1971.

The John Day Dam forms a reservoir (Lake Umatilla), which provides slack water for navigation with a minimum 15-foot depth maintained in the main channel. Lake Umatilla extends from the John Day Dam 76 miles east (upstream) to the foot of McNary Dam.

A navigation lock is located on the Washington side and includes a maximum 113-foot vertical lift that represents the highest single-lift lock in the free world (USACE 2014). Fish ladders are present on both the Washington and Oregon sides of the dam. A juvenile fish bypass system was installed in 1997 on the Oregon side of the John Day Dam. A restricted area is located in the Columbia River extending about 2,500 feet of upstream and downstream of the dam (refer to Figure 7.1-1).

Public day-use parks are present both upstream (Railroad Island Park) and immediately downstream of the John Day Dam (Cliffs Park in Washington and Giles French Park in Oregon). Rail Road Island Park includes a boat launch at the Boat Basin.

The boat launch area and Boat Basin are located about 0.5 miles from the former smelter and upstream from the John Day Dam. The North Shore TFAS is an upland area located immediately west of the boat launch and Boat Basin (refer to Figure 7.1-1).

The Boat Basin does not appear to represent a naturally formed basin and wetland feature. Based on review of 1962, 1967, and 1972 historical aerial photographs, the area of the Boat Basin was extensively filled and graded during the construction of the John Day Dam. It also appears the Boat Basin was constructed during the final phase of dam construction and was formed as river levels behind the dam were raised.

The Boat Basin is separated from the Columbia River by a railroad dike. A large culvert provides access to the Columbia River for boaters and is the only direct connection between the Boat Basin and the river (Ecology 1989).

Two gullies with intermittent flow during infrequent, high intensity, storm events drain from the site vicinity toward the Boat Basin on the Columbia River (refer to Figure 7.1-1). These intermittent rivulets were historically sampled during the 1980s (when the Smelter was in active operation) with results including fluoride concentrations in the two intermittent streams ranging from 4 to 8 mg/L (Ecology 1989). In addition, ongoing and historical use of the Boat Basin (e.g., fueling, historical dam construction and grading) and railroad operations could also potentially contribute to sediment contamination in the Boat Basin.

In 1994, a Preliminary Assessment (PA) and Site Inspection (SI) was conducted at the John Day Lock and Dam (USACE 1994) for site categorization and ranking purposes under CERCLA (refer to Appendix B-1). Historical and current operations of the John Day Lock and Dam are completely unrelated and independent from the former aluminum smelter. Of the identified sites on the Washington shore, the burn pile, access roads, and north storage yard oil storage pad are relatively near the investigation area for the Columbia River Sediments AOC.

The following potential contaminant sources were identified and sampled as part of the SI including:

- A burn pile on the southern side of Railroad Island that forms the southern shore of the Boat Basin. According to the SI report, debris consisting primarily of driftwood, tires, plastics, greases, and oil rags was periodically burned in this area. Burning was limited to wood starting in the late 1980s. Soil sample results show the consistent presence of oil-range petroleum hydrocarbons (215- 923 mg/kg, EPA method 4.18.1). Low levels of benzene, toluene, and xylenes were detected in one sample below current MTCA Method A screening levels for unrestricted land use. Concentrations of various metals were consistently detected (As, Cu, Cr, Cu, Pb, and Ni) below current MTCA soil screening levels for unrestricted land use. Semivolatile organic compound analyses included a few PAH compounds, but the full suite of PAHs were not analyzed and the reporting limits were above current MTCA soil screening levels. PCBs were reportedly not detected, but also with elevated reporting limits.

- Access or service roads on the Washington shore near the dam structure that reportedly include a downstream service road, downstream contractor access road, and an upstream service road. These roads were reportedly sprayed during the early 1970s with used turbine oil, solvents, and grease for dust control. The upstream access road (located closest to the Columbia River AOC investigation area) that is mentioned in the report does not appear to have been sampled.

- The North Storage Yard Oil Storage Pad on the Washington shore just downstream of the dam structure and north of the locks. This area was used for sandblasting, steam cleaning, and equipment and waste storage. Wastes reportedly consisted oil/water

mixtures that were shipped offsite in 1991. PCBs and oil-range petroleum hydrocarbons were detected in soil above current MTCA Method A soil screening levels for unrestricted land use of 2,000 mg/kg and 1mg/kg, respectively.

7.1.1.2 NPDES Outfall Operations, Discharge Limits, and Mixing Zone

Wastewater discharges at the site have been permitted since the initial construction of the facility in the early 1970's. Waste streams from the facility's air pollution control scrubber systems were discharged under a NPDES permit into a series of settling ponds (the NPDES Ponds, SWMU 1) and then into the Columbia River. The scrubber system effluent was historically combined with the plant's other industrial discharges (e.g., cooling water, storm water run-off and treated sewage) as well as the secondary smelter scrubber effluent stream. These combined discharges were then discharged to the Columbia River at the NPDES outfall.

The NPDES Ponds occupy a natural drainage east of the Boat Basin, and consist of a series of settling ponds that have been closed and subsequently remediated (refer to Figure 7.1-1). The associated piping for the permitted NPDES outfall, as well as a water supply pipeline for the plant is also located within the NPDES ponds drainage. The water supply intake is located upstream of the NPDES Outfall.

The permit conditions have been modified several times during the long period of operation of the facility to reflect changes in the wastewater discharge regulations, plant operations, air pollution controls, and associated wastewater treatment.

The NPDES Permit (No. WA 000054-0), effective June 1, 2002, was issued to allow the discharge of treated scrubber water to the Columbia River. Industrial wastewater and stormwater effluent limits and/or monitoring were included in the permit for aluminum, TSS, fluoride, oil and grease, benzo(a)pyrene, antimony, nickel, arsenic, pH, temperature, and flow. This permit was later re-issued on April 1, 2008, modified on March 30, 2012, and was scheduled to expire on May 1, 2013 (Ecology 2012). However, Ecology and NSC are reportedly still in discussion regarding the modified permit, which remains in effect at the time of this Work Plan.

In 2010, Lockheed Martin cleaned up the NPDES Ponds and associated discharges as part of an independent cleanup action (ARCADIS 2011a). A bypass pipeline was constructed in May 2012 to

route stormwater around the former ponds. Currently, active discharges to the Columbia River are limited to stormwater and treated sewage as the plant ceased operations during 2003.

The NPDES outfall is located about one mile upstream from the John Day Dam and consists of a 30-inch diameter coated steel pipe which splits into three ports (ENSR 1997). The 30-inch outfall pipe enters the river at a 70-degree angle to the river flow and extends about 295 feet from the shoreline before branching into three 24-inch diameter coated steel discharge pipes. The three pipes terminate in 8-inch diameter diffuser ports in a coaxial configuration with the downstream arm approximately 95 feet long and the upstream arms 60 and 40 feet long, respectively (Appendix B-1). The depth of the Columbia River in the vicinity of the outfall is about 29 feet under low flow conditions.

The mixing zone boundaries (as determined by the ENSR 1997 study) extend 329 feet downstream of the furthest downstream port and 100 feet upstream of the furthest upstream port. The width of the mixing zone represents 25 percent of the width of the river and extends 1,035 feet south from the Washington shoreline (ENSR 1997; Appendix B-1).

7.1.2 Past Environmental Sediment Investigations

This section summarizes past environmental investigations of the Columbia River sediments in the site vicinity. Most of the studies were performed to meet the requirements of the NPDES permit. Three regional studies that included the reach of the Columbia River in the site vicinity are also discussed in the following sections. Historical sediment sampling stations associated with these investigations are shown in Figure 7.1-1.

Surface water samples were collected during some of these historical investigations, but are not presented in detail because they are not representative of current conditions.

7.1.2.1 1985 Sediment and Water Quality Survey

Sediment and water quality were characterized in 1985 as a requirement of the NPDES permit (JUB Engineering 1985). The work included sediment sampling of NPDES Ponds A, B, C, and D, areas upstream (one sampling station 7NMFS), proximal to (two sample stations 7.1 and 7.3), and downstream of the NPDES outfall (two sample stations one inside and outside of the Boat Basin)

for select PAHs and metals (Cu, Zn, Cd, Pb, Sb, Al, Ni). Results for the chemical analyses of the sediment are summarized in Section 7.1.4 and Appendix B-1.

No sludge accumulation was observed near the NPDES outfall. According the report, there were very little differences in chemical concentrations noted between the upstream background location and sediment samples collected near and downstream of the NPDES outfall.

A dye study was performed as part of this investigation to determine the dilution within the mixing zone. The range of reported dilution ratios were 70:1 to 170:1.

7.1.2.2 1986 Columbia River Sediment Study

A 1986 report (Damkaer and Dey 1986) evaluated potential effects of point and non-point source industrial waste discharges on the Columbia River. The 1986 report included characterization of sediments in the area of the John Day Dam near the Columbia Gorge Aluminum Smelter Site. The samples were collected during 1982. As shown in Figure 7.1-1, collected samples included two sediment samples near the Boat Basin (L1 and L2), two samples at upstream stations (Station 2 and Station 4) and four samples at or near Station 10. The samples were analyzed for select PAHs. Results are summarized in Section 7.1.3 and Appendix B-1.

7.1.2.3 1994 Baseline Sediment Characterization

The 1994 baseline sediment characterization (ENSR 1994) included sampling of 4 surface sediment samples within the mixing zone, one composite sample from the northern boundary of the restricted area, and one upgradient background reference sample from three miles upstream of the diffuser near Towal, Washington (refer to Appendix B-1 and Figure 7.1-1). The upstream sample was reported collected from an area of similar bathymetry and water depth as the other test samples. Coordinates and lithology of the sediments were obtained (Appendix B-1). The samples were collected with a modified van Veen sampler.

Static acute toxicity tests (Hyalella Azteca freshwater sediment test) and microtox toxicity tests were conducted to determine the toxicity of bulk sediment to marine luminescent bacteria (Photobacterium phosphorem, Microx assay). One of the sediment samples within the mixing zone (Sample D) exhibited acute toxicity for Hyalella. None of the sediment samples were toxic at the highest test concentration for the Microtox test.

The sediments were also tested for sediment conventionals including: ammonia, total sulfide, total solids, and particle size. Ammonia concentrations ranged from 4.1 mg/kg to 160 mg/kg, total sulfide ranged from 4.0 mg/kg to 119 mg/kg, total solids ranged from 27.5 percent to 68.4 percent, and total organic carbon was low and ranged from 0.24 to 2.05 percent. The test sediment consisted of very fine to medium sand with a significant fraction of silt and clay. Two samples (Sample F and the background station) were predominantly silt and clay).

The sediments were also analyzed for the following chemical of potential concern including: total cyanide, cyanide amenable to chlorination, fluoride, PAHs, metals (aluminum, antimony, arsenic, cadmium, barium, beryllium, chromium, cobalt, copper, lead, manganese, mercury, nickel, silver, zinc), and oil and grease. Results for the chemical analyses of the sediment are summarized in Section 7.1.4 and Appendix B-1.

7.1.2.4 1997 Dilution Ratio/Mixing Zone Study

This 1997 Dilution Ratio/Mixing Zone study (ENSR 1997) provides a detailed physical description of the NPDES outfall and includes an evaluation of the mixing zone through calculation of acute mixing zone, chronic mixing zone, and human-health based dilution ratios for carcinogenic substances. A compliance check with state water quality acute, chronic, and human-health based criteria as well as a reasonable potential analysis was performed. The acute mixing zone dilution ratio, chronic mixing zone dilution ratio, and human health dilution ratio for carcinogenic substances were calculated to be 13.4 to 1, 69.6 to 1, and 81.6 to 1, respectively. The mixing zone area is included in Appendix B-1.

Outfall effluent data for 1993 to 1996 were evaluated for aluminum, antimony, benzo(a)pyrene, and nickel to determine compliance with Washington State water quality standards. For each chemical, the effluent concentration at the acute and chronic mixing zone boundaries was calculated using the dilution ratios to determine if water quality standards would be exceeded at the zone boundaries. For benzo(a)pyrene, a carcinogenic PAH, a human health screening level of 0.0028 µg/L was used. The maximum detected concentration of the effluent was used in the calculations and screening comparison. None of the chemicals exceeded the screening standards.

A reasonable potential analysis was performed to assess whether the discharge has a reasonable potential to cause an exceedance of an applicable descriptive or numeric water quality criterion. The

reasonable potential analysis was conducted by determining the effluent's reasonable potential multiplier (a statistical parameter that considers the number of data points and the degree of data variability) and multiplying it by the maximum observed effluent concentration. This product is then divided by the applicable dilution ratio to determining the maximum receiving water concentration predicted to occur at the edge of the mixing zone. In all cases, the maximum receiving water at the edge of the mixing zone was below the water quality screening standards and none of the chemicals was seen to have a reasonable potential to exceed state water quality standards.

An outfall inspection/dive survey was performed on October 21, 1996 (ENSR 1997). Very limited visibility was present throughout the dive due to suspended sediment and other particulates in the water column. No variances from the as-built specifications of the piping were observed. The outfall piping was observed to be intact and the port openings were completely free from obstruction. A 20-foot section of the outfall pipe located about 100 feet from the shoreline was buried by gravel. Beyond this section, the pipe remained clear of sediment except for a thin (less than 1/2-inch) coating of silt.

Sediment samples were not collected during the 1997 mixing zone evaluation study.

7.1.2.5 2005 Hanford Sediment Survey

A multi-agency study (WSDOH et al. 2005) of four reservoir pools of Columbia River (upstream of McNary Dam, John Day Dam, The Dalles Dam and Bonneville Dam) that are downriver from Hanford site operations was conducted in 2005. The overall purpose was to characterize radiological and chemical conditions existing in the upper-level sediment deposited behind (upstream) of the dams. Beach sediment was also sampled where available. The program focused on radionuclides associated with Hanford operations. Additional chemical groups were also analyzed as part of the investigation and included COPC for the Columbia Gorge Aluminum Smelter Site: PAHs, PCBs, and metals. Three sample stations were included for the Columbia River upstream of John Day Dam. Sample results are discussed in Section 7.1.4 and the sample stations are shown on Figure 7.1-1. Sample results are also included in Appendix B-1.

Simultaneously extracted metals/acid-volatile sulfides (SEM/AVS) was also performed during the 2005 sediment survey. Acid volatile sulfide is an important binding phase for divalent metals in sediment (WSDOH et al. 2005). Metal sulfide precipitates are typically very insoluble, which limits

the amount of dissolved metal available in the sediment pore-water. For an individual metal, when the amount of AVS exceeds the amount of the metal (i.e., the SEM/AVS molar ratio is below one), the metal concentration in the sediment pore-water will be low. Samples from John Day Dam were characterized by an average SEM/AVS below one indicating a low potential for dissolved metals in sediment.

7.1.3 Summary of Sediment Quality Chemical Results

This section summarizes the available sediment quality results in the vicinity of the Columbia Gorge Aluminum Smelter Site. The sediment results have been summarized from the past environmental investigations described in the preceding section (Section 7.1.2). Historical sediment sampling stations are shown in Figure 7.1-1.

Sediment and surface water screening levels are described and summarized in Section 3.0. A variety of screening levels were selected to evaluate sediment quality in the site vicinity, including the Washington Freshwater SMS, RSET freshwater sediment screening values, and Oregon sediment screening levels protective of recreational/subsistence fish consumption.

The primary ecological and human health exposure routes to contaminated sediments include direct contact and ingestion (refer to Section 4.0). In freshwater systems, the biologically active zone is typically limited to the upper six inches, and as such represent the primary zone of anticipated exposure. Historical sediment surface sample results for the site vicinity are likely not representative of current conditions in part because of the depositional regime for Columbia River in the area, which may have resulted in burial of the historical surface sediment horizons.

7.1.3.1 Background Sediment Concentrations

Sediments are transported from areas of the Columbia River upstream of the site and deposited in the site vicinity. The John Day River also contributes sediments from upstream areas. For this reason, determination of background sediment concentrations is a necessary step in the RI data evaluation process.

Background sediment concentrations from previous investigations are summarized in Table 7.1-1, with the associated background reference sampling stations shown on Figure 7.1-1. The reported range of background concentrations for site COPC are also summarized in the sediment COPC screening Table (3-4) provided in Section 3.0.

7.1.3.2 COPC Concentrations

This section summarizes available past sediment study COPC concentrations for aluminum smelting chemicals (cyanide and fluoride), PAHs, metals, PCBs, and petroleum hydrocarbons. Table 7.1-2 and Appendix B-1 summarize the analytical results for previous sediment investigations. PCBs and petroleum hydrocarbons are summarized only in text because they are limited to a single study.

Aluminum Smelting Indicators

Cyanide and fluoride represent common indicators of contamination for aluminum smelting sites. Based on review of available literature, sediment screening levels for fluoride and sulfate have not been established. Some aluminum smelting indicators such as fluoride dissociate in water and as such have less potential to accumulate in sediments. The no observed adverse effects ecological screening level for free cyanide in freshwater sediment of 0.1 mg/kg (BTAG screening value) (USEPA 2014b) was used for screening purposes.

Cyanide and fluoride were analyzed for during the 1994 Baseline Sediment Characterization Study (ENSR 1994). Total cyanide was not detected in any of the collected samples, but the reporting limit (0.8 mg/kg) was above the free cyanide sediment screening level of 0.1 mg/kg. Fluoride was detected in all 6 samples at concentrations ranging between 268 mg/kg and 1,100 mg/kg with the highest concentrations detected at sample Station A, the upstream background sample collected near the John Day River confluence. No sediment screening levels have been established for fluoride.

PAHs

PAHs represent a primary site COPC and have been detected within Columbia River and Boat Basin sediments. The detection of PAHs has included historical upstream (background) sediment sampling stations based on results of past studies.

Table 7.1-1
Columbia River Historical Background Sediment Sample Results

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Analytes (mg/kg)	Sediment Quality Studies			
	JUB Engineers (1985)	Damkaer and Dey (1986)	ENSR (1994)	WSDOH et al. (2005)
	Background Station Locations			
	Station 7NMFS	Station 2	Station A	John Day Dam Midway and OR Shore
Aluminum Smelting Indicators				
Total cyanide	NA	NA	<0.8	NA
Fluoride	NA	NA	1,100	NA
Polycyclic Aromatic Hydrocarbons (PAHs)				
Acenaphthene	NA	<0.00073	<0.02	<0.330
Acenaphthylene	NA	NA	<0.02	<0.330
Anthracene	0.09	<0.00085	<0.02	<0.330
Benzo(g,h,i)perylene	<0.1	NA	<0.2	NA
Fluoranthene	NA	0.049	0.083	<0.330
Fluorene	<0.02	<0.00082		<0.330
1-Methylnaphthalene	NA	<0.00040	NA	NA
2-Methylnaphthalene	NA	<0.00085	<0.02	NA
Naphthalene	0.5	<0.00076	<0.02	<0.330
Phenanthrene	0.4	0.016	0.027	<0.330
Pyrene	1	0.049	0.077	<0.330
Benzo(a)pyrene	0.7	0.019	0.2	<0.330
Benzo(a)anthracene	1	0.02	0.2	<0.330
Benzo(b)fluoranthene	NA	NA	0.4	<0.330
Benzo(k)fluoranthene	NA	NA	0.4	<0.330
Chrysene	0.8	0.039	<0.2	<0.330
Dibenz(a,h)anthracene	<0.1	0.0074	<0.2	<0.330
Indeno(1,2,3-cd)pyrene	NA	NA	<0.2	NA
Polychlorinated Biphenyls (PCBs)				
Total Aroclors	NA	NA	NA	ND
1016	NA	NA	NA	<0.033
1221	NA	NA	NA	<0.067
1232	NA	NA	NA	<0.033
1242	NA	NA	NA	<0.033
1248	NA	NA	NA	<0.033
1254	NA	NA	NA	<0.033
1260	NA	NA	NA	<0.033
Metals				
Aluminum	27,000	NA	65,300	19,000-22,000
Arsenic	NA	NA	18.4	8.6-9.9
Cadmium	2.8	NA	7.8	2.02-2.5
Chromium	NA	NA	52	27-69.3
Copper	52.0	NA	36	35-46
Lead	39.8	NA	76.8	23-27
Mercury	NA	NA	0.15	NA
Nickel	36.0	NA	35	25-32
Selenium	NA	NA	NA	0.477-1.5
Silver	NA	NA	0.5	0.433-3
Zinc	396	NA	314	250-270
Total Petroleum Hydrocarbons (TPHs)				
Oil and Grease	NA	NA	165	NA

NA Not analyzed.
<50 Chemical was not detected. The associated value represents the reporting limit.

Table 7.1-2
Columbia River Historical Sediment Quality Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Concentrations reported in mg/kg dry-weight)

Analyte (mg/kg)	Freshwater Sediment Screening Levels				Sediment Quality Studies																				
					JUB Engineers (1985)					Damkaer and Dey (1986)								ENSR (1994)						Washington State Department of Health (WSDOH) et al. (2005)		
					Sample Date: 1985					Sample Date								Sample Date: November 1993						Sample Date: 2003		
										04/24/82	04/24/82	4/24/1982-1	4/24/1982-2	06/11/82	06/11/82	06/11/82	06/11/82									
	Washington SMS Freshwater[a]		2006 RSET Sediment Quality Screening Levels Freshwater[b]	Oregon Human Health Sediment Screening Levels[c]	Dilution Zone	Dilution Zone	Outside Boat Basin	Inside Boat Basin	Background							L1 (East Lagoon)	L2 (West Lagoon)	A (3 miles upstream)	B (diffuser)	C (diffuser)	D (diffuser)	E (diffuser)	F (near dam)	John Day WA Shore	John Day Midway	John Day OR Shore
	SCO	CSL	SL1		7.1	7.3			7NMFS	Station 2	Station 4	Station 10	Station 10	Station 10	Station 10											
Aluminum Smelting Indicators																									
Total Cyanide	NA	NA	0.1[d]	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.8	<0.8	<0.8	<0.8	<0.8	<0.8	NA	NA	NA
Total Fluoride	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1,100	264	261	239	288	308	NA	NA	NA
Polycyclic Aromatic Hydrocarbons																									
2-Methylnaphthalene	NE	NE	0.47	NE	<0.02	<0.02	<0.02	<0.02	<0.02	<0.00085	<0.00085	0.0057	0.0061	0.018	0.013	0.02	0.0097	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	<0.33	<0.33	<0.33
Acenaphthene	NE	NE	1.1	NE	<0.02	<0.02	<0.02	<0.02	<0.02	<0.00073	<0.00073	0.016	0.013	0.008	0.0056	0.11	0.055	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.33	<0.33	<0.33
Acenaphthylene	NE	NE	0.47	NE	<0.02	<0.02	<0.02	<0.02	<0.02	NA	NA	NA	NA	NA	NA	NA	NA	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.33	<0.33	<0.33
Anthracene	NE	NE	1.20	NE	0.04	0.09	0.02	0.09	0.09	<0.00085	<0.00085	0.14	0.14	0.037	0.016	0.2	0.088	<0.02	<0.02	0.006	0.014	0.008	<0.02	<0.33	<0.33	<0.33
Benzo(a)anthracene	NE	NE	4.3	NE	0.6	2.0	0.3	1.0	1.0	0.02	0.0043	1.5	2.0	0.28	0.1	1.2	0.72	<0.2	<0.2	<0.2	0.06	<0.2	<0.2	<0.33	<0.33	<0.33
Benzo(a)pyrene	NE	NE	3.3	NE	0.8	2.8	0.3	0.09	0.7	0.019	0.0047	1.7	2.1	0.27	0.15	1.2	0.72	<0.2	<0.2	0.06	0.08	0.07	<0.2	<0.33	<0.33	<0.33
Benzo(b)fluoranthene	NE	NE	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(k)fluoranthene	NE	NE	NE	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(b+k)fluoranthene	NE	NE	1	NA	<0.4	<0.4	<0.4	<0.4	<0.4	NA	NA	NA	NA	NA	NA	NA	NA	<0.4	<0.4	0.19	0.19	0.12	<0.4	NA	NA	NA
Benzo(g,h,i)perylene	NE	NE	4.0	NE	0.8	2.0	0.3	0.2	<0.1	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	<0.2	<0.2	<0.2	0.08	<0.2	<0.33	<0.33	<0.33
Chrysene	NE	NE	5.9	NE	0.7	3.0	0.3	1.0	0.8	0.039	0.012	4.0	5.8	0.78	0.31	2.1	1.5	<0.2	<0.2	<0.2	0.07	<0.2	<0.2	<0.33	<0.33	<0.33
Dibenz(a,h)anthracene	NE	NE	0.8	NE	**1.5**	**2.2**	<0.1	<0.1	<0.1	0.0074	<0.0019	0.63	0.7	0.14	0.094	0.43	0.28	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.33	<0.33	<0.33
Fluoranthene	NE	NE	11.0	510/62	0.6	0.6	0.4	0.6	1.5	0.049	0.013	1.1	1.2	0.34	0.14	2.0	1.4	0.083	0.058	0.071	0.07	0.052	0.095	<0.33	<0.33	<0.33
Fluorene	NE	NE	1	NE	<0.010	<0.010	<0.01	<0.02	<0.02	<0.82	<0.00082	0.023	0.02	0.013	0.0082	0.078	0.044	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	<0.33	<0.33	<0.33
Indeno(1,2,3-c,d)pyrene	NE	NE	4	NE	<0.2	<0.2	<0.2	<0.2	<0.2	NA	NA	NA	NA	NA	NA	NA	NA	<0.2	<0.2	0.09	0.08	0.1	<0.2	<0.33	<0.33	<0.33
Naphthalene	NE	NE	0.5	NE	0.2	<0.080	<0.1	<0.2	**0.5**	<0.76	<0.00076	0.013	0.012	<0.0005	<0.0005	0.042	0.029	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	<0.33	<0.33	<0.33
Phenanthrene	NE	NE	6.1	NE	0.3	0.25	0.1	0.5	0.4	0.016	0.014	0.23	0.23	0.1	0.066	0.83	0.46	0.027	0.018	0.024	0.028	0.019	0.032	<0.33	<0.33	<0.33
Pyrene	NE	NE	8.8	380/47	0.6	0.8	0.3	1.0	1.0	0.049	0.014	1.1	1.2	0.36	0.15	2.3	1.5	0.027	0.018	0.024	0.028	0.019	0.032	<0.33	<0.33	<0.33
Total PAHs	17	30	NE	ne	6.14	13.74	2.02	5.29	5.99	0.199	0.062	10.458	13.421	2.346	1.053	10.51	6.806	0.187	0.130	0.505	0.651	0.494	0.210	<0.33	<0.33	<0.33
Metals																										
Aluminum	NE	NE	NE	NE	20,000.00	19,000.00	18,000.00	16,000.00	27,000.00	NA	NA	NA	NA	NA	NA	NA	NA	65,300	54,200	55,500	51,800	56,400	64,000	18,000	19,000	22,000
Arsenic	14	120	20	(7) Background	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.0	<1.0	1.0	<1.0	<1.0	3.0	**7.4**	**8.6**	**9.5**
Cadmium	2.1	5.4	1.1	(1) Background	**1.2**	0.9	**1.1**	0.5	**2.8**	NA	NA	NA	NA	NA	NA	NA	NA	**7.8**	0.7	**1.3**	0.8	0.6	**7.6**	**2.4**	**2.3**	**2.5**
Chromium	72	88	95	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	52	36	32	39	39	52	25	27	30
Copper	400	1,200	80	NE	31	35	35	39	52	NA	NA	NA	NA	NA	NA	NA	NA	36	8.0	13	11	8.0	42	34	35	46
Lead	360	<1300	340	(17) Background	**23.3**	11.6	**22.8**	**19.50**	**39.8**	NA	NA	NA	NA	NA	NA	NA	NA	**76.8**	**21.8**	**26.8**	**24.7**	**19.1**	**82.5**	**22**	**23**	**27**
Mercury (inorganic)	0.66	0.8	0.28	(0.07) Background	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	**0.15**	0.03	0.04	0.02	<0.01	**0.16**	**0.28**	**0.30**	**0.29**
Nickel	26	110	60	NE	**49**	**32**	**31**	**35.7**	**36**	NA	NA	NA	NA	NA	NA	NA	NA	**35**	18	18	21	20	**34**	24	25	**29**
Selenium	11	<20	NE	(2) Background	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	1.6	1.5	1.5
Silver	0.57	1.7	2	NE	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	<0.5	<0.5	<0.5	<0.5	<0.5	**1.3**	**2.8**	**3.0**	**2.9**
Zinc	3,200	<4200	130	NE	**168**	**233**	**204**	**259**	**396**	NA	NA	NA	NA	NA	NA	NA	NA	**314**	98	115	108	85	**301**	**240**	**250**	**270**

a 2013 Washington State Freshwater Sediment Management Standards (SMS): SCO = Sediment Cleanup Objective; CSL = Cleanup Screening Level; SCUM = Sediment Cleanup User's Manual (SCUM) II Tables.
b 2009 Regional Sediment Evaluation Team (RSET) screening levels for freshwater sediments (Sediment Evaluation Framework for the Pacific Northwest). SL1 = No effects screening value.
c 2007 State of Oregon Sediment Screening Level values for recreational and subsistence fish consumption.
d Free Cyanide screening level represents an ecological no observed adverse effects level compiled by the EPA Region III Biological Technical Assistance Group (BTAG) (USEPA 2014a).

Notes:
NA Not Analyzed
NE Not established in Look-up Tables
Bolding/Shading indicates exceedance of at least one screening level.
<50 The chemical was not detected. The associated value represents the reporting limit.

Total PAHs do not exceed Washington SMS freshwater screening levels in any of the previously collected sediment samples. The RSET screening level for dibenz(a,h)anthracene of 0.8 mg/kg was exceeded in two samples (Dilution Zone samples 7.1 and 7.3) collected from the dilution zone in 1985 (refer to Table 7.1-2). For this same 1985 investigation, the concentrations of indeno(1,2,3-cd)pyrene in upstream background reference station 7NMFS equaled the RSET screening level of 0.5 mg/kg. This chemical was not detected in 4 of the 5 downstream samples. Detected concentrations of fluoranthene and pyrene did not exceed the Oregon human health fish consumption screening levels established for these chemicals in any of the historical sediment samples (refer to Table 7.1-2 and Figure 7.1-1).

PCBs

PCB data is limited to three stations spanning the Columbia River across from the site (WSDOH et al. 2005). PCBs were not detected in any of the samples; however the reporting limits were above the Oregon human-health sediment screening PCB values for fish consumption (0.00039 mg/kg).

Petroleum Hydrocarbons

Oil and grease were analyzed for in 5 sediment samples collected during the 1994 baseline characterization (ENSR 1994). Oil and grease were detected in all 5 of the samples (stations A through F) at concentrations ranging between 5 mg/kg and 165 mg/kg (ENSR 1994). Highest concentrations were detected at the background reference station (Station A) that is located about three miles upstream. Washington SMS TPH sediment screening levels include those for diesel-range TPH and heavy oil-range TPH. The oil and grease chemical analyses measure a wider spectrum of petroleum hydrocarbons and are not considered as accurate as TPH analytical testing. However, the detected concentrations of oil and grease are lower than any of the Washington SMS TPH screening levels.

Metals

Several metals were detected at concentrations above both ecologic and Oregon human health fish consumption sediment screening levels (refer to Table 7.1-2 and Figure 7.1-1). Note that several of the Oregon human health sediment screening levels for fish consumption for metals are based on background concentrations because the risk-based calculations resulted in screening levels lower than background concentrations.

In all cases, the elevated concentrations exceeding sediment screening levels were detected in both upstream background sampling stations as well as stations proximal and downstream of the NPDES outfall and the former smelter. The following metals were found to exceed one or more sediment screening levels: arsenic, cadmium, lead, mercury, nickel, silver, and zinc. Of these, only antimony, arsenic, and nickel have been included in the NPDES discharge criteria, and based on initial review of the historical waste data only nickel and lead appears to have been found in elevated concentrations in ESI and/or WSI sludges (Ecology 1989).

7.1.4 Sediment AOC Data Gaps and Data Needs

The results of past investigations of sediments in the Columbia River and Boat Basin show low level detections of PAHs and some metals above certain current sediment screening levels. However, these results were generally collected about 10 to 30 years ago during the period of former plant operations. The past studies were also performed with varying objectives and program goals and not designed to address all potential site transport pathways and potential COPC.

The following data gaps and data needs have been identified:

- Information and/or data regarding sediment transport in Boat Basin and the reach of the Columbia River near the site (e.g., depositional rate, areas of re-suspension, degree of connection and circulation, and potential dredging areas).

- Current sediment quality data for surface (0-6 inch) sediments in the Boat Basin and Columbia River near the site to determine existing conditions for site COPC.

- Data and information on potential sediment contaminant sources (e.g., sheet flow, springs, groundwater, and intermittent drainages) to determine current conditions for site COPC, and evaluate potential transport pathways to Columbia River sediment.

- Further characterization and evaluation of background sediment concentrations for site COPC to determine current conditions.

7.2 GROUNDWATER IN THE UPPERMOST AQUIFER

This section summarizes site hydrogeologic conceptual model, site hydrogeology, and COPC concentrations in site groundwater. Data gaps and data needs for the RI are summarized at the end of the section.

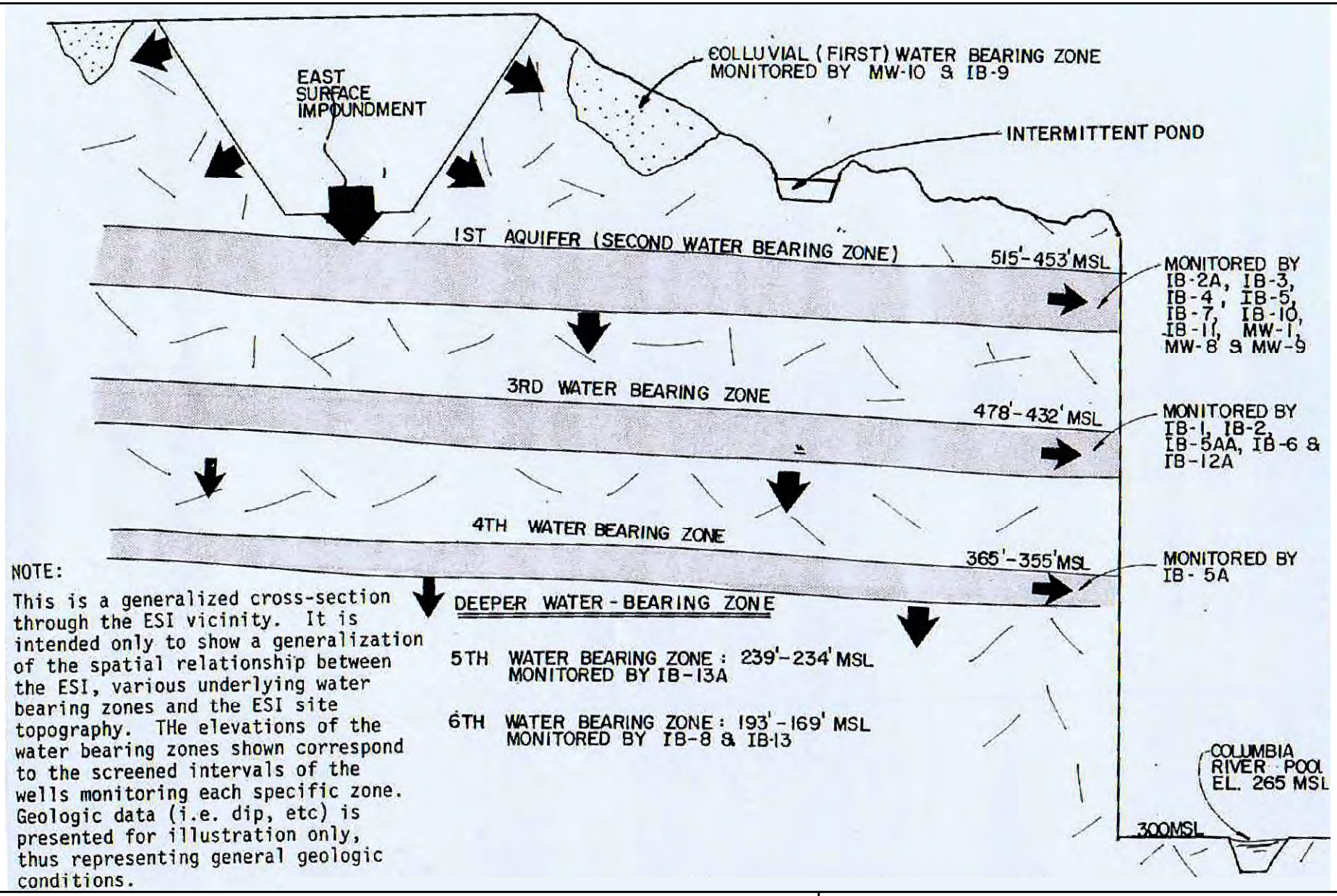
7.2.1 Past Hydrogeologic Interpretations

Several investigations of site groundwater have been performed at the site since the mid-1980s. The hydrogeologic conceptual understanding of the site has been presented in investigation reports for the ESI (Century 1986; Century West 1985a,b Geraghty & Miller 1986), the WSI (Golder 1988, Century West 1985a,b), and more recently site-wide investigation reports (URS 2009, 2011). These reports were focused on either groundwater flow in particular areas of the site or on specific aquifer zones. For example, the ESI and WSI reports focused on the eastern and western portion of the site, respectively, and the site wide investigations focused on characterization of deeper water-bearing zones in the basalt bedrock. None of these reports presented a summary of the groundwater flow for the entire site, but are summarized for context.

7.2.1.1 East Surface Impoundment Hydrogeology

Six water-bearing zones were identified in the colluvium and basalt near the ESI (Geraghty & Miller and Century 1986). Figure 7.2-1 summarizes the past hydrogeologic conceptual model in the ESI site vicinity. The reports indicate that some water-bearing zones, particularly within the basalt, may not represent true aquifers.

Groundwater flow within the colluvial aquifer and the uppermost zone in the basalt was reportedly to the south and west toward the Columbia River and generally consistent with area topography. Past reports have stated that static water level measurements indicate that the groundwater in the colluvial water-bearing zone may actually be an expression of the water table in the first basalt water-bearing zone (Geraghty & Miller and Century 1986). The vertical gradient within the basalt bedrock water-bearing zones was consistently downward.



Source: Century 1986

Figure 7.2-1
East Surface Impoundment
Hydrostratigraphic Conceptual Model

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Changes in conditions and identified uncertainties with respect to the ESI hydrogeologic model include the following:

- Changes in site conditions since 1986 when the hydrogeologic conceptual model was developed have likely affected hydrogeologic conditions at the site. Discharges at the ESI permanently ceased in June 1985, which substantially reduced the amount of water infiltrating into the basalt bedrock at the site. Closure and capping of the ESI occurred in 1987, which further reduced infiltration. The intermittent pond located west of the ESI was addressed though backfilling and construction of an engineered drainage, which reduced the amount of ponding and infiltration near the ESI.

- In the late 1980s and early 1990s, there was concern by Ecology that the wastes within the ESI had been seasonally below the water table elevation for the uppermost aquifer that would serves as a source of continued leaching of wastes into shallow groundwater. However, a subsequent investigation (Geraghty & Miller 1992) showed that the wastes were no longer submerged seasonally and chemical concentration in groundwater were shown to have significantly declined within a few years of closure and capping of the site (Technico Environmental Services 1988).

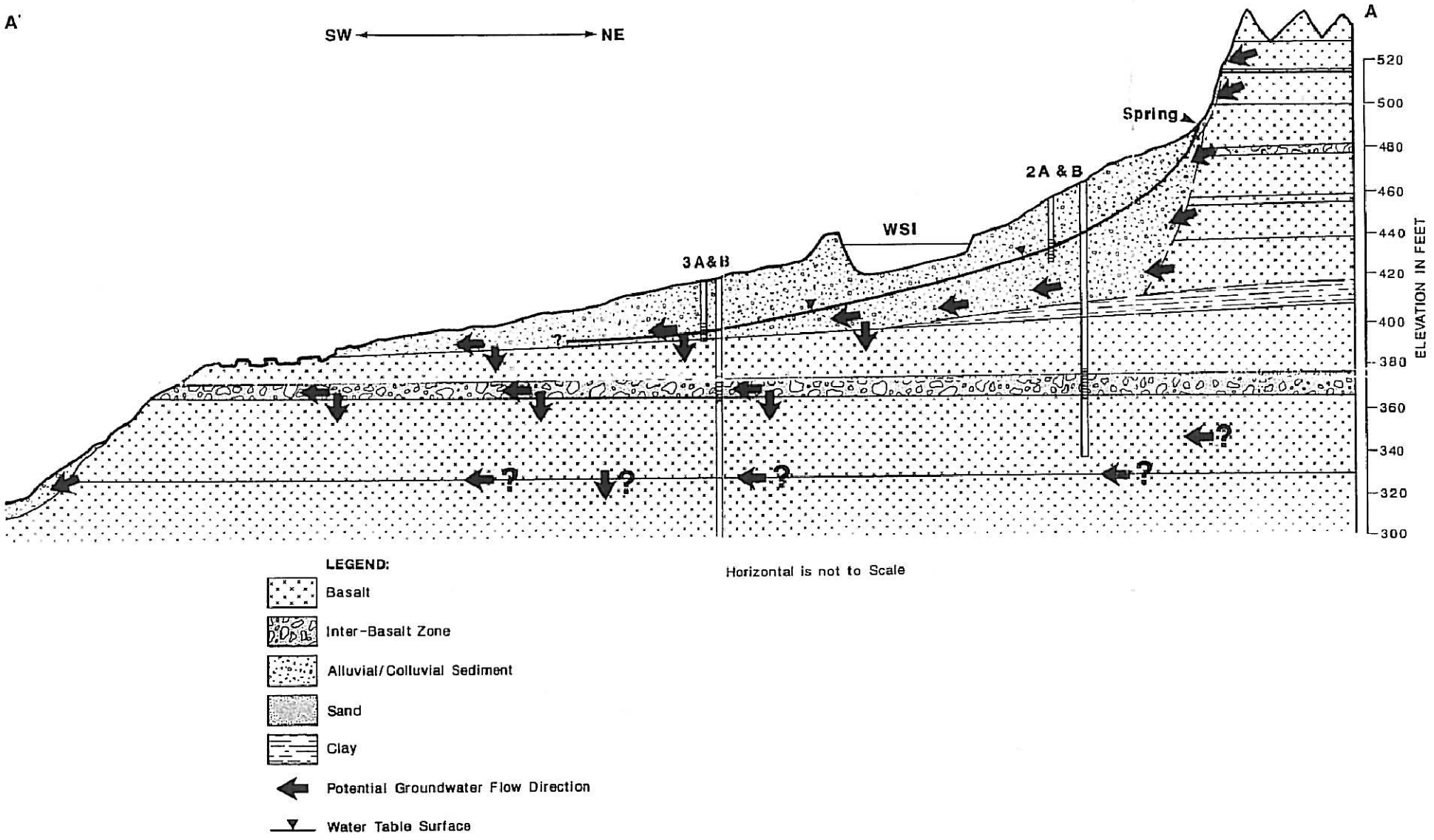
- From the reports and review of the borings logs, it doesn't appear that all of the water-bearing zones within the basalt at the ESI represent laterally continuous interbed/interflow zones. In some cases, the wells have become dry, in others only one or two wells were used to establish the presence of the zone, and when viewed on a site-wide basis the water-levels for particular vertical zones appear to be similar enough to combine.

- Groundwater flow within the deeper basalt zones was radial around the ESI (Century 1986), which is inconsistent with the groundwater flow direction for the colluvial aquifer and shallowest basalt water-bearing zone, site topography, or the overall concept of groundwater flow laterally to the Columbia River to the southwest. It is uncertain whether this apparent flow pattern is caused by the larger amount of recharge that was present in the mid-1980s within a few years of pond closure, or assignment of wells into aquifer zones that did not accurately represent the potentiometric surface.

These changes in conditions and uncertainties are taken into consideration in the further development of the overall site groundwater conceptual model.

7.2.1.2 West Surface Impoundment Hydrogeology

The WSI hydrogeologic conceptual model was originally presented in Golder (1988) and is presented in Figure 7.2-2. Based on the Golder (1988) report, the WSI is directly underlain by alluvial sands and gravels in the western half and by colluvial boulders, sand, silt and clays in the eastern half. The thickness of the unconsolidated deposits ranged from 38 to 70 feet in the vicinity



Source: Golder 1988

Figure 7.2-2

Conceptual Hydrogeological Model
West Surface Impoundment Monitoring Network

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

of the WSI. The uppermost aquifer was determined to occur in unconsolidated deposits and flow in the unconsolidated aquifer was found to be generally to the south to southwest. Groundwater in the uppermost unconsolidated aquifer was expected to discharge through basalt fractures to the lower fractured basalt aquifer as the groundwater moves through the unconsolidated material along the top of the uppermost basalt stratum.

A second water-bearing zone was encountered in a fractured and vesicular interflow zone about 14 to 28 feet below the weathered top of the top of the basalt bedrock. The interflow zone was about 3 to 10 feet thick. Groundwater flow in the interflow basalt water-bearing zone was reportedly to the southwest to west. Golder (1988) noted the presence of other water bearing zones in fractured zones and vesicular tops of the basalts below the second water-bearing zone at the WSI. The vertical hydraulic gradient appears to be downward among the uppermost water bearing zones (Golder 1988, Parametrix 2007). The two-year post-closure groundwater evaluation (Parametrix 2007) and 2014 annual groundwater monitoring report (GeoPro 2014) both state that the unconsolidated aquifer occurs under unconfined conditions while the basalt aquifer zone is characterized by confined conditions.

7.2.1.3 Site-Wide Groundwater Investigation Basalt Hydrogeology

A site-wide groundwater investigation was conducted during 2009-2010 (URS 2009, 2011), which included characterization of the lower basalt aquifer zone at the site during 2010. Prior characterization of these zones was limited.

The hydrogeologic conceptual model presented by URS (2009, 2011) includes the Unconsolidated Aquifer (UA) and a Basalt Aquifer (BA). A key difference between the site-wide investigation and prior investigations is that there is not a clearly defined set of distinct laterally continuous water-bearing zones within the basalt across the site, and for this reason the basalt aquifer was considered as a single hydrostratigraphic unit. The UA is described as a colluvial aquifer that is more continuous in the western portion of the site than the eastern portion of the site. The topography and geometry of the basalt bedrock surface underlying the UA was thought to influence the occurrence and flow of groundwater within the UA with groundwater flowing through UA-sediment-filled depressions, and scour channels.

Under the URS (2009, 2011) site-wide investigation conceptual model, there is a strong downward gradient and a potential downward component of groundwater flow through the BA to a base level corresponding to surface water elevation of the Columbia River.

The site-wide investigation notes that there is a strong vertical downward gradient within the basalts down to the surface water elevation of the Columbia River at an elevation of approximately 257 to 268 feet MSL (Columbia Basin Research 2014), and that near this elevation the vertical gradient becomes significantly less steep. The Columbia River surface elevation was conceptualized as a constant head boundary for the basalt aquifer system, and representing the discharge point for Basalt aquifer groundwater. The URS (2009, 2011) conceptual model also states that since the elevation of the Columbia River is significantly lower downstream of the dam, the base elevation of the BA may be lower in western portion of the site than the eastern portion.

The existing well network evaluation and current hydrogeological understanding are summarized in Sections 7.2.2 and 7.2.3, respectively.

7.2.2 Existing Well Network Evaluation

The existing well network has been identified primarily based on the well inventory performed in 2009 as part of the site-wide groundwater investigation (URS 2009, 2011). Well construction, well location, and water level information was compiled in an Access data base prepared by URS (2011). The data base represents a compilation of information from the Ecology well log database, site project files, and other Ecology files. The compiled well information included well construction data and water levels through the 2010 site-wide investigation. The original database has been updated including: well screen lithology, notes, and post-2010 water level information for the WSI (GeoPro 2014).

Well location and well construction information is summarized in Table 7.2-1 and Table 7.2-2, respectively (URS 2009, 2011). Well construction and lithologic information from the Washington State On-line Well Log Viewer, as well as several historical groundwater investigation reports including cross-sections were used to help confirm well construction details and reconcile inconsistencies. The available compiled well logs and well construction diagrams are included in Appendix B-2.1, and historical cross-sections are included in Appendix B-2.2.

Table 7.2-1
Existing Well Identification and Elevation Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, WA
Page 1 of 2

Well Identification	Ecology Well Log No.	Well Location (NAD83')		Ground Surface Elevation (ft-NGVD88')	Top of Well Casing Elevation (ft-NGVD88')
		Northing	Easting		
Monitoring Wells					
ESI Vicinity					
ESI-1		1592845.5	147148.97	524.4	NF
IB-1	138187	1591849.7	146594.95	518.2	519.60
IB-10	138182	1593869.9	146600.50	518.4	519.78
IB-11	136408	1594534.8	147023.54	517.6	518.99
IB-12A	138185	1592393.6	146612.30	510.0	513.53
IB-13	138180	1593639.0	145707.74	328.0	329.89
IB-13A	138180	1593639.0	145707.74	328.0	329.69
IB-2	138179	1592042.6	147613.07	516.4	517.31
IB-2A	136406	1591875.3	147544.96	512.7	513.85
IB-3	138183	1593750.7	148315.14	531.7	533.15
IB-4	136410	1593586.4	147423.11	524.2	525.81
IB-5	138181	1592464.7	145956.71	501.5	503.26
IB-5A	138186	1592464.7	145956.71	501.4	503.04
IB-5AA	138186	1592464.7	145956.71	500.0	502.82
IB-6	138184	1591701.3	146012.82	492.1	493.25
IB-7	NF	1591798.4	145427.63	471.8	473.57
IB-8	136409	1592059.5	145411.57	460.6	462.36
IB-9	136407	1593309.1	146344.12	504.5	505.21
MW-1 **	NF	1594332.8	148747.06	538.4	541.36
MW-10 **	NF	1593063.1	146907.80	512.4	514.79
MW-8 **	NF	1592255.2	147362.38	519.3	520.92
MW-9 **	NF	1592350.8	146645.90	511.3	513.84
WSI/West SPL Vicinity					
MW-10A	138153	1585727.9	143372.84	425.0	427.95
MW-11A	296244	1585625.3	144029.68	454.0	456.21
MW-12A	138160	1585051.0	142942.35	439.0	441.38
MW-13A	138156	1585533.2	143219.83	428.0	430.09
MW-14A	138155	1585915.6	143531.53	429.0	431.65
MW-15A	296245	1586150.7	143701.39	436.0	438.47
MW-18	390596	1584732.9	141060.71	346.0	348.40
MW-2A	143048	1585435.4	144171.67	486.0	488.63
MW-2B **	NF	1585435.4	144171.67	485.0	487.69
MW-3A **	143053	1585432.1	142735.02	408.0	410.35
MW-3B **	NF	1585432.1	142735.02	408.0	410.90
MW-4A **	NF	1586246.1	142993.13	419.0	421.92
MW-6B **	NF	1586207.1	143936.33	452.0	454.97
MW-7B **	NF	1584958.7	143609.60	464.0	466.93
MW-8A	138157	1584970.5	143846.08	490.0	492.97
MW-9A	138158	1585321.4	143098.07	436.0	438.22
MW-16A	NF	1586266.2	144098.65	467.22	468.54
MW-17A	NF	1586466.0	144227.1	459.93	461.91
East SPL Vicinity					
MW-E7	556369	1590904.0	146693.4	498.3	497.84
EELF Vicinity					
MW-E1	NF	1590620.9	145322.78	NF	NF
MW-E1-A	556363	1590805.0	145509.59	484.0	486.60
MW-E3	556420	1591215.7	145713.85	487.1	489.88
MW-E4	556365	1591285.9	145722.37	479.8	481.89
MW-E8	556367	1591354.4	146092.30	492.0	491.69

Table 7.2-1
Existing Well Identification and Elevation Summary
Columbia Gorge Aluminum Smelter Site
Goldendale, WA
Page 2 of 2

Well Identification	Ecology Well Log No.	Well Location (NAD83')		Ground Surface Elevation (ft-NGVD88')	Top of Well Casing Elevation (ft-NGVD88')
		Northing	Easting		
WELF Vicinity					
MW-W1	556374	1587932.0	143689.82	452.7	455.11
MW-W2	556375	1588107.1	143678.91	460.9	462.81
MW-W3	556371	1588219.9	143783.97	472.4	474.53
MW-W4	556372	1588142.3	144012.36	491.6	491.65
BAMW-Designated Wells					
BAMW-1	627937	1588156.1	143733.92	466.2	468.51
BAMW-2	627933	1590676.1	145278.59	479.7	482.65
BAMW-3	627949	1591433.2	146134.86	491.4	494.07
BAMW-4	627935	1591396.2	145086.02	471.1	473.83
Production Wells					
Well #1	296437	1588174.8	144651.26	NF	NF
Well #2	296436	1591175.7	146347.32	NF	NF
Well #3	296435	1587390.3	143951.14	NF	NF

Notes and abbreviations:

The wells are grouped by area for ease of presentation only. Note that wells in the vicinity of a given SWMU are not necessarily associated with that SWMU or its monitoring program.

** Denotes change in well nomenclature (well name on construction log has been changed as indicated).

NAD83' North American Datum 83' (horizontal position).

NGVD88' National Geodetic Vertical Datum 88' (vertical position).

NF Not Found.

ESI East Surface Impoundment

WSI West Surface Impoundment

EELF East End Landfill

WELF West End Landfill

West SPL West Spent Pot Liner Storage Area

East SPL East Spent Pot Liner Storage Area

Table 7.2-2
Existing Well Construction Information Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, WA

Well Identification	Total Well Depth (ft-bgs)	Screen Interval (ft-bgs)	Static Water Level at Construction (ft-bgs)	Well Diameter (Inches)	Aquifer Designation	Screen Interval Lithology	Comment
Monitoring Wells							
ESI Vicinity							
ESI-1	14	6 - 14	DRY	2	UA	Dark gray clay, clayey silt	Completed on top of basalt with screen within sludges (Geraghty & Miller 1992).
IB-1	63	40 - 50	33	2	BAU	Fractured and broken gray basalt, vesicular near base of screen interval	Second zone within basalt at ESI (Century 1986).
IB-10	31	17 - 27	12.5	2	BAU	Gray and brown basalt, fractured and vesicular	First zone within basalt at ESI (Century 1986).
IB-11	29	14 - 24	10	2	BAU	Fractured and vesicular, black, gray hard	First zone within basalt at ESI (Century 1986).
IB-12A	64	49 - 59	13.5	2	BAU	Basalt, hard, gray	Second zone within basalt at ESI (Century 1986).
IB-13	153	135 - 140	66.07	2	BAL	Basalt, vesicular, with fractures	Fifth zone within basalt at ESI (Century 1986). Nested well with bentonite grout seal.
IB-13A	99	89 - 94	65	2	BAL	Basalt, hard, gray, with fractures	Fourth zone within basalt at ESI (Century 1986). Nested well with bentonite grout seal.
IB-2	59	44 - 54	51.6	2	BAU	Basalt, fractured brown and gray	Second zone within basalt at ESI (Century 1986).
IB-2A	23	16 - 21	5.1	2	BAU	Brown, vesicular basalt	First zone within basalt at ESI (Century 1986).
IB-3	35	20 - 30	12	2	BAU	Fractured and vesicular basalt	First zone within basalt at ESI (Century 1986). No colluvial aquifer present with basalt contact at 7 ft-bgs.
IB-4	42	12 - 22	15.7	2	BAU	Basalt medium hard, brown, some fractures	First zone within basalt at ESI (Century 1986). No colluvial aquifer present with basalt contact at 2 ft-bgs.
IB-5	25	10 - 20	16	2	BAU	Basalt gray, fractured,	First zone within basalt at ESI (Century 1986). No colluvial aquifer present with basalt contact at 3 ft-bgs.
IB-5A	145	135 - 145	58.44	2	BAL	Basalt, hard, grey with some fractures	Third zone within basalt at ESI (Century 1986). Appears to be nested well with bentonite seal between screen intervals.
IB-5AA	68	58 - 68	59.3	2	BAU	Basalt, hard, grey with some fractures	Second zone within basalt at ESI (Century 1986). Appear to be nested well with bentonite seal between screen intervals.
IB-6	62	18 - 58	DRY	2	NA	Basalt, gray to brown, fractured and vesicular	Second zone within basalt at ESI (Century 1986). Very long screen interval of 40 feet.
IB-7	25	10 -20	DRY	2	BAU	Basalt, highly fractured	First zone within basalt at ESI (Century 1986).
IB-8	306	281 - 291	193	2	BAL	Weathered, vesicular brown & black basalt	Fifth zone within basalt at ESI (Century 1986).
IB-9	15	5 - 10	5.3	2	UA	Black and brown silty sand	Colluvial (UA) Century (1986).
MW-1**	27	22 - 27	8	6	BAU	Gray and brown basalt	First zone within basalt at ESI (Century 1986). Well completed in substantially backfilled boring. No colluvial aquifer present.
MW-10**	13	8 - 13	2	4	UA	Sand, loose rock, basalt contact at base	Century West (1985).Completed at base of colluvium (UA).

Table 7.2-2
Existing Well Construction Information Summary
Columbia Gorge Aluminum Smelter Site
Goldendale, WA
Page 2 of 4

Well Identification	Total Well Depth (ft-bgs)	Screen Interval (ft-bgs)	Static Water Level at Construction (ft-bgs)	Well Diameter (Inches)	Aquifer Designation	Screen Interval Lithology	Comment
ESI Vicinity (Continued)							
MW-8**	14	9- 14	4	4	UA	Hard grey basalt and gray and broken brown basalt	Colluvial (UA) Century (1986), Completed in top of basalt (shallow perched zone).
MW-9**	16	11 - 16	6	2	UA	Broken basalt and hard gray basalt	Appears to be completed in fractured zone at top of basalt (shallow perched zone).
WSI/West SPL Vicinity							
MW-10A	26	13 - 26	15	4	UA	Silty fine sand with gravel	Bore hole below screen (26 to 40 ft-bgs) backfilled with bentonite chips.
MW-11A	29	19 - 29	20	4	UA	Sandy gravel with light brown silt	Basalt/colluvial contact at 31 ft-bgs.
MW-12A	55	40 - 55	32.5	4	UA	Silt, silty gravel light brown	Basalt/colluvial contact at 56 ft-bgs.
MW-13A	31	18.5 - 30.6	21	4	UA	Silty fine sand with gravel	Basalt/colluvial contact at 27 ft-bgs.
MW-14A	30	8.5 - 29.5	7.5	4	UA	Silty fine sand with gravel and cobbles	Basalt/colluvial contact at 26 ft-bgs. 20-foot screen interval.
MW-15A	29	12.5 - 28	10.5	4	UA	Silty fine sand and light brown silt	Basalt/colluvial contact at 25.5 ft-bgs.
MW-18	51	35 - 50	23.25	4	BAU	Fractured and weathered basalt, brown and gray	Basalt/colluvial contact at 5.5 ft-bgs.
MW-2A	55	50-55	31	2	UA	Loose, broken, basalt	MW 2A and B are nested wells, screened at different intervals. Basalt in screen interval was previously interpreted as colluvium rather than intact bedrock
MW-2B**	109	104-109	78	4	BAU	Basalt, black red, vesicular/porous	MW 2A and B are nested wells, screened at different intervals.
MW-3A**	25	20-25	22	4	UA	Sandy soil and gray basalt, hard	Well screen interval completed across colluvium/basalt contact
MW-3B**	51	46-51	22	4	BAU	Gray basalt, hard, fractured	Well was back plugged with bentonite seal from 58 to 150 ft-bgs.
MW-4A**	21	16-21	4	4	UA	Gray sand	Basalt/colluvial contact at 21 ft-bgs.
MW-6B**	50	35-40	15	4	UA	Sand and gray and brown, basalt, broken	Basalt/colluvium contact at 38 ft-bgs. Well screen is across the contact. 5-foot screen.
MW-7B**	109	104-109	82	4	BAU	Gray basalt fractured and porous/vesicular	Basalt/colluvial contact at 73 ft-bgs.
MW-8A	32	21.5 - 31.5	26	4	UA	Sand and gravel, dark brown and basalt, black	Basalt/colluvial contact at 26.5 ft-bgs. Well completed at base of colluvium and top surface of basalt (shallow perched zone.
MW-9A	35	30.5 - 35.5	32.5	4	UA	Silt, fine sand	Basalt/colluvial contact at 34.5 ft-bgs.
MW-16A	42	22 - 42	30	4	UA	Silt with sand, light brown (ML)	Basalt/colluvial contact at 44.5 ft-bgs. 20-foot screen.
MW-17A	35	15 - 35	22	4	UA	Silty sand (SM), brown and Sandy silt (SM) in bottom half of interval	Basalt contact not encountered. 20-foot screen.

Table 7.2-2
Existing Well Construction Information Summary
Columbia Gorge Aluminum Smelter Site
Goldendale, WA
Page 3 of 4

Well Identification	Total Well Depth (ft-bgs)	Screen Interval (ft-bgs)	Static Water Level at Construction (ft-bgs)	Well Diameter (Inches)	Aquifer Designation	Screen Interval Lithology	Comment
East SPL Vicinity							
MW-E7	28	18 - 28	18.5	2	UA	Gravel with sand (GP) and gray fractured basalt	7 feet of the screen interval is completed in top of fractured basalt (shallow perched water).
EELF Vicinity							
MW-E1	13	NA	DRY	2	UA	Poorly graded gravel (GP) with basalt bedrock at 8 feet	Originally intended as monitoring well, but did not encounter groundwater while drilling. Unclear if it is still present.
MW-E1-A	15	8 - 15	10	2	UA	Fractured and weathered basalt	Basalt contact at 7 ft-bgs; well completed in top of fractured basalt (shallow perched water).
MW-E3	25	20 - 25	DRY	2	UA	Poorly graded gravel (GP) and competent basalt	Groundwater not encountered during drilling. Well completed in top of fractured basalt (shallow perched water).
MW-E4	38	22 - 36	DRY	2	UA	Silty sand, poorly graded sand (SP), and basalt in bottom half	Groundwater not encountered during drilling. Well completed in top of fractured basalt (shallow perched water).
MW-E8	23	13 - 23	17	2	UA	Poorly graded gravel (GP) with basalt bedrock at 18 feet	Groundwater not encountered during drilling.
WELF Vicinity							
MW-W1	30	20 - 30	20	2	UA	Silty sand (SM)	Near toe of landfill; likely completed in colluvium rather than fill.
MW-W2	30	20 - 30	22	2	UA	Silty sand (SM) and silty gravel (GM)	Some fill material noted in shallower portion of log.
MW-W3	30	18 - 30	20	2	UA	Silty sand (SM) with gravel lens	Presence of fill noted in screen interval in boring log.
MW-W4	65	50 - 65	53.5	2	UA	Mottled Silty sand (SM)	Thick interval of coarse gravel fill noted above screen interval.
BAMW-Designated Wells							
BAMW-1	162	142 - 162	134	2	BAL	Highly fractured basalt zone	Shallow groundwater at 32 ft-bgs and 40 ft-bgs in fill/colluvium. Colluvium/basal contact at 40 ft-bgs. Well completed in first water within the basalt formation.
BAMW-2	240	220 - 240	219, static water level varied by 40 feet during sampling rounds in 2010	2	BAL	Basalt highly fractured and slightly weathered	Water bearing zone between 10 and 35 ft-bgs in colluvium and top of basalt that produced up to 50 gallons per minute (gpm) at time of drilling. Basalt contact at 17.5 ft-bgs. Slight amount of water in fractured basalt from 122 to 127 ft-bgs. Elevation of screen interval close to Columbia River elevation.
BAMW-3	131	111 - 131	116	2	BAL	Poorly graded gravel (GP) composed of sub-angular to sub-rounded basalt	Basalt contact at 3 ft-bgs. First water-bearing zone within basalt at this location. Probable interbed.
BAMW-4	220	200 - 220	199	2	BAL	Basalt, vesicular, moderately fractured and porous	10 feet of fill added for drilling pad. Completed in first-water bearing zone within basalt at this location. Screen interval near river elevation.

Table 7.2-2
Existing Well Construction Information Summary
Columbia Gorge Aluminum Smelter Site
Goldendale, WA
Page 4 of 4

Well Identification	Total Well Depth (ft-bgs)	Screen Interval (ft-bgs)	Static Water Level at Construction (ft-bgs)	Well Diameter (Inches)	Aquifer Designation	Screen Interval Lithology	Comment
Production Wells							
Well #1	1,000	490 - 550 perforations	270	12	BAL	Multiple basalt layers	Appears to be open hole below 550 ft-bgs. Blank 12-inch casing to 490 ft-bgs. 20-inch grouted outer casing to 7 ft-bgs. Surface cement grout seal from ground surface to 32 ft-bgs. 840 gpm with 215 feet drawdown at 24 hours and slow recovery reported.
Well #2	504	23* - 504*	243	10	BAL	Multiple basalt layers	May be open hole from base of casing at 23 feet to total depth. Outer surface casing (16-inch) with cement grout surface seal to 23 ft-bgs and including 10-inch outer well casing to same depth. Log states that the well was no longer used (abandoned) since it no longer produced water after producing 800 gpm initially.
Well #3	1,128	308-400 assumed perforations	228, 308 feet first encountered water	12	BAL	Multiple basalt layers	Appears to be open hole below 400 ft-bgs. 20-inch casing to 30 feet with assumed cement grout surface seal. Geological structure of potable water well drawing dated 1/18/71 shows that the pump is set between 380 and 400 feet with the 12-inch casing extending to 400 feet. Depth of perforations is assumed to include the pump interval and overlying water producing zones. 1,000 gpm with 238 feet of drawdown after 24 hours; 880 gpm with 167 feet of drawdown at 6 hours.

* Assumes open hole below 23 feet bgs, but could have perforated interval in 10-inch casing not described on log similar to other facility production wells that were constructed by the same driller.

* * Denotes change in well nomenclature (Well name on construction log has been changed as indicated).

Notes and abbreviations:

The wells are grouped by area for ease of presentation only. Note that wells in the vicinity of a given SWMU are not necessarily associated with that SWMU or its monitoring program.

BAL	Basalt Aquifer-Lower
BAU	Basalt Aquifer-Upper
ft-bgs	Feet Below Ground Surface
gpm	Gallons per minute
UA	Unconsolidated Aquifer
ESI	East Surface Impoundment
WSI	West Surface Impoundment
EELF	East End Landfill
WELF	West End Landfill
West SPL	West Spent Pot Liner Storage Area
East SPL	East Spent Pot Liner Storage Area

Based on a review of the assembled well and lithologic logs, water-levels at the time of drilling, static water levels, and past groundwater characterization reports, the wells were assigned to various hydrostratigraphic zones as described in the following section. The existing monitoring well network categorized by aquifer zone is shown on Figure 7.2-3.

7.2.3 Hydrogeology

This section describes the historical and current conceptual understanding of groundwater flow at the site. As previously summarized in Section 2.3, the site is located on a topographic bench above the Columbia River that is underlain by basalt flows of the Grande Ronde Basalt Formation. The irregular surface of the basalt on the topographic bench was formed by erosional scour during the Pleistocene Missoula Floods (URS 2009, PGG 2013b). Conceptually, the aquifer system represents a colluvial/fill aquifer underlain by a series of variably interconnected basalt bedrock aquifer zones that represent the more permeable zones between and within individual flows. Previous investigations concluded that the lateral continuity of the individual water bearing zones within the basalts is variable. Groundwater flow is generally southwesterly and toward the Columbia River. Based on a review of historical reports, water-level elevation information, well construction logs, and historical cross-sections, both an upper and lower water-bearing zone within the basalt has been identified.

Three primary aquifer zones have been identified at the site. For the purposes of the RI, the uppermost aquifer has been defined to consist of two main zones at the site depending on the location: the UA and the Basalt Aquifer-Upper Zone (BAU) in areas where the UA is not present. Deeper zones within the basalt have been termed the Basalt Aquifer-Lower Zone (BAL). A description of these primary aquifer zones is provided in the following section along with a discussion of associated groundwater flow within each zone.

The UA occurs within the surficial unconsolidated sediment and is thought to be directly recharged by precipitation and by shallow groundwater recharge from the hillsides north of the site. The thickness of the UA hydrostratigraphic unit varies across the site; it is thickest in the western portion of the site and is significant thinner or absent in the eastern portion of the site.

Legend

- Unconsolidated Aquifer Well
- Uppermost Basalt Aquifer Well
- Lower Basalt Aquifer Well
- Undesignated Well

N
W E
S

0 500 1,000 2,000
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 7.2-3
Existing Well Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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The BAU and BAL is thought to be recharged from combination of: 1) direct precipitation where the UA is absent, 2) recharge/leakage from the overlying units, 3) groundwater recharge and runoff from the hillsides north of the site, and 4) potential lateral recharge from upgradient water-bearing zones within the basalt bedrock.

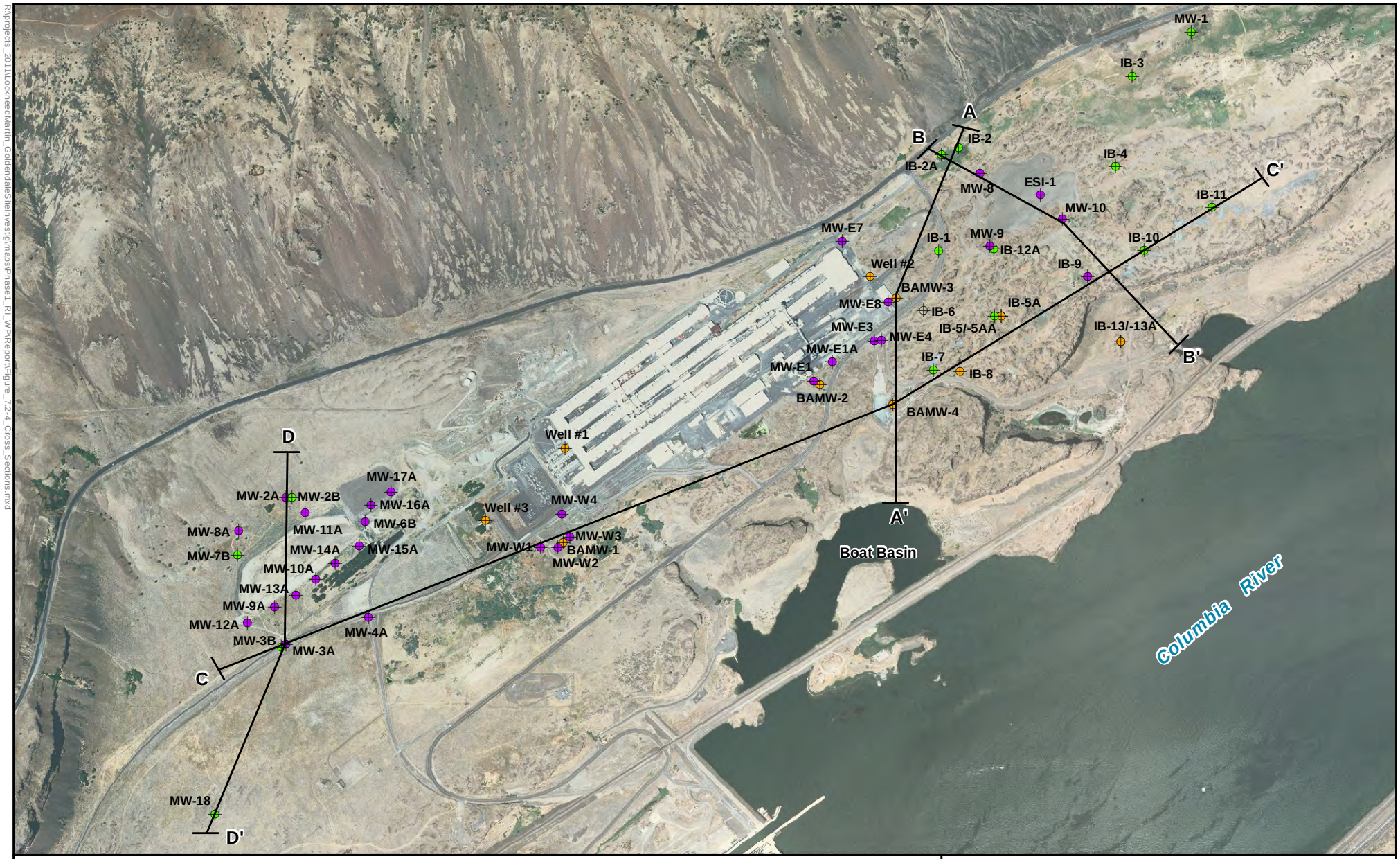
A series of four cross-sections have been prepared to depict site geology and the occurrence of groundwater. The lines of section are shown on Figure 7.2-4. Cross-sections A-A' and B-B' are situated in a north-south orientation in the vicinity of the Production Area, cross-section C-C' is situated in an east-west orientation across the facility, and cross-section D-D' is situated in a north-south orientation, in the vicinity of the WSI. The individual cross-sections are shown on Figures 7.2-5, 7.2-6, 7.2-7, and 7.2-8, respectively.

7.2.3.1 Groundwater Flow Directions

This section summarizes the occurrence of groundwater for the designated aquifer zones based on review of available boring logs and water-level data. A series of water-level elevation contour maps have been prepared to show the water-level elevations and groundwater flow directions in each aquifer zone, as well as a figure showing water-level elevations for all monitoring wells (refer to Figures 7.2-9, 7.2-10, 7.2-11, and 7.2-12). Because groundwater elevations have not been collected in a synchronous manner across the site, the maps represent a composite of water levels for different time periods. However, based on review of the available data, the range of groundwater elevation across the site for the different aquifer zones appear significantly greater than the range of seasonal fluctuations, so the maps provide an adequate general interpretation of water-level elevations across the site.

7.2.3.2 Unconsolidated Aquifer Zone

The UA Zone includes the shallow water-bearing zone in the colluvium, alluvium, and fill that overlies basalt bedrock at the site. This unit is thicker and more laterally extensive on the western side of the site than in the eastern portion (refer to Figures 7.2-6 and 7.2-8). At some locations near the plant, shallow groundwater appears to occur within the first 2 to 3 feet of weathered and fractured basalt bedrock, and is considered as part of this zone.



Legend

- Unconsolidated Aquifer Well
- Uppermost Basalt Aquifer Well
- Lower Basalt Aquifer Well
- Undesignated Well

A — A' Cross-Section

N W E S

0 500 1,000 2,000

Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 7.2-4
Line of Cross-Section

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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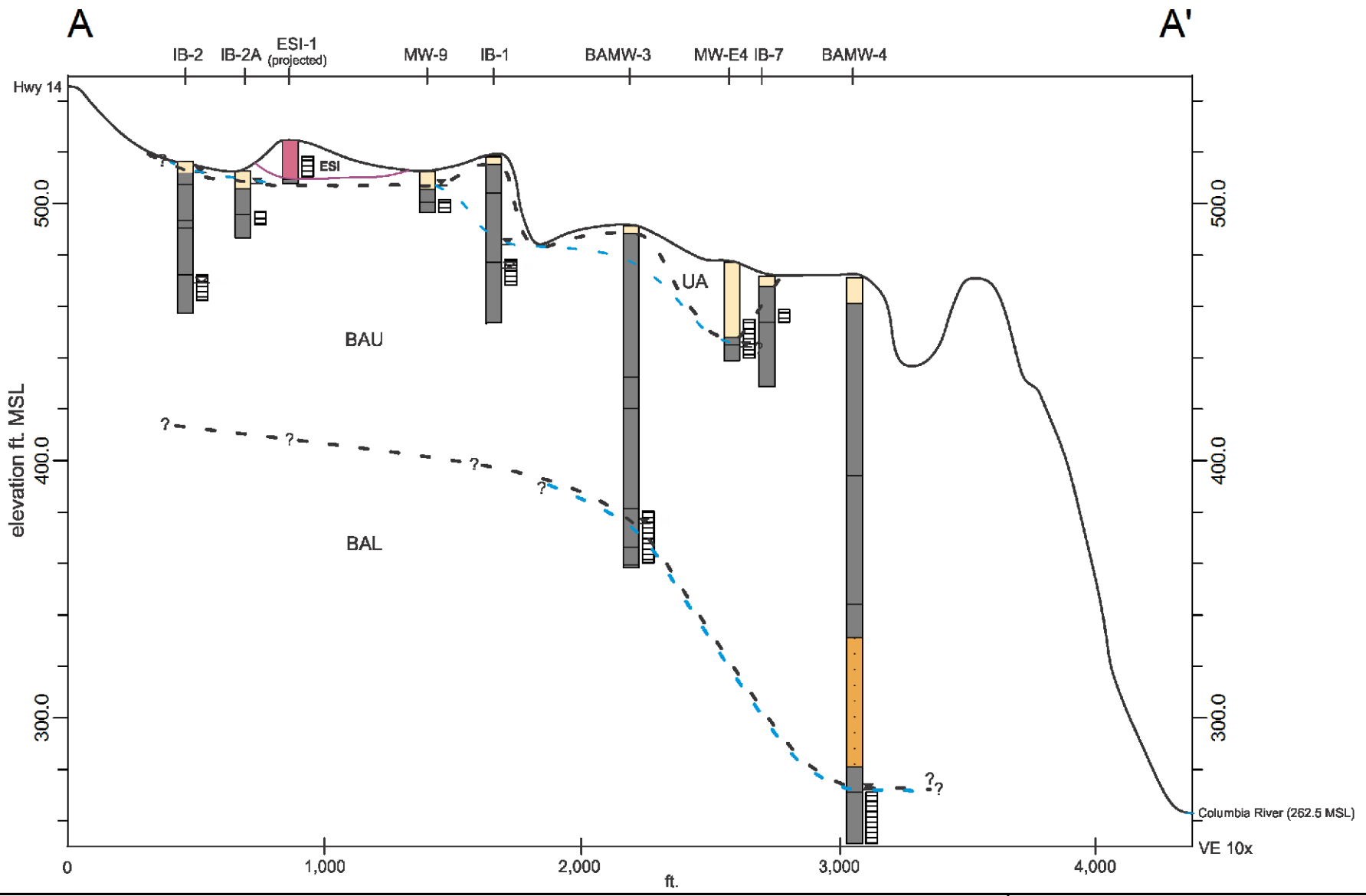
Cross-Section A-A'



Legend

- Sludge
  ESI-East Surface Impoundment
- Unconsolidated colluvial and glacial fluvial deposits
- Basalt, undifferentiated
  black line denotes fracture, porous, or red color zone
- Sand and ash
- Monitoring well screen
- SWL - static water level
- SWL correlated
- Groundwater first encountered
- Aquifer Zone Boundaries

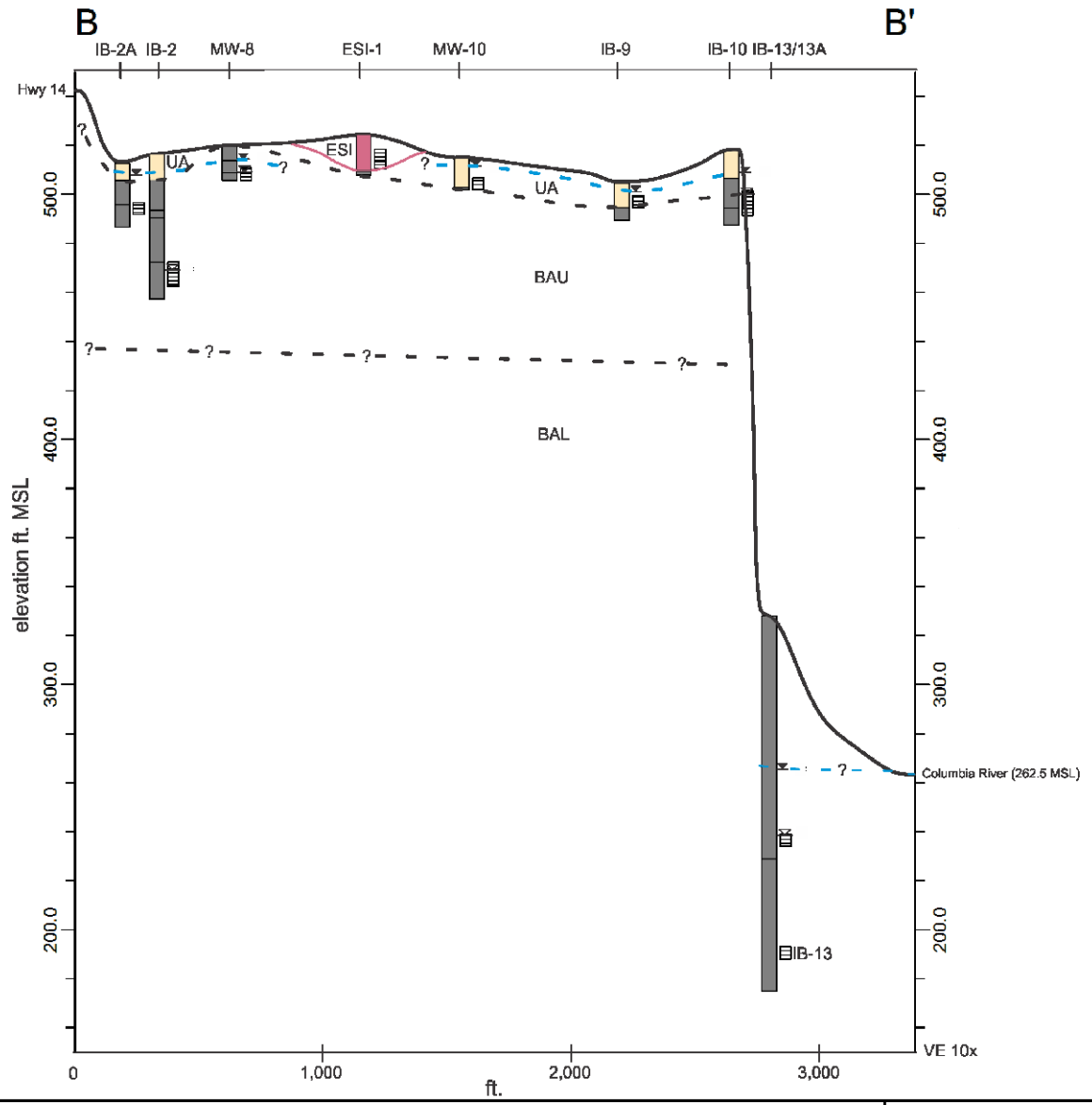
UA Unconsolidated Aquifer
BAU Basalt Aquifer Upper
BAL Basalt Aquifer Lower

Source: PGG

Figure 7.2-5
Cross-Section A-A'

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Cross-Section B-B'



Legend

- Sludge
  ESI-East Surface Impoundment
- Unconsolidated colluvial and glacial fluvial deposits
- Basalt, undifferentiated
  black line denotes fracture, porous, or red color zone
- Sand and ash
- Monitoring well screen
- SWL - static water level
- SWL correlated
- Groundwater first encountered
- Aquifer Zone Boundaries

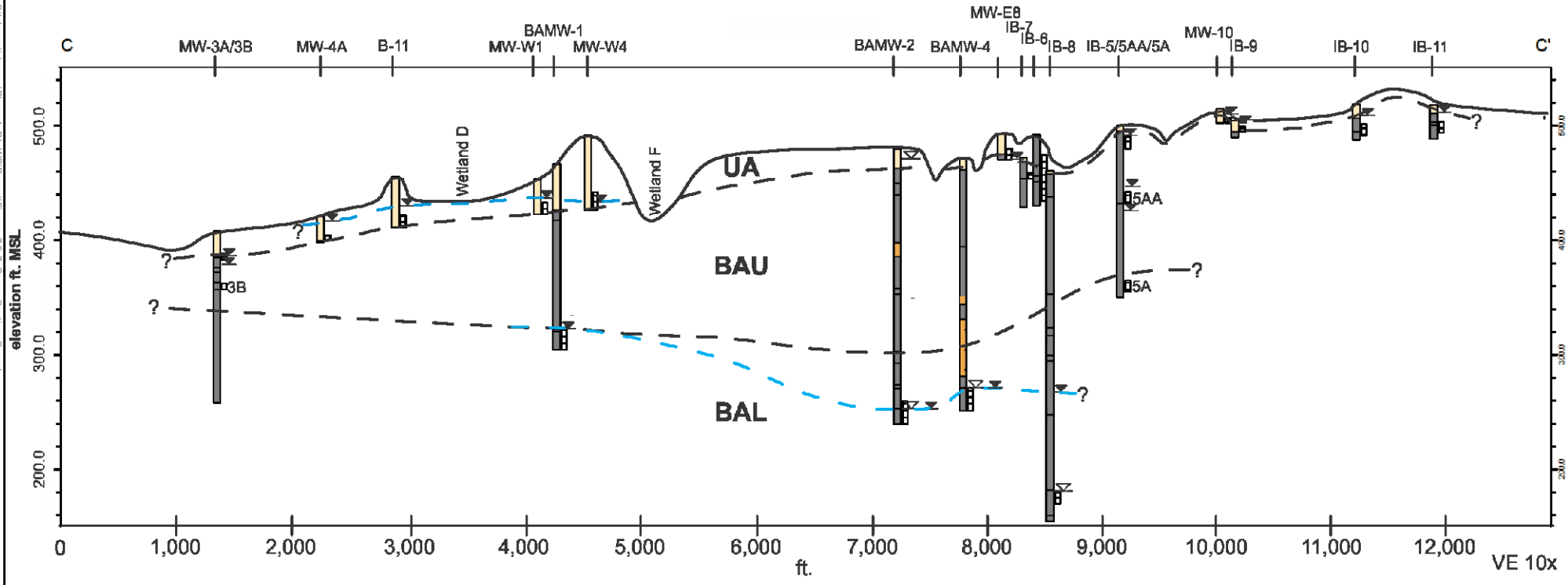
UA Unconsolidated Aquifer
BAU Basalt Aquifer Upper
BAL Basalt Aquifer Lower

Source: PGG

Figure 7.2-6
Cross-Section B-B'

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Cross-Section C-C'



Legend

- Unconsolidated colluvial and glacial fluvial deposits
- Basalt, undifferentiated
  black line denotes fracture, porous, or red color zone
- Sand and ash

- Monitoring well screen
- SWL - static water level
- SWL correlated
- Groundwater first encountered
- Aquifer Zone Boundaries

UA Unconsolidated Aquifer
BAU Basalt Aquifer Upper
BAL Basalt Aquifer Lower

Source: PGG

Figure 7.2-7
Cross-Section C-C'

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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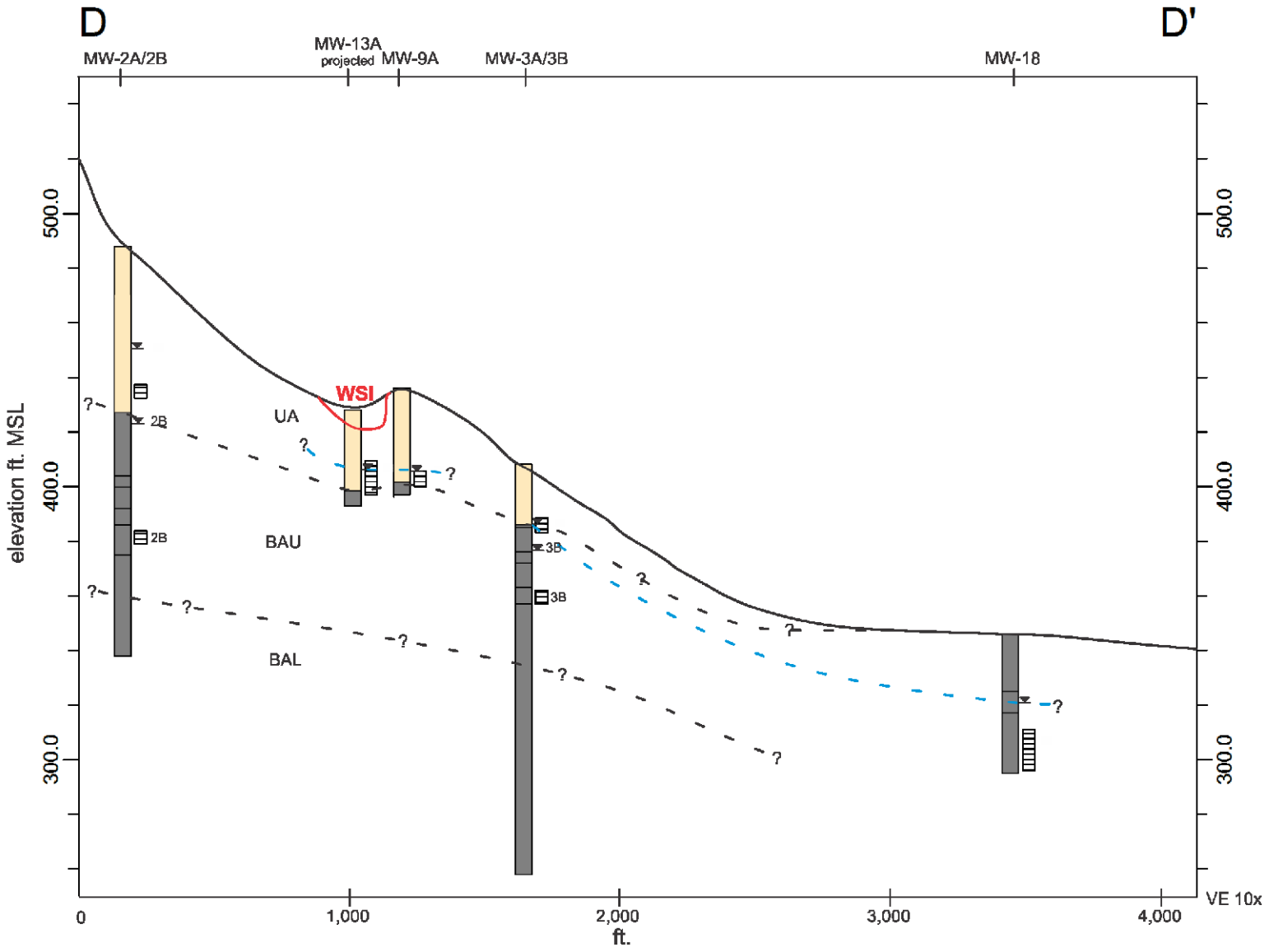
Cross-Section D-D'



Legend

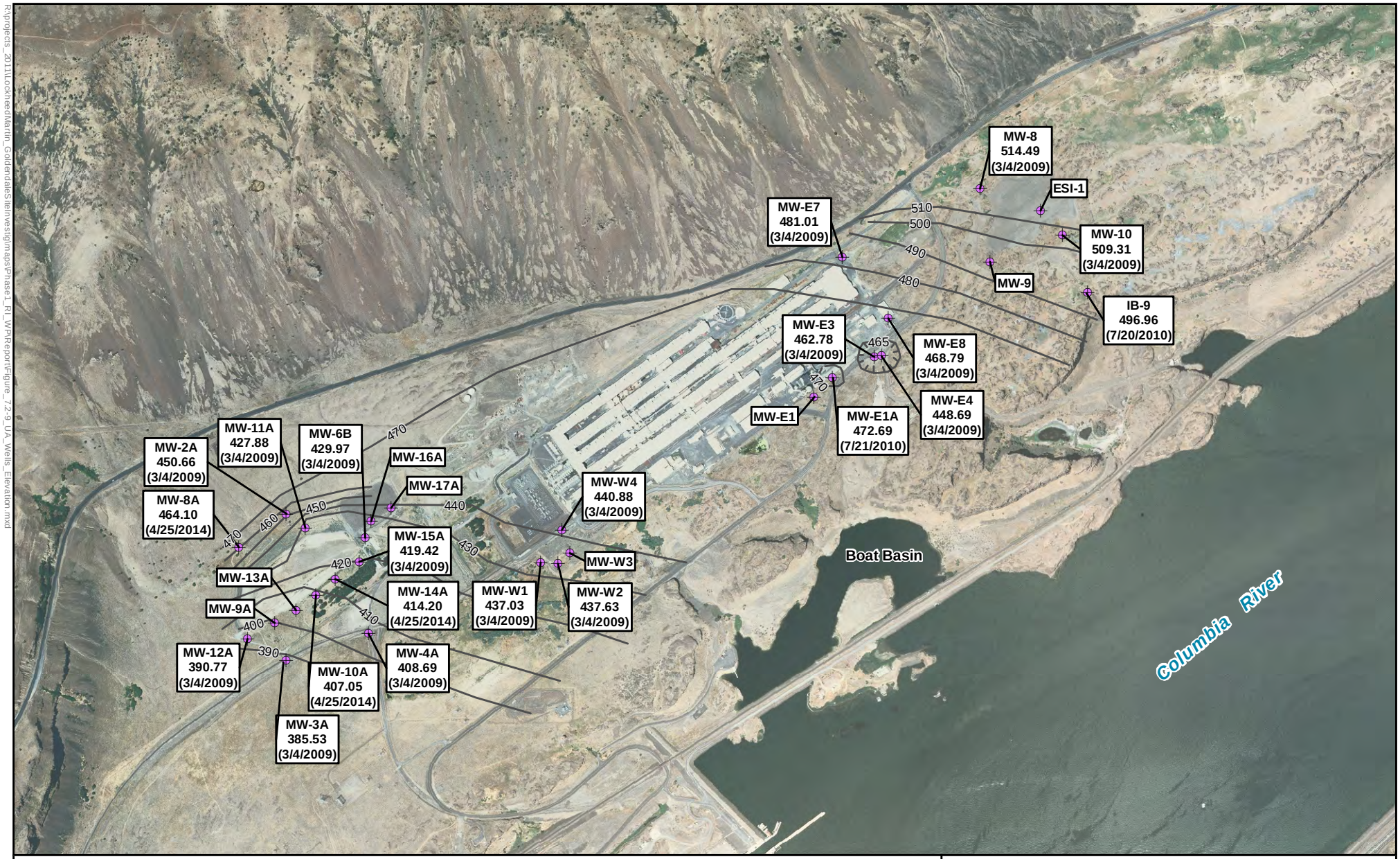
- Unconsolidated colluvial and glacial fluvial deposits
- Basalt, undifferentiated
  black line denotes fracture, porous, or red color zone
- Sand and ash
- Monitoring well screen
- SWL - static water level
- SWL correlated
- Groundwater first encountered
- Aquifer Zone Boundaries

UA Unconsolidated Aquifer
BAU Basalt Aquifer Upper
BAL Basalt Aquifer Lower

Source: PGG

Figure 7.2-8
Cross-Section D-D'

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



Legend

Unconsolidated Aquifer Well

MW-2A 450.66 (3/4/2009) — Well Identification, Groundwater Elevation, Sampling Date

470 — Water-level Elevation Contour

N
W E
S

0 500 1,000 2,000
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 7.2-9
Composite Groundwater Elevations of Unconsolidated Aquifer (UA) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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Legend

Uppermost Basalt Aquifer Well

470 Water-level Elevation Contour

MW-2A
450.66
(3/4/2009)

Well Identification
Groundwater Elevation
Sampling Date

N
W E
S

0 500 1,000 2,000
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 7.2-10
Composite Groundwater Elevations of
Uppermost Basalt Aquifer (BAU) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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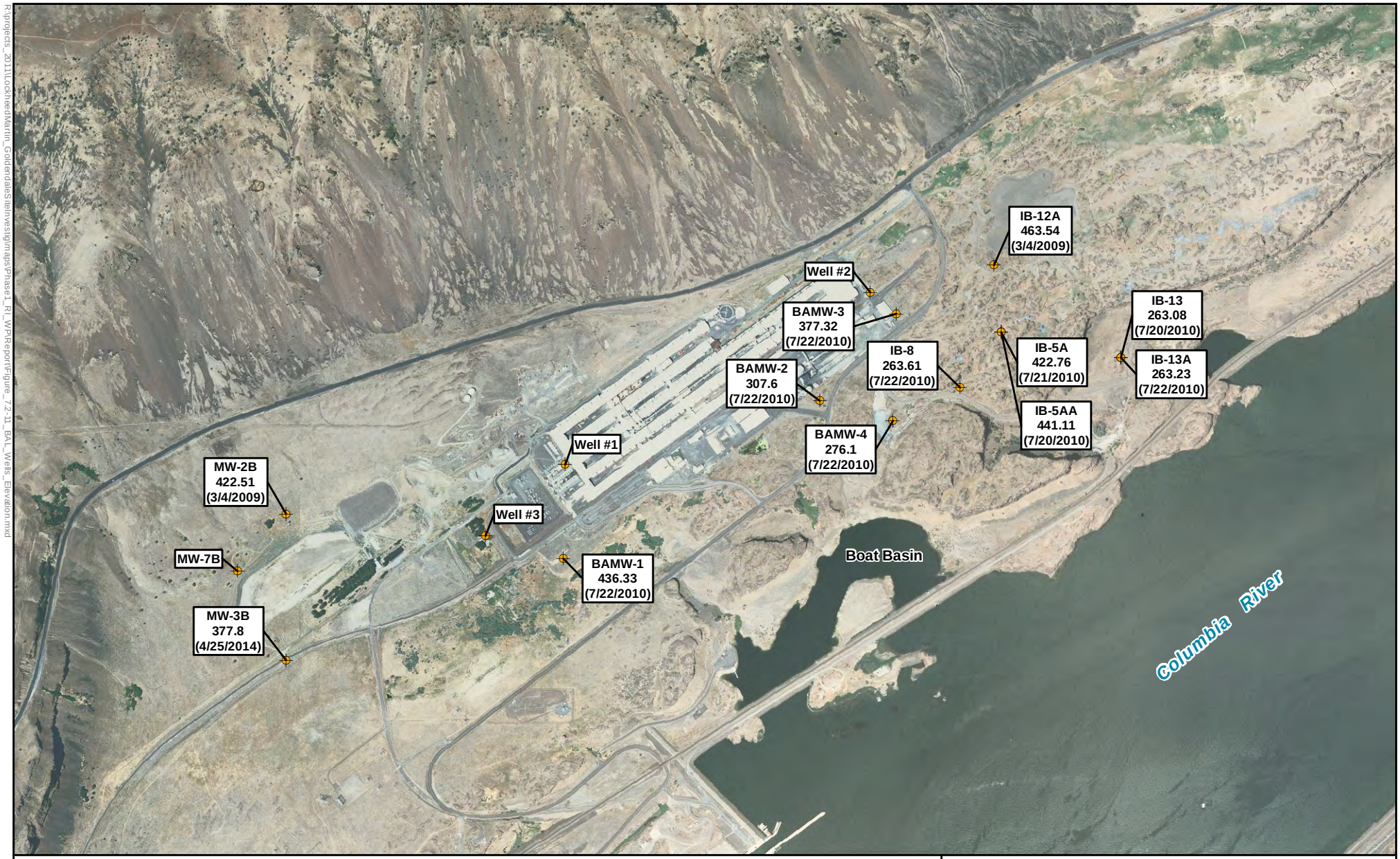

Legend

Lower Basalt Aquifer Well

MW-2A
450.66
(3/4/2009)

Well Identification
Groundwater Elevation
Sampling Date

N
W E
S

0 500 1,000 2,000
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 7.2-11
Composite Groundwater Elevations of
Lower Basalt Aquifer (BAL) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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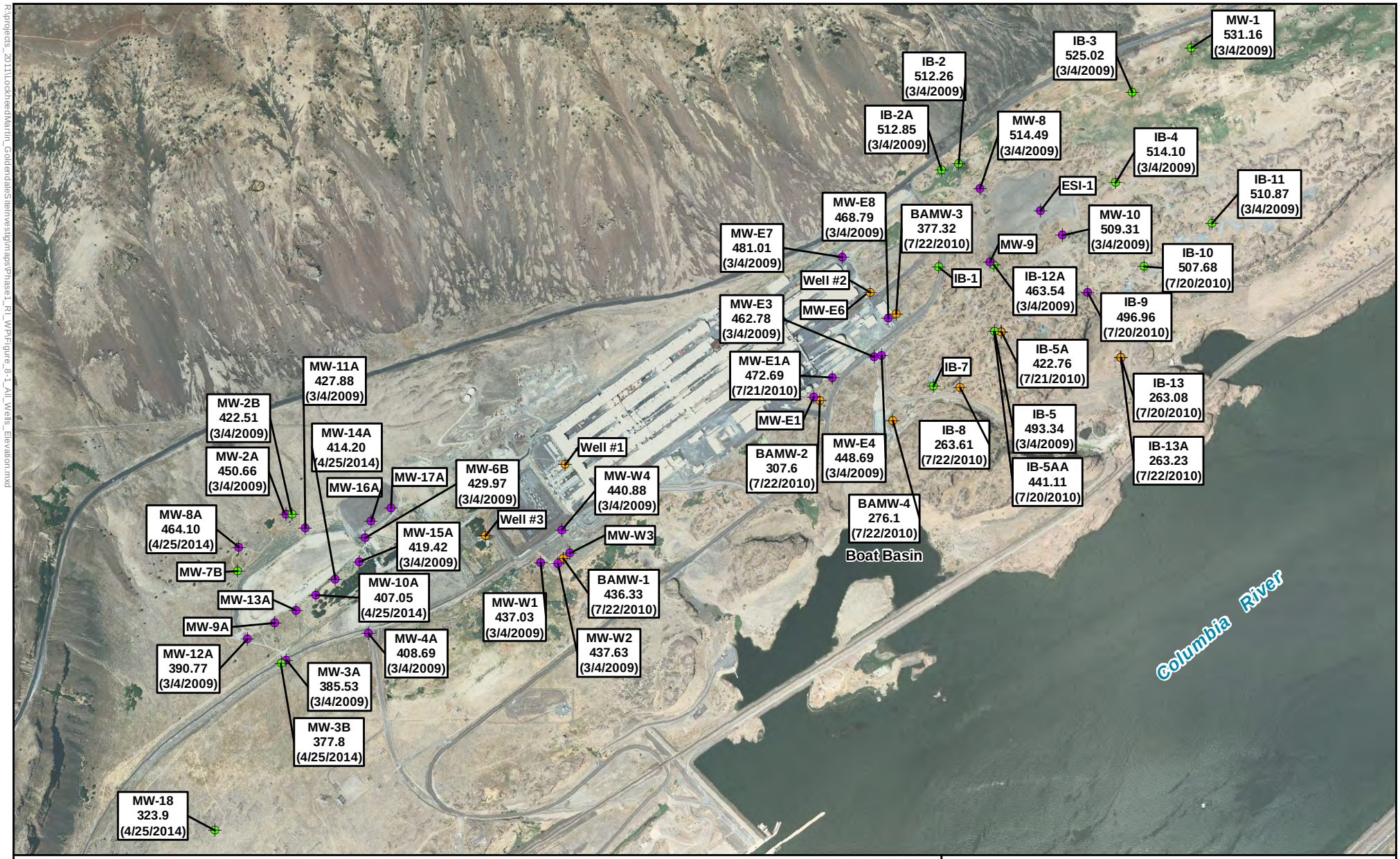

Legend

- Unconsolidated Aquifer Well
- Uppermost Basalt Aquifer Well
- Lower Basalt Aquifer Well

MW-2A
450.66
(3/4/2009)

Well Identification
Groundwater Elevation
Sampling Date

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

N
W E
S

0 500 1,000 2,000
Feet

Figure 7.2-12
Composite Groundwater Elevations
of Existing Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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A French-drain system was installed beneath the northern and eastern portion of the Production Area to collect shallow groundwater. The northern shallow groundwater collection system appears to be connected to the stormwater collection system that drains to the Stormwater Pond. A separate French-drain system is present in the eastern portion of the Production Area that appears to discharge via a pipe at the head of NPDES Pond A. The configuration of the groundwater collection systems is summarized in more detail in Sections 6.2.18 and Section 7.5 that describe the Stormwater Pond and Appurtenant Facilities (SWMU 32) and Plant Area AOC, respectively. This collection system may impact shallow groundwater flow beneath the plant. The groundwater-stormwater transport pathway will be evaluated as part of the stormwater system evaluation (refer to Section 6.2.18) and Plant Area AOC (refer to Section 7.5).

Historic aerial photographs reveal a surficial drainage feature eroded into the basalt beneath the east side of the plant. The feature extends south in a north-south orientation from the Columbia Hills to the NPDES ponds area. The feature was filled during construction of the plant and by operation of the EELF (SWMU 17) (URS 2008a, Tetra Tech 2011a). This filled drainage feature is the primary expression of the UA in the eastern portion of the site, where the UA is typically discontinuous and localized.

Groundwater flow within the UA is influenced by the geometry of the bedrock surface and thickness of the unconsolidated deposits (PGG 2013b). Glacial flood scouring of the surface of the basalt during the Pleistocene Era in the vicinity of Wetland D appears to have resulted in development of a trough and ridge surface. These subsurface features appear to influence groundwater flow to the southwest.

Figure 7.2-9 shows the water-elevation contours for the UA. The overall pattern of groundwater flow is to the southwest, which is down valley and toward the Columbia River. This groundwater flow pattern is documented through monitoring of the ESI, WSI, and WELF. There are irregularities in the groundwater elevation within this unit near the eastern end of the plant at wells MW-E1A, MW-E3, and MW-E4. These may result from several factors including the subsurface channel feature, shallow groundwater collection system, irregular basalt surface topography, or the presence of the EELF.

7.2.3.3 Basalt Aquifer – Upper Zone

The BAU upper water-bearing zone appears to be consistently present below the first basalt flow/interval/bed at both the ESI and WSI (Century 1986, Golder 1988). At the WSI, the BAU represents a fractured and vesicular interflow zone encountered about 14 to 28 feet below the top of the basalt bedrock surface (Golder 1988). At the ESI, a distinct interflow zone is not as apparent (in part because the available logs are not detailed), but there is a grouping of wells with similar water elevations below the top of the first basalt flow. At the ESI the UA and BAU are thought to be significantly interconnected.

A composite water-level elevation contour map for the BAU is shown on Figure 7.2-10. Groundwater flow is to the southwest with the horizontal gradient being steeper near the WSI than the ESI. Water-levels in the BAU are lower in elevation that the UA, but are generally within about 10 feet and show a similar overall pattern of groundwater flow directions, possibly suggesting some interconnection.

At the ESI, more than one water-bearing zone within the BAU has been identified. The second deeper water-bearing zone has been identified based on wells IB-2, IB-5AA, and IB-12A. These wells are screened from 49-54 feet bgs, 49-59 feet bgs, and 58-68 feet bgs, respectively. Water levels in the second zone are similar to the first zone at well IB-2 (compared to IB-2A) and about 40 to 50 feet deeper in wells IB-12A and IB-5AA (compared to IB-5). Refer to Figures 7.2-10 and 7.2-12 for the water-level information as well as cross-sections A-A', B-B' and C-C' (Figures 7.2-5, 7.2-6, and 7.2-7) for further details. The direction of groundwater flow in this zone is to the southwest similar to the main BAU zone with flow to the southwest. These wells were included with the shallower BAU wells based on stratigraphic elevation and an overall similarity in water levels with other BAU wells.

7.2.3.4 Basalt Aquifer – Lower Zone

The BAL includes all of the saturated zones beneath the BAU. The BAL extends vertically from below the interpreted BAU zone to the surface elevation of Columbia River, which conceptually represents a natural constant head boundary for the site basalt aquifer system. The elevation of the Columbia River surface, or Lake Umatilla pool elevation, is between 257 and 268 feet MSL.

Four BAL wells were constructed (BAMW-1, BAMW-2, BAMW-3, and BAMW-4) and sampled during 2010 to provide more detailed characterization of the basalt aquifer system. The lithologic and well construction logs for these wells represent the most detailed description of the lithology and encountered water bearing zones within the basalts. The BAMW wells are shown in cross-sections A-A' and C-C' on Figures 7.2-5 and 7.2-7, respectively. Table 7.2-3 summarizes information regarding the BAMW wells and the encountered water bearing zones.

Table 7.2-3
BAMW Series Monitoring Well Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Well	Total Depth	Screen Interval (ft-bgs)	Static Water Level at time of Drilling (ft-bgs)	Screen Interval Lithology	Description of Additional Water-Bearing Zones During Drilling	Depth of Colluvial/Basalt Contact (ft-bgs)
BAMW-1	162	144-162	134	Fractured and weathered basalt	32 to 40 ft-bgs in silty sand (SM) to poorly graded sand (SP).	40
BAMW-2	240	220-240	219, significant fluctuations (more than 40 feet) observed during rounds of water-level measurements during 2010	Weathered and fractured basalt	10-17.5 ft-bgs in silty sand (SM with basalt clasts. 17.5 to 35 ft-bgs in highly fractured, weathered, and vesicular basalt. 10 to 35 foot boring interval yielded 50 gpm. 122 to 127 ft-bgs in fractured basalt that yielded a slight amount of water 204 to 209 ft-bgs in weathered and fractured water-bearing basalt.	17.5
BAMW-3		111-133		Poorly graded basaltic gravel (GP) with sand at depth	None.	3
BAMW-4	220	200-220	199	Vesicular, fractured reddish basalt	None. Highly weathered basalt from 77 to 127 ft-bgs with no water. Also, potential lacustrine ash/sand deposit between 140 and 190 ft-bgs that is also dry.	None. 10 feet of fill added on top of the basalt for drilling pad.

A water-bearing zone was encountered in the shallow colluvium during drilling of BAMW-1 and BAMW-2. At BAMW-2, two water-bearing zones within the basalt were encountered above the screen interval. At BAMW-3 and BAMW-4, the screen interval appears to represent the uppermost water-bearing zone within the basalt at these locations. These data show that the occurrence of water-bearing zones within the basalt bedrock is variable and that correlation of individual water-bearing zones laterally and vertically within the basalt is uncertain.

The three facility production wells extend down to significantly deeper basalt intervals than were characterized by environmental investigations at the site (production well depths range between 504

and 1,128 feet bgs), and below the Lake Umatilla pool elevation. The Lake Umatilla pool surface is projected beneath the Production Area at about 212 to 233 feet bgs based on an estimated range of elevations at the Production Area of 480 to 490 feet MSL, and the reported range of pool elevations (257 to 268 feet MSL). However, based on review of the well construction logs for the production wells (refer to Table 7.2-2), there appears to be long intervals of open hole within the wells. The open-hole portion in production well #2 may extend upward into the BAL zone.

A composite water-level elevation map for the BAL (refer to Figure 7.2-11) shows a large range of groundwater elevations (about 200 feet) and the groundwater elevations are not contoured because of uncertainties. Some variability of the water-levels for the basalt aquifer zones would be expected because of heterogeneity in the fracture patterns, lithologic variability, and lateral variability of the interflow zones across the site. Water-levels for the wells in the vicinity of the NPDES drainage channel and topographically below the cliff band near the Columbia River (BAMW-2, BAMW-4, IB-8, IB-13, and IB-13A) are characterized by significantly lower elevations that are within about plus 0.5 to 45 feet above the Lake Umatilla pool average elevation of 262.5 feet MSL (refer to cross-sections A-A' and B-B'; Figures 7.2-5 and 7.2-6).

The water-level elevations in the deeper water-elevation grouping could potentially be affected by the natural and subsurface topographic channel (NPDES ponds drainage) in this area, differing lithology and/or stratigraphy, and/or long-term pumping of the facility production wells.

7.2.3.5 Vertical Gradients

The vertical gradients between the UA and the BAU are downward. There appears to be interconnection between these two zones based on their similar groundwater flow patterns and contaminant distribution.

Within the basalt aquifer system, vertical gradients between the basalt water-bearing zones are consistently and strongly downward until the base elevation of the Lake Umatilla Pool Elevation (257 to 268 feet MSL) is reached. Near the river base elevation the downward vertical gradients become smaller (URS 2009, 2012). The downward vertical gradient within the BAL MW-13/13A well cluster located near the Columbia River is small (0.0033 foot/foot) based on 2010 water-level measurements (refer to Figure 7.2-12). Upward vertical gradients and artesian conditions were also

noted during drilling of borings and wells near the John Day Dam near the Lake Umatilla pool elevation (Golder 1988).

7.2.3.6 Hydraulic Conductivity

As expected, the hydraulic conductivity ranges for the UA, BAU, and BAL are variable. Data from the 1980's at the ESI (Century 1986, URS 2011) included rising head slug tests of 9 wells. Results for the two tested UA wells range from 6.52 to 470.55 feet per day (URS 2011). Results for 6 BAU-designated wells range from 0.85 to 191.91 feet per day. Results for well IB-12A, which is completed in the BAL (second water-bearing zone in the basalt at the ESI) was 0.037 feet per day.

URS (2011) evaluated the hydraulic conductivity of some of the water supply wells at and near the site from driller's pump test logs and calculated hydraulic conductivity of 1.39 to 8.55 feet per day.

7.2.3.7 Aquifer Zone Interconnection

Based on review of historical reports and water-level elevations, the UA and BAU appear to be hydraulically interconnected. The degree of interconnection between the BAU and BAL aquifer zones is unclear. In the eastern and western portion of the site, the BAU and BAL appear to show similar flow patterns as the shallower UA unit, while in the area of NPDES drainage channel and near the Columbia River, there are large head difference between the UA and the BAL and between the BAL (in other areas) and the BAL in the area of the NPDES ponds. The occurrence of site contaminants in the BAL (further discussed in Section 7.2.4) suggests some interconnection between the BAL and overlying units.

An aquifer pumping test was performed as part of site-wide characterization (URS 2011). The three facility wells were pumped over a 56-hour period while the water levels in wells BAMW-1, BAMW-2, BAMW-3, BAMW-4, and IB-5A were monitored with pressure transducers. These monitoring wells are completed in the BAL zone, but at a significantly shallower depth than the facility production wells. The monitoring wells are all located at least 1,000 feet from the facility production wells with the exception of BAMW-3, which is located about 400 feet from production well #2.

A drawdown response was found at BAMW-1, which is located at the WELF and about 1,000 feet and 1,200 feet from production wells #3 and #1, respectively. The total depth of production wells #1 and #3 are greater than 1,000 feet bgs, and monitoring well BAMW-1 is screening from 144 to 162 feet bgs. This result suggests hydraulic interconnection within the basalts, and that long-term pumping of the production wells could potentially affect water levels in the shallower basalt aquifer zones. The lack of response at the other wells and near production well #2 may suggest variability in the degree of interconnection across the site, or could reflect limitations and uncertainties associated with the aquifer test design.

7.2.3.8 Occurrence of Springs and Seeps

An electrical resistivity study was performed in the vicinity of Wetland D, which is located southwest of the WELF and south of the WSI and West SPL Storage Area (PGG 2013b) in the western portion of the site. Glacial-flood scouring of the surface of the basalt in the vicinity of Wetland D has reportedly resulted in development of a trough and ridge surface. These subsurface features appear to influence groundwater flow to the southwest. In areas where the bedrock troughs and potholes are deep enough, water is retained in the depressions and can contribute along with storm water and overland flow to the formation of wetlands.

A spring is present in the NESI area northwest of the ESI and the recharge for the spring is likely shallow groundwater from the talus slope on the north side of the highway (Century West 1985, 1986).

During the site-wide groundwater investigation, basalt bedrock outcrops were searched for evidence of springs and seeps and none were found draining the cliff faces near the Columbia River (URS 2009). Areas at lower elevations near the river may be recharged by groundwater seepage from the BAL zone, but may also be recharged by stormwater or overland flow within the drainages.

Spring and seep locations, data, and wetlands are described in detail under the Wetlands AOC (refer to Section 7.3). Stormwater is discussed in more detail in Section 6.0 under SWMU 32.

7.2.3.9 Potential Groundwater Transport Pathways

Potential groundwater contaminant transport pathways to be evaluated in the RI include the following: 1) potential downward vertical migration of groundwater to the lower basalt aquifer zones in which the deep facility production wells are completed; 2) horizontal and downward vertical migration of groundwater to springs, seeps, and wetlands; and 3) horizontal and vertical migration of groundwater to surface water of the Columbia River, including the Boat Basin.

Potential migration of stormwater into shallow groundwater and potential preferential migration of shallow groundwater along or into underground stormwater and groundwater collection systems will be evaluated as part of the stormwater system (Section 6.0; SWMU 32).

7.2.4 Groundwater Monitoring Program Summary

The site has a long history of groundwater monitoring dating back to the mid-1980s. Table 7.2-4 briefly summarizes the various groundwater characterization and monitoring programs. Much of the groundwater characterization and monitoring work has been conducted as part of specific investigation and long-term monitoring of individual SWMUs at the site, most notably the ESI and WSI. Routine groundwater monitoring was also conducted from around 1986. Groundwater investigations also have been performed as part of independent remedial investigations and cleanups at various SWMUs including the WELF, EELF, and the North and South SPL Soaking Stations (refer to Table 7.2-4). Potential shallow groundwater and wetland inter-connection was also evaluated for Wetland D, which is located in the western portion of the site near the WELF and WSI (PGG 2013b).

7.2.5 Groundwater Quality Summary

This section summarizes site groundwater quality for the various aquifer zones at the site. A series of chemical posting maps have been prepared that show the most recent data for common aluminum reduction COPC including cyanide (various species), fluoride, and sulfate. In addition to cyanide, fluoride, and sulfate, data for several additional chemical groups is included in the database, which was searched and evaluated to determine if the most recent chemical concentration exceed the current screening values.

Table 7.2-4
Groundwater Investigation/Monitoring Program Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 1 of 2)

Area of Investigation	Groundwater Monitoring Activity Summary	Current Monitoring Well Network	Groundwater Monitoring Parameter(s)	Current Frequency of Monitoring	Date of Latest Monitoring and Report Reference
West Surface Impoundment (SWMU 4)	Sampling and analysis of groundwater has been performed since 1984. A quarterly sampling schedule was implemented from 1991 to 2004. Post- closure sampling at 5 wells was conducted quarterly from 2005-2007, semiannually from 2008-2010, and annually beginning in 2011.	Wells MW-8A (upgradient), MW-3B, MW-10A, MW-12A, MW-14A, and MW-18 are in the current program. Additional wells are nearby including the West SPL Storage Area monitoring well network.	Total cyanide, fluoride, sulfate, and chloride.	Annual	2014 Annual Groundwater Monitoring Report (GeoPro 2014)
East Surface Impoundment (SWMU 2)	SWMU under long-term groundwater monitoring program with groundwater monitoring and characterization beginning in 1985. The groundwater quality assessment program first report (Century 1986) presents and summarizes much of the hydrogeologic characterization information.	Wells IB-3 (upgradient), MW-10, IB-5, and IB-8 (deeper zone) are in the current program. Several additional wells are also present.	Fluoride, sulfate, and iron	Quarterly for one year; then quarterly once every 5 or 7 years; next scheduled round in 2017	2010 ESI Groundwater Monitoring Report (ARCADIS 2011b)
West End Landfill (SWMU 18)	Groundwater characterized during independent remedial investigation (URS 2008f). Four shallow groundwater monitoring wells (MW-W1 through MW-W4) were installed, developed, and sampled. One deeper monitoring well was later constructed in bedrock (BAMW-1) and sampled as part of site-wide groundwater investigation activities (URS 2011).	Five wells are present (MW-W1, MW-W2, MW-W3, MW-W4, and BAMW-1).	One round of groundwater samples was collected from the four shallow wells and analyzed for the following constituents: TPH-Gx, TPH-Dx, VOCs, SVOCs, PCBs, RCRA metals, total cyanide, WAD cyanide, fluoride, and sulfate. Well BAMW-1 was subsequently sampled for a similar list.	NA	WELF RI/FS Report (URS 2008f) and cleanup action plan (Tetra Tech 2010)
East End Landfill (SWMU 17)	Groundwater characterized during independent remedial investigation (URS 2008a). Five borings were installed within shallow unconsolidated soils; four were completed as wells (MW-E1A, MW-E3, MW-E4, and MW-E8). Groundwater was only found in MW-E1A.	Four wells were completed (MW-E1A, MW-E3, MW-E4, and MW-E8), but only one well contained water (MW-E1A) BAMW-2 installed downgradient of EELF.	One round of groundwater samples was collected from well MW-E1A and analyzed for the following constituents: TPH-Gx, TPH-Dx, VOCs, SVOCs, PCBs, RCRA metals, total cyanide, WAD cyanide, fluoride, and sulfate. Well BAMW-2 was subsequently sampled as part of site-wide groundwater program.	NA	EELF RI/FS Report (URS 2008a) and site-wide groundwater investigation (URS 2011)
East SPL Storage Area (SWMU 12)	One well was installed on the south and presumed downgradient side of the East SPL Storage Area (MW-E8), but the well was dry and could not be sampled. Well BAMW-3 was installed to evaluate potential cyanide and fluoride impacts to deep groundwater during site-wide groundwater evaluation.	Well MW-E8 (Dry) and BAMW-3.	BAMW-3 had four sampling events for total cyanide, fluoride, sulfate, VOCs, metals, and chloride.	NA	East SPL Storage Area RI/FS (URS 2008c)

Table 7.2-4
Groundwater Investigation/Monitoring Program Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 2 of 2)

Area of Investigation	Groundwater Monitoring Activity Summary	Current Monitoring Well Network	Groundwater Monitoring Parameter(s)	Current Frequency of Monitoring	Date of Latest Monitoring and Report Reference
West SPL Storage Area (SWMU 13)	Groundwater monitoring performed generally quarterly from 1990-2002 with annual monitoring from 2002-2008. Monitoring program discontinued in 2008 due to Aleris International, Inc. bankruptcy.	Wells MW-06B, MW-11A, MW-16A, and MW-17A.	Free cyanide, total cyanide, chloride, fluoride, sulfate, and sodium.	NA	Aleris (2010) letter and associated data See also Bakemeier (2009)
North and South Pot Liner Soaking Station (SWMUs 10 and 11)	Groundwater was characterized during independent remedial investigation (URS 2008e).	One well was installed in bedrock (MW-E7) and sampled.	Total and WAD cyanide, fluoride, sulfate, TPH-Gx, TPH-Dx, VOCs, PAHs, PCBs, and metals.	NA	North and South Pot Liner Soaking Station RI/FS (URS 2008e)
Site-Wide Groundwater Evaluation	A well inventory and data base compilation of historical data was prepared. A pumping test with the facility production wells was performed. Four basalt bedrock wells were installed to evaluate hydrostratigraphy and chemical concentrations (BAMW-1 through -4). The hydrogeologic conceptual model was updated.	A comprehensive round of water-level measurements was conducted. Four wells were installed in the basalt bedrock (BAMW-1 through BAMW-4) and sampled.	Four sampling events for total cyanide, fluoride, sulfate, VOCs, metals, and chloride.	NA	Well Inventory (URS 2009) and Site wide groundwater investigation report (URS 2011)

Notes:

EELF	East End Landfill
ESI	East Surface Impoundment
NA	Not applicable
PAHs	Polynuclear aromatic hydrocarbons
PCBs	Polychlorinated biphenyls
RCRA	Resource conservation recovery act
SPL	Spent pot liner
TPH-Dx	Total petroleum hydrocarbons-diesel extended range
TPH-Gx	Total petroleum hydrocarbons-gasoline extended range
SVOCs	Semivolatile organic compounds
SWMU	Solid Waste Management Unit
VOCs	Volatile organic compounds
WAD	Weak acid-dissociable
WELF	West End Landfill
WSI	West Surface Impoundment

The Access database prepared by URS (2011) has been updated to include the most recent WSI groundwater data (GeoPro 2014) and West SPL Storage Area groundwater data (Bakemeier 2009) and was used to evaluate chemical concentrations. Historical groundwater data for individual SWMUs has also been summarized in Section 6.0 and included in the supporting Section 6 Appendices. The original database included historical groundwater chemical data through 2010 when the site-wide groundwater investigation (URS 2011) was completed. The database was compiled from the historical chemical data from project site files. Historical data quality was not evaluated for the original database compilation or for this Phase 1 Work Plan. Both most recent and maximum concentrations were evaluated using database searches.

Much of the recent historical groundwater data for various COPC chemical groups were collected during the 5 sites (East SPL Storage Area, North and South Potliner Soaking Stations, EELF, WELF, and Drum Storage Area) independent remedial investigations (URS 2008a,e,f) as well as the site-wide groundwater investigation (URS 2011) that included 4 quarters of sampling at the BAMW wells, other selected monitoring wells, and the plant production wells. The well network sampled during the 2010 site-wide groundwater investigation included: selected existing monitoring wells (MW-E1A, IB-5A, IB-5AA, IB-8, IB-9, IB-10, IB-13, and IB-13A) the four new BAMW series wells (BAMW-1, BAMW-2, BAMW-3, and BAMW-4), and the three production wells (well #1, well #2, and well #3).

Ongoing groundwater quality monitoring programs include the ESI and WSI, which are included in the database. The ESI program includes sampling of four wells (IB-3, MW-10, IB-5, and IB-8) for fluoride, sulfate, and iron (ARCADIS 2011b). Sampling of the ESI wells was last conducted during 2010. The WSI program includes sampling of six wells (MW-8A, MW-3B, MW-10A, MW-12A, MW-14A, and MW-18) for total cyanide, fluoride, sulfate, and chloride (GeoPro 2014).

In the following sections a series of figures have been prepared to show the most recent data for selected site COPC in the existing well network. For some well locations (e.g., wells near the ESI) the most recent data is quite old (from the 1980's) and is likely not representative of current conditions because chemical concentrations in groundwater have generally improved at the ESI since the data were collected. To address the issue caused by the use of old data to represent current conditions, groundwater data collected during 1999 or earlier have been excluded from the figures showing the most recent concentrations. The post-1999 data was selected as the most recent data

for the purposes of the figures in order to provide data for the majority of the wells, so that the contaminant distribution can be seen, as well as to address the problem of unrepresentative older data.

The data in the following sections has been compared against available Washington MCLs and MTCA Method B formula values. It should be noted that the MTCA Method B formula values for cyanide and fluoride have recently been lowered (refer to Table 3-1). For these chemicals in groundwater, characterization and Ecology-approved long-term monitoring have been conducted using the MCLs as cleanup levels and site cleanup decision criteria. For this reason, both the MCLs and MTCA Method B formula values are shown.

Metals (e.g., iron, nickel, lead, and arsenic), and other inorganic substances (e.g. fluoride, chloride, and sulfate) represent naturally occurring chemicals in groundwater, and natural background concentrations have not been determined on a site-wide basis for each aquifer zone. In some cases, the natural background concentrations could exceed screening levels for groundwater. For example, the 95th percentile UCL for fluoride calculated for upgradient UA well MW-8A in 2014 (GeoPro 2014) is 1.30 mg/L, which is below the MCL of 4.0 mg/L, but above the MTCA Method B formula screening level of 0.640 mg/L. Also, concentrations of fluoride in upgradient BAU well IB-3 at the ESI during 2010 ranged from 0.25 mg/L to a maximum of 0.850 mg/L (ARCADIS 2011b), which again is below the MCL, but above the MTCA Method B formula screening level.

Available groundwater chemical data for other groups of COPC including: petroleum hydrocarbons, VOCs, SVOCs including PAHs, PCBs, and metals are presented and summarized at the end of the section.

7.2.5.1 Cyanide

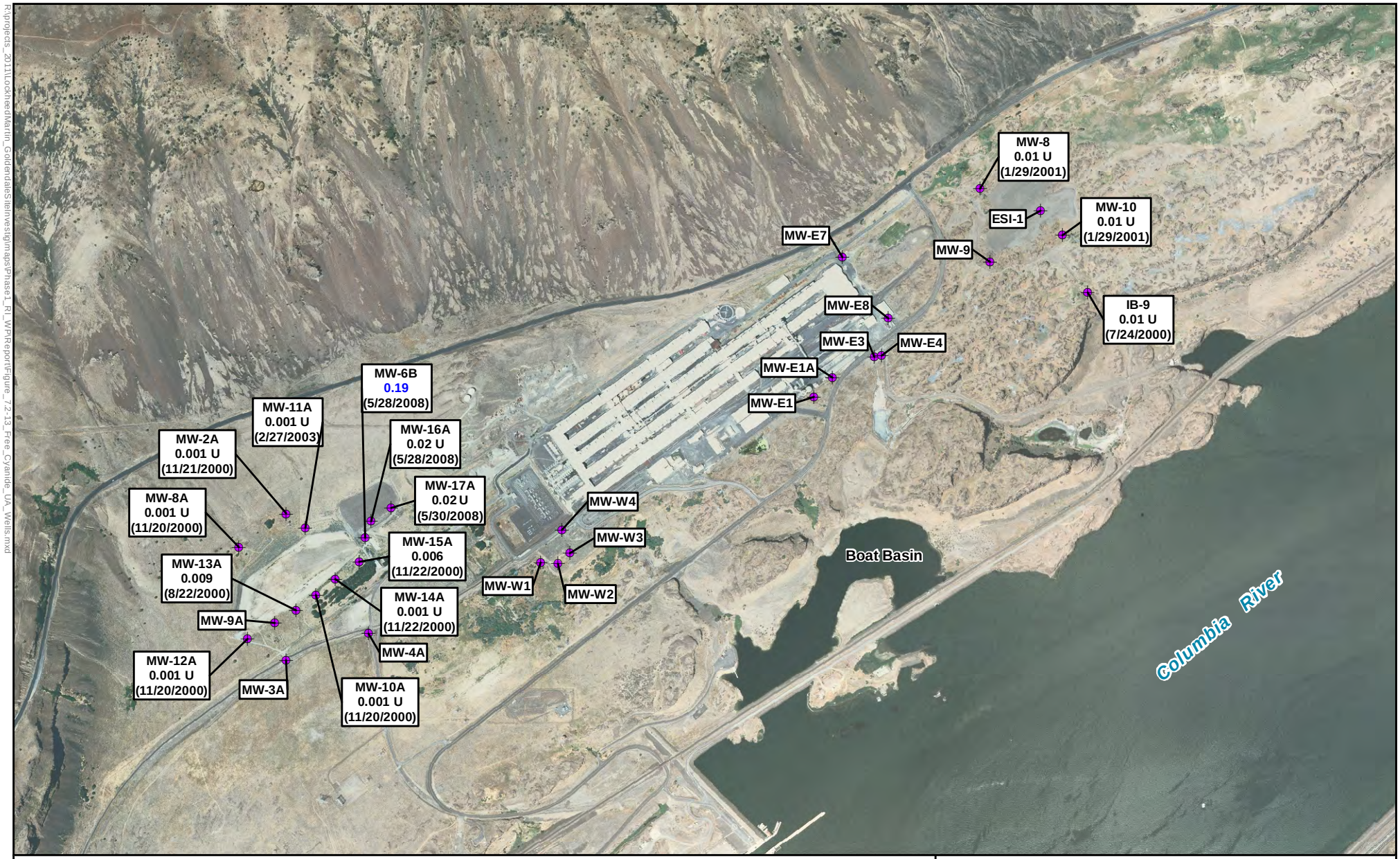
Cyanide is one of the main groundwater COPC and has been included in all of the groundwater characterization and monitoring programs at the site. Cyanide is derived from SPL, which was managed in various ways over the history of plant operations. Cyanide occurs in a variety of chemical forms that include hydrogen cyanide and the cyanide anion (collectively referred to as free cyanide), various weakly complex metal cyanides such as copper cyanides, and strongly complex metal cyanides, such as iron cyanides.

The toxicity of cyanide is significantly higher for free cyanide than for the strongly complexed metal cyanides, and cyanide cleanup levels in groundwater are typically calculated based on the toxicity of free cyanide. The analytical program at the site has incorporated analysis of free cyanide, WAD cyanide that measures free cyanide and weakly complex metal cyanides, as well as total cyanide that measures the total concentration of free cyanide and all of the complex metal cyanides. For the long-term groundwater monitoring programs at the site, total cyanide concentrations have been routinely screened against the MCL for cyanide of 0.200 mg/L, which represents a conservative, if not inappropriate, comparison.

Figures 7.2-13, 7.2-14, and 7.2-15 show the distribution of free cyanide in the UA, BAU, and BAL, respectively. Based on the available data, free cyanide has been detected in the UA at concentrations (maximum of 0.19 mg/L) below the MCL 0.200 mg/L, but above the MTCA Method B formula value of 0.0096 mg/L in MW-6B located near the West SPL Storage Area and WSI during 2008.

Figure 7.2-16, shows the distribution of WAD cyanide in the UA at the site. This chemical was analyzed only during the more recent independent investigations conducted at 5 SWMUs (informally termed the "five sites" investigation) by Lockheed Martin. WAD cyanide was detected at concentrations above MTCA Method B formula value of 0.0096 mg/L at two wells (MW-W1, MW-W3, and MW-E1A), but below the MCL of 0.200 mg/L. WAD cyanide has not been analyzed for in the BAU or BAL wells.

Total cyanide has been detected above both the MCL and the MTCA Method B formula value for free cyanide within the UA and BAL aquifer zones at the site (Figures 7.2-17 and 7.2-19). For the BAU, total cyanide was detected above MTCA Method B formula value, but below the MCL in well IB-1 (Figure 7.2-18). Elevated concentrations of total cyanide are most commonly detected near the West SPL Storage Area and WSI. Highest concentrations of total cyanide are associated with monitoring wells at and downgradient of the West SPL Storage Area and include MW-16A, MW-17A, MW-15A, MW-6B and MW-13A. Some of these wells are also in close proximity to the WSI (MW-15A and MW-13A). At the eastern end of the site near the ESI total cyanide concentrations are significantly lower than at the western end of the site and do not exceed the cyanide MCL.



Legend

Unconsolidated Aquifer Well

MW-18
2.6
(3/13/2007)

Well Identification
Concentration
Sampling Date

Note: Reported concentrations represent the most recent data collected from individual wells from 2000 to present.

Screening Levels

0.2 mg/L MCL

0.0096 mg/L MTCA Method B

MCL: Maximum Contaminant Level
MTCA: Model Toxics Control Act

N
W E
S

0 500 1,000 2,000
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 7.2-13
Most Recent Concentrations for Free Cyanide
In Unconsolidated Aquifer (UA) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Legend

Uppermost Basalt Aquifer Well

MW-18
2.6
(3/13/2007)

Well Identification
Concentration
Sampling Date

Note: Reported concentrations represent the most recent data collected from individual wells from 2000 to present.

Note: All are non-detected (U).

N
W E
S

0 500 1,000 2,000
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 7.2-14
Most Recent Concentrations for Free Cyanide
In Uppermost Basalt Aquifer (BAU) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_Goldendale\Site\investig\maps\Phase1_RI_WP\ReportFigure_7.2-14_Free_Cyanide_BAU_Wells.mxd

Legend

Lower Basalt Aquifer Well

MW-18
2.6
(3/13/2007)

Well Identification
Concentration
Sampling Date

Note: Reported concentrations represent the most recent data collected from individual wells from 2000 to present.

Note: All are non-detected (U).

N
W E
S

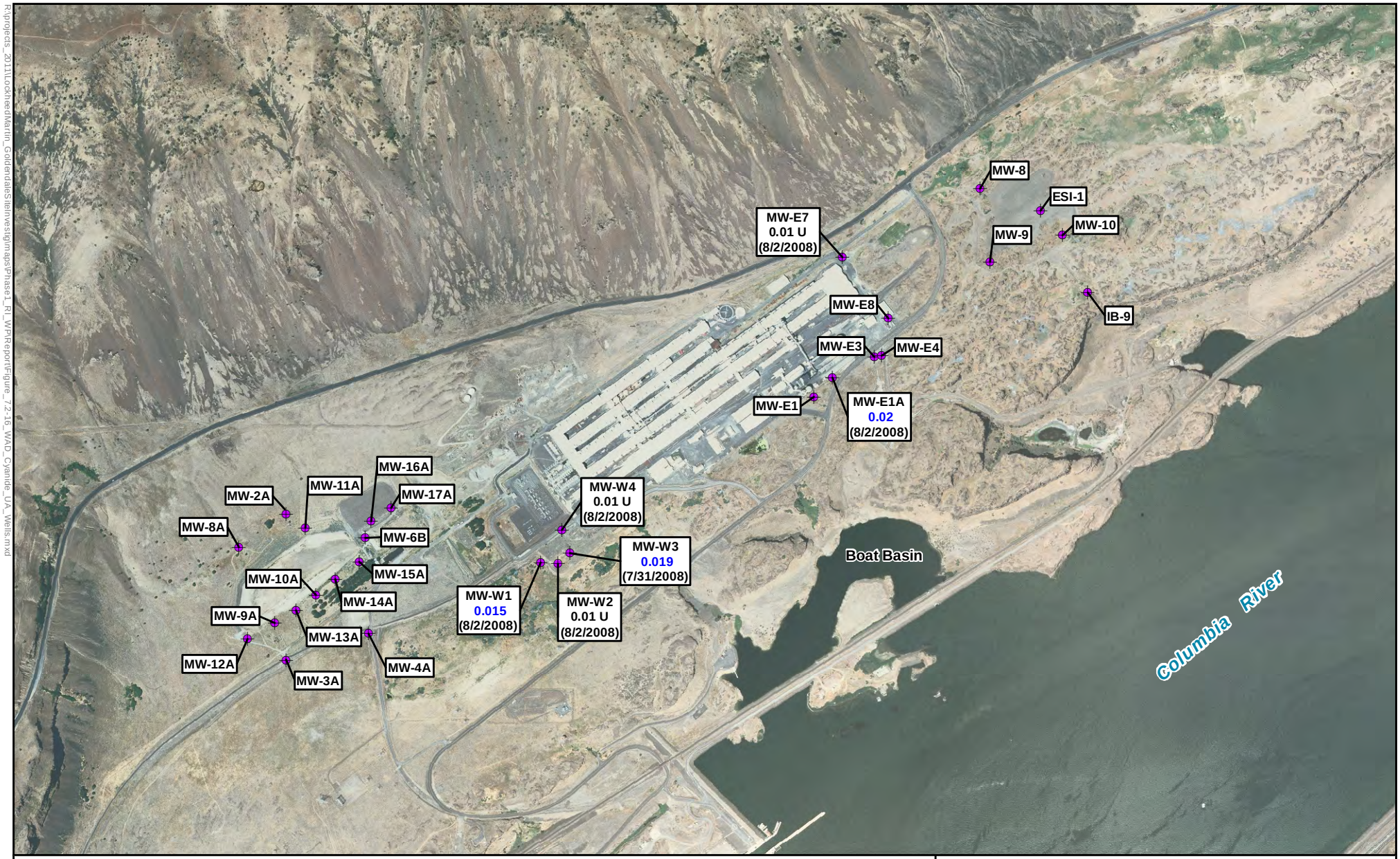
0 500 1,000 2,000
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 7.2-15
Most Recent Concentrations for Free Cyanide
In Lower Basalt Aquifer (BAL) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_Goldendale\Siteinvestigmaps\Phase1_RI_WP\Free_Cyanide_Latest_LBA.mxd



Legend

Unconsolidated Aquifer Well

MW-18
2.6
(3/13/2007)

Well Identification
Concentration
Sampling Date

Screening Levels

0.2 mg/L MCL

0.0096 mg/L MTCA Method B

MCL: Maximum Contaminant Level
MTCA: Model Toxics Control Act

Note: Reported concentrations represent the most recent data collected from individual wells from 2000 to present.

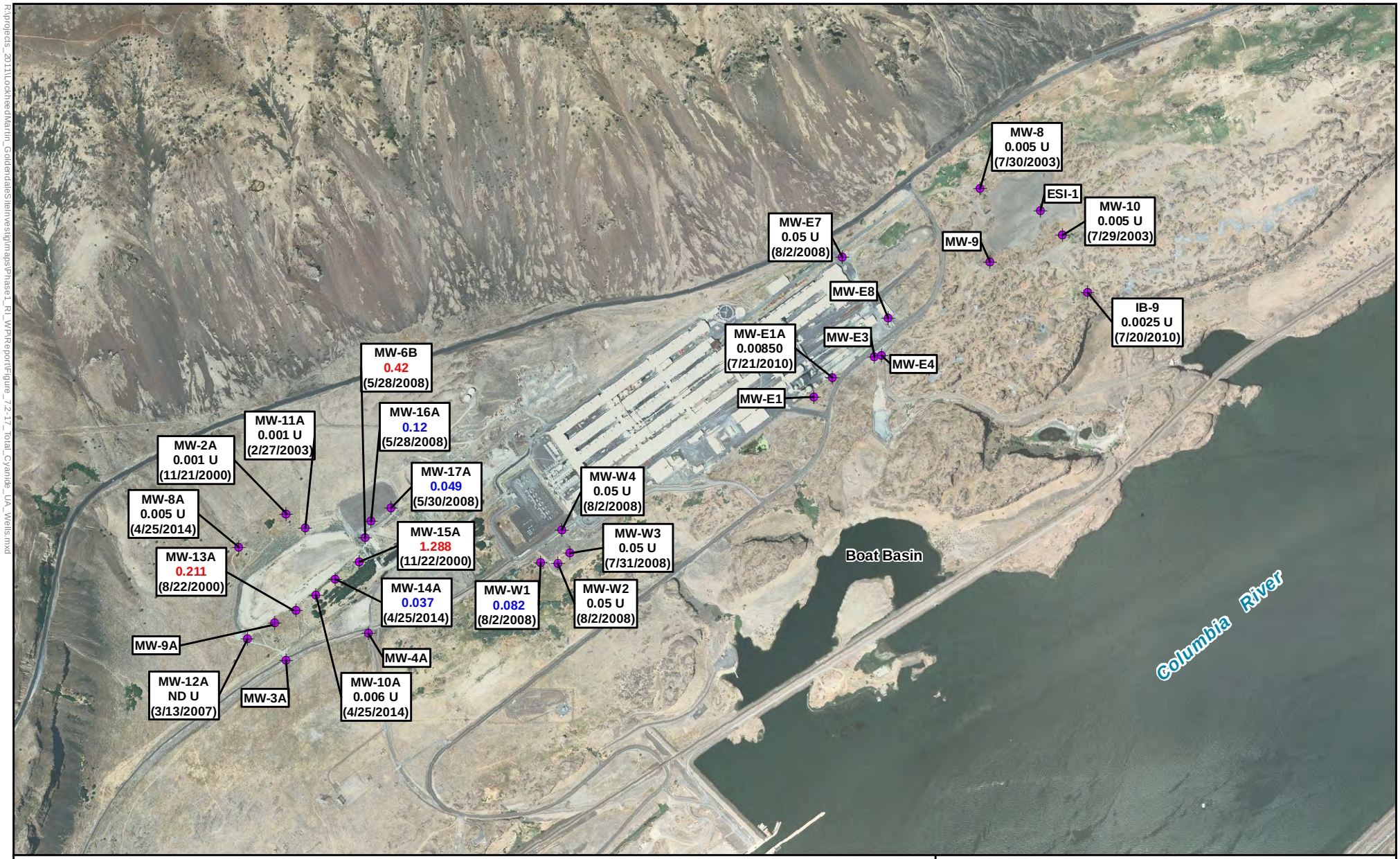
Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

N
W E
S

0 500 1,000 2,000
Feet

Figure 7.2-16
Most Recent Concentrations for WAD Cyanide In Unconsolidated Aquifer (UA) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington



Legend

Unconsolidated Aquifer Well

MW-18
2.6
(3/13/2007)

Well Identification
Concentration
Sampling Date

Screening Levels

0.2 mg/L MCL

0.0096 mg/L MTCA Method B

MCL: Maximum Contaminant Level
MTCA: Model Toxics Control Act

Note: Reported concentrations represent the most recent data collected from individual wells from 2000 to present.

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

N
W E
S

0 500 1,000 2,000
Feet

Figure 7.2-17
Most Recent Concentrations for Total Cyanide
In Unconsolidated Aquifer (UA) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_GoldendaleSite\Investigmaps\Phase1_RI_WP\ReportFigure_7.2-17_Total_Cyanide_UA_Wells.mxd

Legend

Uppermost Basalt Aquifer Well

MW-18
2.6
(3/13/2007)

Well Identification
Concentration
Sampling Date

Screening Levels

0.2 mg/L MCL

0.0096 mg/L MTCA Method B

MCL: Maximum Contaminant Level
MTCA: Model Toxics Control Act

Note: Reported concentrations represent the most recent data collected from individual wells from 2000 to present.

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

N
W E
S

0 500 1,000 2,000
Feet

Figure 7.2-18
Most Recent Concentrations for Total Cyanide
In Uppermost Basalt Aquifer (BAU) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_Goldendale\Site\investig\maps\Phase1_RI_WP\ReportFigure_7.2-18_Total_Cyanide_BAU_Wells.mxd

Legend

Lower Basalt Aquifer Well

MW-18
2.6
(3/13/2007)

Well Identification
Concentration
Sampling Date

Note: Reported concentrations represent the most recent data collected from individual wells from 2000 to present.

Screening Levels

0.2 mg/L MCL

0.0096 mg/L MTCA Method B

MCL: Maximum Contaminant Level
MTCA: Model Toxics Control Act

N
W E
S

0 500 1,000 2,000
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 7.2-19
Most Recent Concentrations for Total Cyanide
In Lower Basalt Aquifer (BAL) Wells

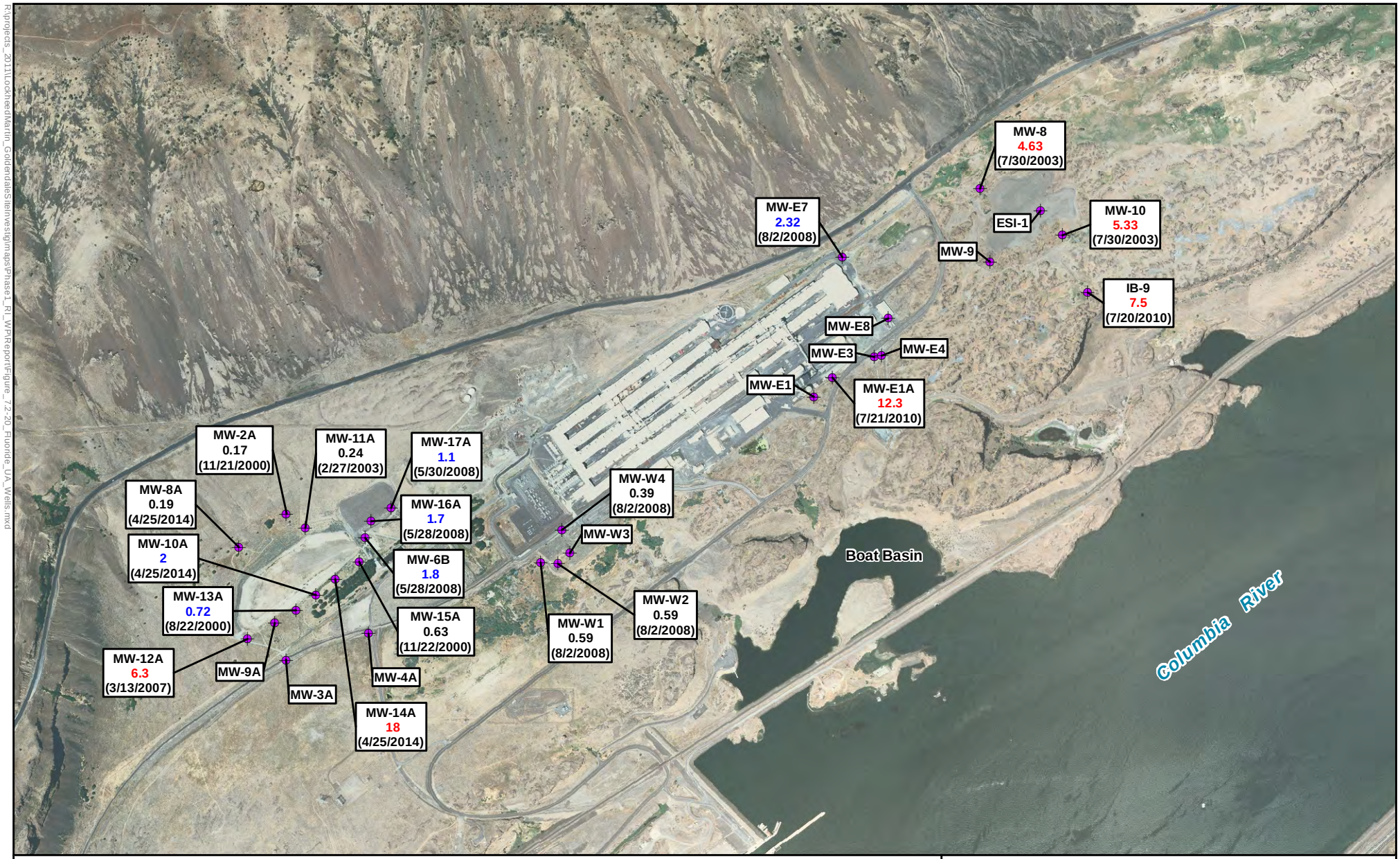
Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

For the BAL zone, total cyanide was detected in well BAMW-3 (0.725 mg/L) at concentrations above the MCL, which is based on free cyanide. This well is located near the NPDES ponds and the static water level was close to the elevation of the Columbia River. Total cyanide was detected in facility production well #3 (0.00860 mg/L) and production well #2 (0.0362 mg/L) during the most recent sampling round in July 2010. The *total* cyanide concentration in production well #2 exceeded MTCA Method B formula value for *free* cyanide of 0.0096 mg/L. *Total* cyanide was also detected above the *free* cyanide MTCA Method B formula value in wells BAMW-4 (0.0112 mg/L) and IB-8 (0.0355 mg/L), but below the MCL during 2010.

A spike of total cyanide, fluoride, and sulfate was initially noted during 1996 within a few years of landfill cap construction in wells associated with the West SPL Storage Area (Goldendale Aluminum Company 1996a,b; CH2MHill 1996a,b,c). This contaminant increase was reportedly related to a blocked culvert in the WSI sludge line drainage ditch on the south side of West SPL Storage Area during March 1996. At this same time, settlement and cracking on the south and west slopes above the drainage ditch and topographically below the capped pot liner pile was noted. The spike in groundwater concentrations was not thought to be related to the problems with the design and functioning of the cap, but was reportedly related to shallow soil contamination associated with the drainage ditch located next to the wells (CH2MHill 1996a,b,c). These surface drainage problems were later corrected during fall 1996 and summer 1997 (Goldendale Aluminum Company 1997c, CH2MHill 1996c). The chemical groundwater monitoring program at this unit ceased in 2008. The West SPL Storage Area is discussed in detail in Section 6.3.2.

7.2.5.2 Fluoride

Fluoride is also one of the main site COPC and always has been included in the monitoring programs for the ESI and WSI. Figure 7.2-20, 7.2-21, and 7.2-22 show the distribution of fluoride within the UA, BAU, and BAL, respectively. Based on the most recent data, fluoride has been detected in the UA and BAL at concentrations above both the MCL of 4 mg/L and the MTCA Method B formula value of 0.640 mg/L. For the BAU, fluoride was detected at a concentration exceeding the MTCA Method B formula value only in one well near the ESI (IB-11) during 2003. The extent of fluoride in groundwater exceeding screening levels includes wells at and downgradient (south or southwest) of the ESI, NESI, eastern end of the plant, NPDES ponds, WSI, and West SPL Storage Area.



Legend

Unconsolidated Aquifer Well

MW-18
0.12
(4/25/2014)

Well Identification
Concentration
Sampling Date

Screening Levels

4 mg/L MCL

0.640 mg/L MTCA Method B

MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act

Note: Reported concentrations represent the most recent data collected from individual wells from 2000 to present.

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

N
W E
S

0 500 1,000 2,000
Feet

Figure 7.2-20
Most Recent Concentrations for Fluoride
In Unconsolidated Aquifer (UA) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_Goldendale\SiteInvestigMaps\Phase1_RI_WP\ReportFigure_7.2-20_Fluoride_UA_Wells.mxd

Legend

Uppermost Basalt Aquifer Well

MW-18
0.12
(4/25/2014)

Well Identification
Concentration
Sampling Date

Screening Levels

4 mg/L MCL

0.640 mg/L MTCA Method B

MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act

Note: Reported concentrations represent the most recent data collected from individual wells from 2000 to present.

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

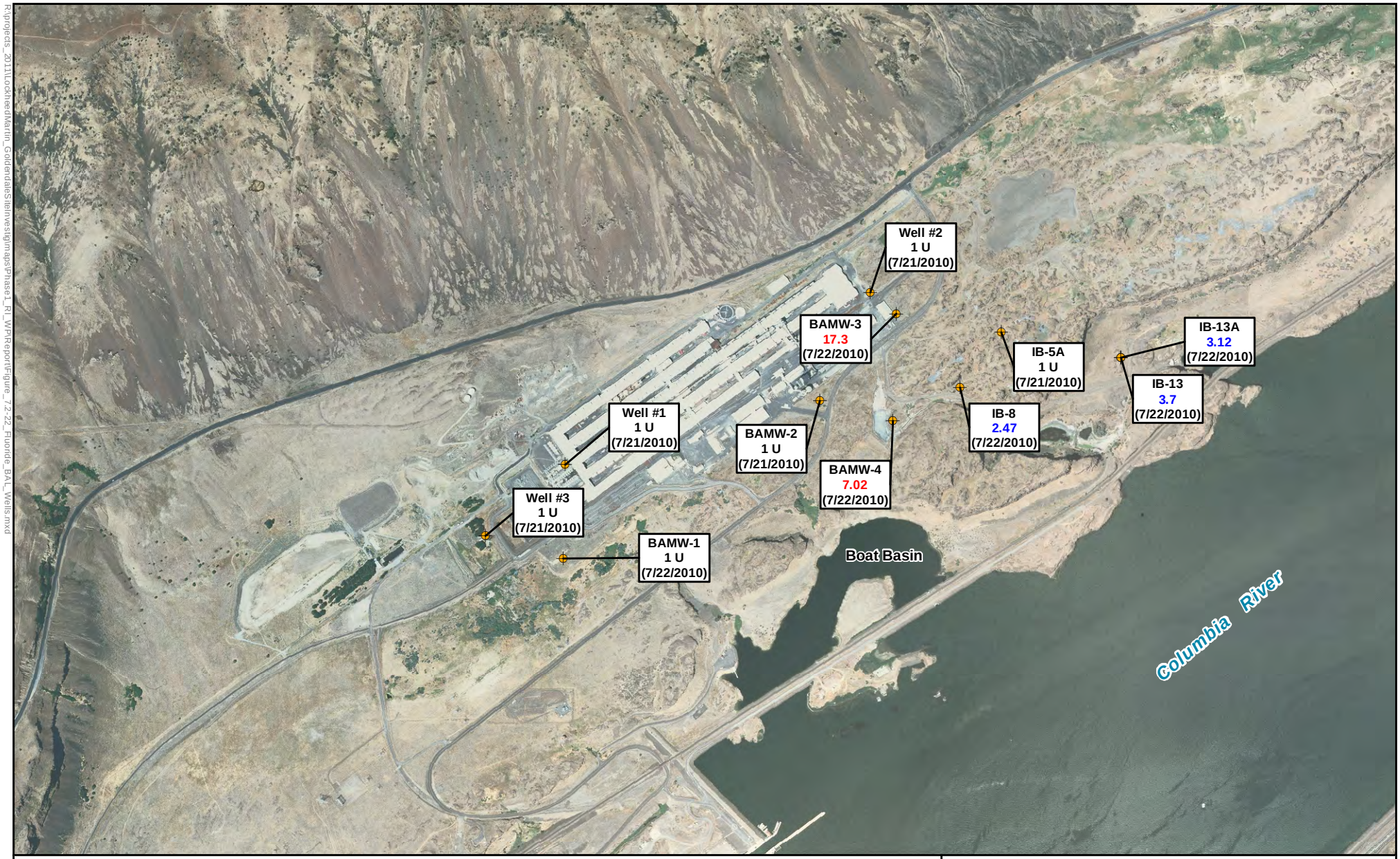
N
W E
S

0 500 1,000 2,000
Feet

Figure 7.2-21
Most Recent Concentrations for Fluoride
In Uppermost Basalt Aquifer (BAU) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_Goldendale\Site\investigmaps\Phase1_RI_WP\Report\Figure_7.2-21_Fluoride_BAU_Wells.mxd



Legend

Lower Basalt Aquifer Well

MW-18
0.12
(4/25/2014)

Well Identification
Concentration
Sampling Date

Note: Reported concentrations represent the most recent data collected from individual wells from 2000 to present.

Screening Levels

4 mg/L MCL

0.640 mg/L MTCA Method B

MCL: Maximum Contaminants Level
MTCA: Model Toxics Control Act

N
W E
S

0 500 1,000 2,000
Feet

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

Figure 7.2-22
Most Recent Concentrations for Fluoride
In Lower Basalt Aquifer (BAL) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

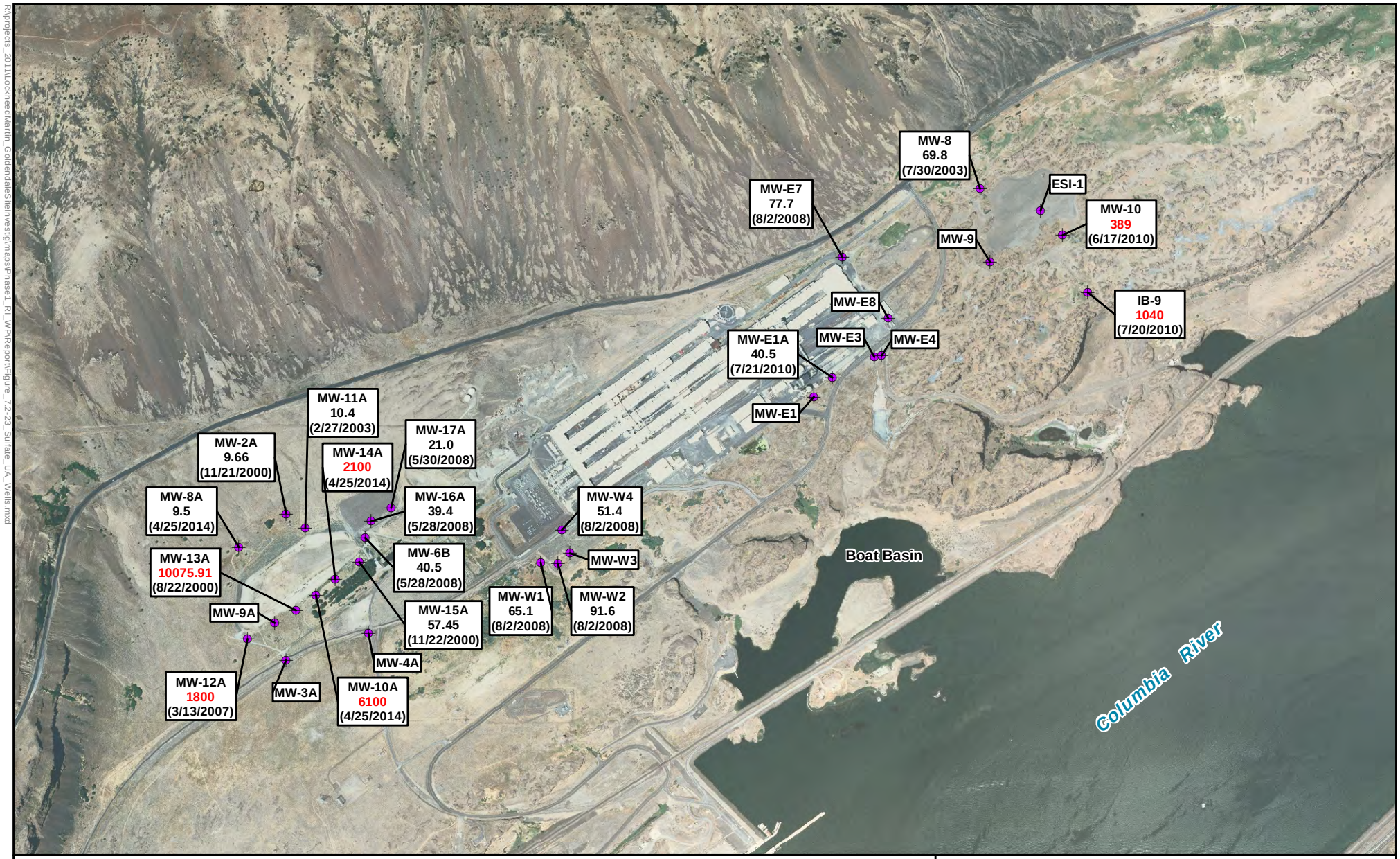
For the BAL zone, some of the highest recent fluoride concentrations detected at the site were found in BAMW-3 (17.3 mg/L) and BAMW-4 (7.02 mg/L) during 2010. Fluoride concentrations in the IB-13/IB-13A well cluster located about 1,000 feet from the Columbia River were 3.7 mg/L and 3.12 mg/L, respectively during 2010 and exceed the MTCA Method B formula value, but not the MCL.

7.2.5.3 Sulfate and Other Plume Indicators

Sulfate is a common groundwater plume indicator at aluminum reduction facilities because of its relatively high solubility and common presence in aluminum reduction plant wastes. Other chemicals in the same category as sulfate include chloride and to a lesser extent iron. Figures 7.2-23, 7.2-24, and 7.2-25 show the site-wide distribution of sulfate in the UA, BAU, and BAL, respectively. Sulfate concentrations have been compared against the secondary MCL of 250 mg/L consistent with the screening/cleanup levels used for the ESI and WSI. Note that secondary MCLs do not represent health-based criteria and are based on aesthetic, cosmetic, and technical effects such as corrosion (USEPA 2014b). A MTCA Method B formula value has not been established for sulfate.

Results show the presence of sulfate above the secondary MCL in all three aquifer zones based on the most recent data. A groundwater plume appears to be present at and down gradient (southwest) of the WSI and the ESI. Elevated sulfate concentrations have also been found in the BAL wells located the vicinity of the NPDES ponds.

Chloride and iron have been included in the analytical program for the WSI and ESI, respectively. During 2014 at the WSI, chloride was detected in all 5 down gradient wells at the WSI, but below the secondary MCL of 250 mg/L (GeoPro 2014). During the site-wide investigation in 2010 chloride was detected in all of the 15 wells sampled during this program at concentrations ranging between 2.82 and 400 mg/L (URS 2011). During 2010, iron remained above the secondary MCL of 0.3 mg/L at well MW-10 at the ESI (ARCADIS 2010).



Legend

Unconsolidated Aquifer Well

MW-18
2.6
(3/13/2007)

Well Identification
Concentration
Sampling Date

Screening Levels

250 mg/L Secondary MCL

MCL: Maximum Contaminant Level

Note: Reported concentrations represent the most recent data collected from individual wells from 2000 to present.

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

N
W E
S

0 500 1,000 2,000

Feet

Figure 7.2-23
Most Recent Concentrations for Sulfate
In Unconsolidated Aquifer (UA) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Legend

Uppermost Basalt Aquifer Well

MW-18
2.6
(3/13/2007)

Well Identification
Concentration
Sampling Date

Screening Levels

250 mg/L Secondary MCL

MCL: Maximum Contaminant Level

Note: Reported concentrations represent the most recent data collected from individual wells from 2000 to present.

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

N
W E
S

0 500 1,000 2,000

Feet

Figure 7.2-24
Most Recent Concentrations for Sulfate
In Uppermost Basalt Aquifer (BAU) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_GoldendaleSite\investigmaps\Phase1_RI_WP\ReportFigure_7.2-24_Sulfate_BAU_Wells.mxd

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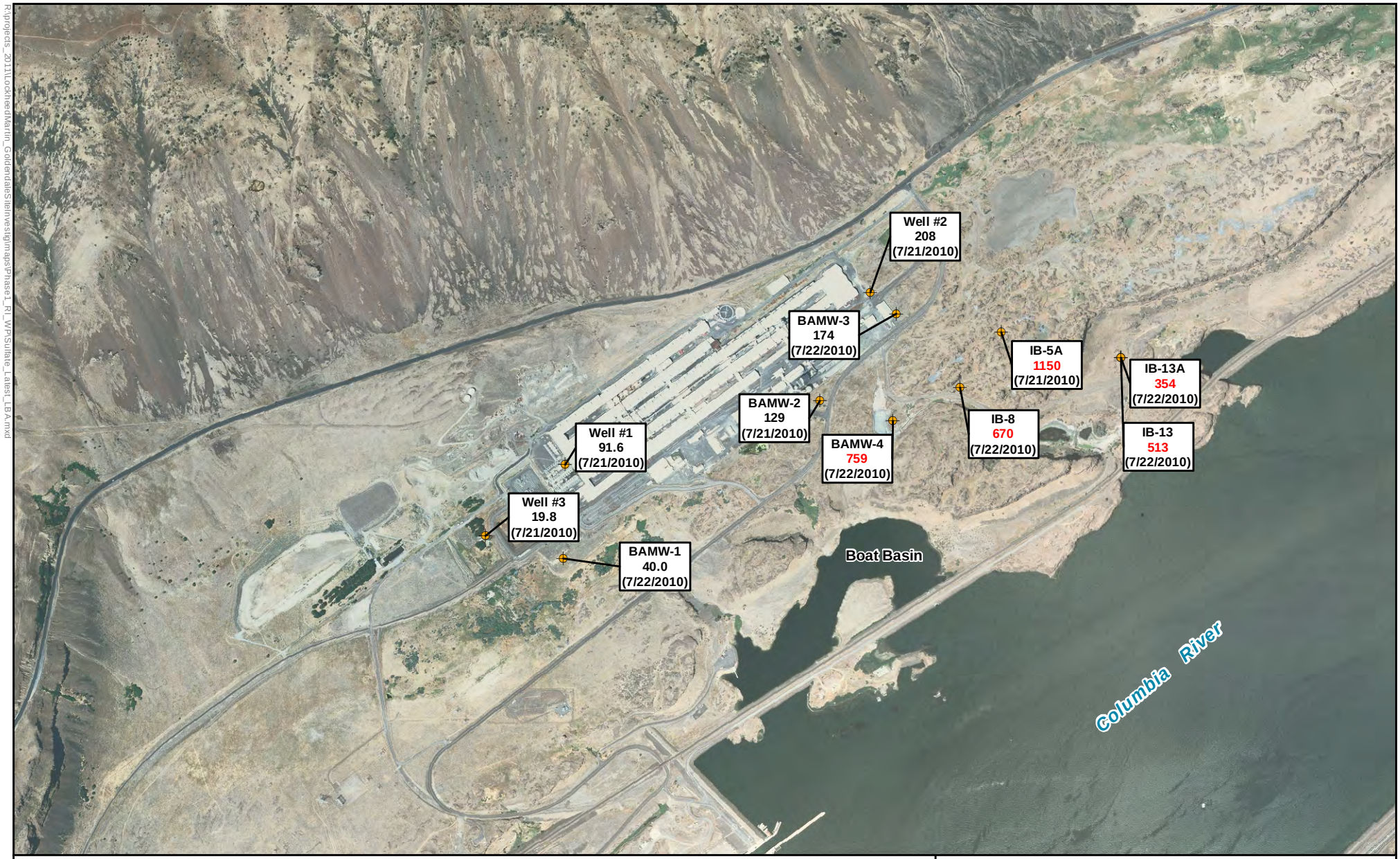


Legend

Lower Basalt Aquifer Well

MW-18
2.6
(3/13/2007)

Well Identification
Concentration
Sampling Date

Screening Levels

250 mg/L Secondary MCL

MCL: Maximum Contaminant Level

Note: Reported concentrations represent the most recent data collected from individual wells from 2000 to present.

Imagery Data Sources: USDA NAIP 1-m Imagery, 2006.

N
W E
S

0 500 1,000 2,000

Feet

Figure 7.2-25
Most Recent Concentrations for Sulfate
In Lower Basalt Aquifer (BAL) Wells

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

7.2.5.4 Other Chemicals of Potential Concern

Groundwater has been sampled for other chemicals related to SWMU-specific investigations as well as the site-wide groundwater investigation and including: TPH, VOCs, PAHs, PCBS and metals.

Total Petroleum Hydrocarbons

Gasoline range and diesel range petroleum hydrocarbons were not detected in any of the sampled wells for the WELF groundwater investigation (MW-W1, MW-W2, and MW-W4), the EELF groundwater investigation (MW-E1A), or North and South Pot Liner Soaking Stations investigations (MW-E7).

Volatile Organic Compounds

VOCs were not detected in groundwater in the four BAMW-series wells in 2010, during the WELF groundwater investigation, or during the North and South Pot Liner Soaking groundwater investigation (MW-E7). VOCs were not detected in ESI monitoring wells during 1985. VOCs were not detected during the groundwater investigation of the WELF (MW-W1, MW-W2, and MW-W4), the EELF (MW-E1A) or the North and South Pot Liner Soaking Stations (MW-E7).

Polynuclear Aromatic Hydrocarbons and Other SVOCs

PAHs including benzo(a)pyrene and other carcinogenic PAHs were not detected in groundwater samples collected during 1986 at the ESI. PAHs and other SVOCs were not detected during the groundwater investigations of the WELF (MW-W1, MW-W2, and MW-W4), the EELF (MW-E1A), or the North and South Pot Liner Soaking Stations (MW-E7).

Polychlorinated Biphenyls

PCBs were not detected in shallow groundwater samples collected in 2008 during groundwater investigation of the WELF (MW-W1, MW-W2, and MW-W4), the EELF (MW-E1A), or the North and South Pot Liner Soaking Stations (MW-E7).

Metals

Several metals including: arsenic, barium, cadmium, chromium, mercury, selenium, silver, and zinc were included in the site-wide groundwater investigation during 2010. Of these, only barium, total

chromium, and selenium were detected at low concentrations, but below MTCA Method A cleanup levels and MCLs during sampling of the BAMW series wells during 2010 (URS 2011).

Arsenic (8.46 µg/L), total chromium (285 µg/L), and lead (212 µg/L) were detected at the WELF at concentrations above MTCA Method A cleanup levels of 5 µg/L, 50 µg/L, and 15 µg/L, respectively, during the WELF groundwater investigation in 2008 (URS 2008f). However, because these concentrations were detected in the upgradient well (MW-W4) and because only unfiltered samples were collected with a bailer, the results were considered to be potentially biased high and may not be representative of groundwater chemical concentrations at this location (Tetra Tech 2010).

There are also database records of several historical positive detections of geochemical plume indicator constituents including: sodium, manganese, and iron. These metals represent naturally occurring groundwater constituents that can also indicate groundwater geochemistry or the presence of a contaminant plume.

7.2.6 Identified Groundwater Data Gaps and Data Needs

The following data gaps and data needs have been identified:

- Confirm and update the site hydrogeologic conceptual site model to reflect current conditions. Additional site-wide investigation is needed.
- Detailed hydrostratigraphic characterization of the UA, BAU, and BAL, including occurrence of groundwater, lithology, and continuity of permeable zones within the basalt.
- Evaluation of aquifer characteristics for the UA, BAU, and BAL aquifer zones including: groundwater flow directions, horizontal and vertical gradients, hydraulic conductivity, and aquifer interconnection within the underlying basalt aquifer system.
- Characterization of current groundwater quality for site COPC, geochemistry, and background concentrations for the UA, BAU, and BAL aquifer zones.
- Characterization in the Production Area to determine hydrogeology and water quality concentrations. Further characterization at the east end of the Production Area near the filled drainage channel and associated NPDES drainage. There is a general lack of groundwater characterization in these areas.
- Evaluation of potential releases to groundwater for SWMUs and other source areas that have not been characterized.

- Better definition and refinement regarding the lateral extent of contamination for various aquifer zones to evaluate the groundwater to surface water pathway.

- Development of an appropriate groundwater screening level for sulfate.

- Development of soil screening levels protective of groundwater for fluoride and cyanide consistent with the requirements of MTCA.

- Verification of the physical condition of the wells and ancillary equipment (e.g., pumps). Evaluation of the construction details for existing wells to determine which wells are appropriate from a construction standpoint for inclusion in the RI sampling program. Verification of well elevation and location information. These data needs should be addressed before completion of the Phase 2 Work Plan.

- Identification of wells that may serve as potential pathways for contaminant migration that may require physical modification or decommissioning as appropriate.

7.3 WETLANDS

Investigation of wetlands was included in the Agreed Order to "determine if any fallout from aluminum smelter emissions affected these areas." No other specific objectives for the wetlands AOC are noted in the Agreed Order.

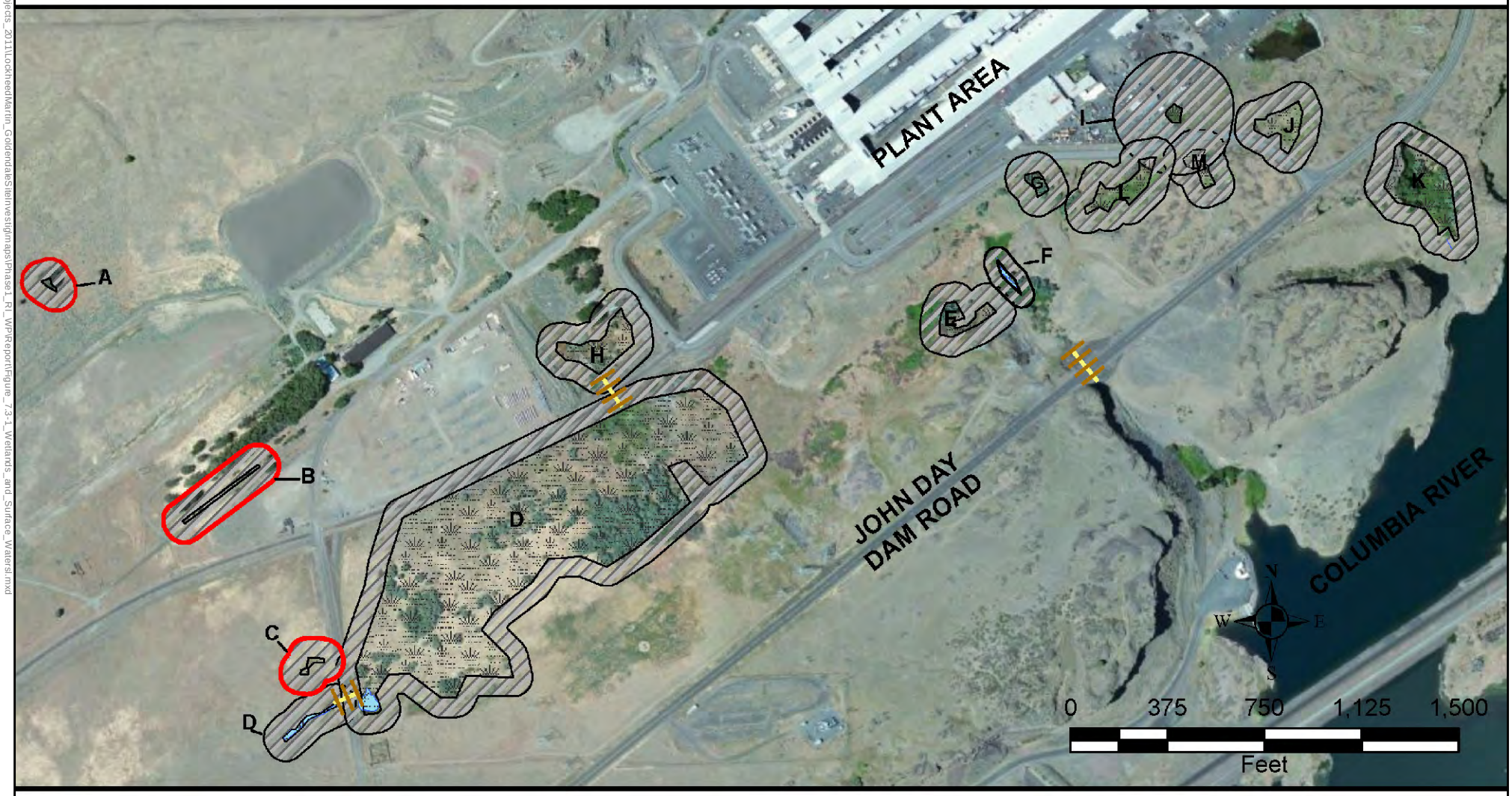
In a letter dated September 2, 2011, the Yakama Nation provided comments to DOE regarding whether wetlands adjacent to onsite SWMUs may have been, or continue to be, impacted by site activities and requested that "sediment" sampling be conducted (Yakama Nation 2011). Their letter was accompanied by a map of onsite wetlands based on the U.S. Fish and Wildlife Service National Wetland Inventory. Since wetlands were an identified stakeholder concern, NSC voluntarily elected to perform wetland delineation and characterization of wetland areas on a portion of the facility. Wetland delineation also was independently conducted by Lockheed Martin for a portion of the Smelter Sign Area (SWMU 31).

7.3.1 Previous Investigations

NSC conducted two wetland investigations. First, an evaluation was conducted to classify potential wetland areas near the former Production Area (PGG 2013a). Second, an investigation of soil types and groundwater conditions was conducted at Wetland D, which is the largest wetland located adjacent and downgradient from the former production area (PGG 2013b). Relevant figures and tables for these investigations are provided in Appendix B-3.

7.3.1.1 Wetland Delineation and Evaluation

Potential wetlands adjacent to the south, west, and north of the former production area were evaluated in May 2012 (PGG 2013a). The evaluation consisted of review of available site information, field survey of the evaluation area to identify and delineate wetlands and preparation of a site wetland map. The wetland evaluation only included sampling and analysis of surface soil for the purpose of wetland classification. The results of the wetland evaluation are reported in Septic System, Wetlands, Upper Fluoride Area, and Soil Background Investigation Report (PGG 2013a). The locations of the delineated wetlands are shown in Figure 7.3-1.



Legend

- Wetland Area
- Wetlands Not Regulated
- Buffer
- Surface Water
- Culvert

N
W E
S

Source: PGG 2013

Figure 7.3-1
Wetland and Surface Water
Location Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Review of available site information indicated hydric soils are mapped to the east, south, and southwest of the production area (refer to Appendix B-3). Hydric soils are typically associated with wetlands. The NWI identified several wetlands located southwest, south, and southeast of the production area; NWI identified wetlands southeast of the production area are coincident with the existing NPDES Ponds A through D; however, these ponds do not meet the definition of waters of the United States pursuant to 33 CFR 328.3 (a)(8) due to their status as constructed settlement ponds operated under a NPDES permit.

Using Corps of Engineers wetland delineation methodology, and Klickitat County Critical Areas Ordinance No. 012704 criteria, a field survey was conducted to determine whether positive wetland indicators (vegetation, soils, and hydrology) were present to designate and delineate wetland areas.

The field survey resulted in delineation of thirteen wetlands designated Wetlands A through M. The wetlands are located south, west, and northwest of the former production area and are shown on the Wetland and Surface Water Location Map of Figure 7.3-1. A fourteenth wetland has been identified by Lockheed Martin northeast of the former production area that will be investigated as part of the Smelter Sign Area (SWMU 31) and is discussed separately in Section 6.5.4.

The thirteen wetlands consist primarily of Category III and IV Palustrine emergent and/or scrub/shrub wetlands. Palustrine wetlands represent a category of inland, non-tidal wetlands characterized by the presence of trees, shrubs, and emergent vegetation (vegetation that is rooted below water but grows above the surface). Category III and IV wetlands represent wetlands with a moderate to low level functions that generally have been disturbed in some ways and are often smaller, less diverse, and/or more isolated from other natural resources than other higher functional category wetlands. The wetlands have generally been used for livestock grazing and have been historically disturbed to a degree by grading, clearing, and other activities.

The least physically disturbed wetlands are I and K and wetland I represents the only Category II wetland. Wetlands A, B, C are the smallest wetland areas (less than 2,500 square feet) and would not be regulated for development under the Klickitat County Critical Areas ordinance.

Recharge associated with the identified wetlands comes primarily from springs and shallow groundwater flow within the UA, along with snow melt and runoff from the Production Area. Year-

round or seasonal surface water is present in most of the wetlands although the overall area/volume of water is small. Further description of the wetland areas is as follows:

- **Wetland A**: Wetland A occurs at the site of a spring which has been piped to an overflowing livestock watering trough.

- **Wetlands B and H**: Stormwater from the northern edge of the production area drains by ditch towards Wetlands B and H, and from H flows through a culvert to Wetland D. Standing surface water is present during wetter months of the year in Wetlands B and H.

- **Wetland C:** Seasonal standing water is present in Wetland C, located adjacent to the north of the western end of Wetland D. Water may be derived from groundwater seepage associated with the spring at the western margin of Wetland D.

- **Wetland D**: A seasonal spring occurs at the southwestern margin of Wetland D, flows into a small pond, and then flows westward through a roadway culvert to pool in an open area to the west where it infiltrates into the ground (see photographs, Appendix B-3). Wetland D represents the largest wetland area at the facility.

- **Wetland E**: A seasonal spring south of the plant parking lot entrance road flows through Wetland E and infiltrates into the ground before reaching the flow channel located in Wetland F.

- **Wetland F**: A spring south of the plant parking entrance road, east from the Wetland E spring, flows in an established channel through Wetland F but infiltrates into the ground before reaching the culvert beneath the John Day Dam Road fill. Wetland F occupies a ravine that becomes deeper and wider south of the John Day Dam Road and ends at the Boat Basin near the TFAS (western intermittent drainage referred to in historical reports and Section 7.1, Sediment AOC). No surface water has been observed in the ravine downstream of John Day Dam Road during the period of 2010 through 2013.

- **Wetlands G, J, L and M**: Localized surface water was observed in Wetlands G, J, L, or M only during the wettest winter. These wetlands may receive water from stormwater runoff and/or shallow groundwater flow from the production area. Wetland J may receive water from the stormwater retention pond.

- **Wetland I**: Surface water is present in Wetland I and may be present year-round. Wetland I may receive water from stormwater runoff and shallow groundwater flow from the production area.

- **Wetland K**: A seasonal spring at the south side and base of John Day Dam Road flows through Wetland K in a shallow and moderately well-developed channel (eastern intermittent drainage referred to in historical reports and Section 7.1, Columbia River Sediments AOC). During wetter months the flow appears to infiltrate into the ground at the lower end of the wetland and does not appear to reach the Columbia River at the Boat Basin. Wetland K may receive water from the stormwater retention pond.

7.3.1.2 Soil and Groundwater at Wetland D

An investigation of Wetland D was conducted in between November 2012 and April 2013 to evaluate soil and groundwater conditions at the wetland. Wetland D is the largest of the identified site wetlands and is located immediately down gradient from the production area. The investigation consisted of a geophysical resistivity survey, shallow soil borings, and a groundwater assessment. The groundwater assessment included installation of four shallow piezometers, and measurement of water levels in the four piezometers and four nearby shallow monitoring wells. Results of the investigation are reported in Geophysical, Soil, and Groundwater Investigation of Wetland D (PGG 2013b). Groundwater flow in the vicinity of Wetland D was found to be to the southwest consistent with the overall groundwater flow pattern in this part of the site (refer to Appendix B-3) for the water-level elevation contour map in the vicinity of Wetland D.

An electrical resistivity survey was conducted to characterize geologic features, particularly the surface of basalt beneath the wetland that may influence groundwater movement. The results of the resistivity survey indicate a scoured basalt surface characterized by troughs and ridges that overall slope gently southwestward along the axis of the wetland. These "pothole" features are interpreted to influence the direction of groundwater flow and retain groundwater within a succession of basalt surface potholes (PGG 2013b). Figures from the electrical resistivity survey are included in Appendix B-3.

Twelve shallow hand-auger soil borings were drilled at locations across the wetland to characterize subsurface soil. The upper soil unit consists of micaceous brown fine sand to silty fine sand that is approximately 10 to 12 feet thick; the upper soil is thickest at topographic high points within the wetland. Underlying the silty fine sand is black to greenish black micaceous basaltic medium sand to fine gravel.

The silty fine sand becomes increasingly mottled below approximately 4 feet depth to gleyed soil at the base of the upper silty fine sand soil unit. The mottling and gleyed soil is characteristic of hydric soil. Shallow groundwater was consistently encountered within the gleyed soil at the base of the upper silty fine sand soil unit.

7.3.2 Potential Wetland-Related Exposure and Transport Pathways

Stormwater runoff and shallow groundwater discharge from springs and seeps can accumulate in wetland areas and become ponded surface water. Ponded water could potentially result in exposures of ecological receptors within the wetlands to site-related contaminants.

In most cases, wetland-associated surface water infiltrates into the ground at locations that are a significant distance from the Columbia River. Conceptually, wetland surface water infiltrates into the ground a relatively short distance downstream of a given wetland and may migrate downward and into the underlying basalt aquifers where vertical and lateral flow may eventually result in discharge to the Columbia River. Potential examples include Wetlands D, H, I, G, J, L, and M.

In other cases, surface water moves to a ravine as is the case with Wetlands E and F, or unconsolidated slope debris as is the case with Wetland K. Both areas have a more direct pathway for discharge to the Columbia River. Springs have not been observed at lower elevations near the Boat Basin in these two areas in the past few years since aluminum production ceased, which reduced the volume of water potentially released to the subsurface beneath the former production area through pipe leaks and other water use.

Groundwater flow and surface water flow near the Boat Basin downslope from Wetlands E, F, and K will be addressed under the Groundwater in the Uppermost Aquifer AOC and the Columbia River Sediment AOC consistent with the Agreed Order.

7.3.3 Wetland Water Quality

Springs associated with wetlands were sampled during 2012 and 2013 to evaluate presence of site-related contaminants that may be present in surface water. Surface water in Wetlands D, E, F, and K were sampled and analyzed for metals, fluoride, cyanide, PAHs, PCBs, and petroleum hydrocarbons. Complete results of analyses are reported in PGG (2013b) and included in Appendix B-3.

Wetland water results have been compared against freshwater chronic ecologic screening levels (e.g., Criterion Continuous Concentration) that represent Washington state (WAC 173-201A), Clean Water Act Section 3094 or 40 CFR 131 values protective of freshwater ecologic receptors under a chronic exposure scenario. This exposure scenario is anticipated to be plausible, though

conservative for the site wetlands. Note that the wetlands at and near the site represent relatively small and physically disturbed wetlands of relatively low wetland functional categories. Comparison with human health screening levels was not included because of the current restricted access to most of the wetland areas and overall lack of potential human exposures at these isolated wetland features.

Aluminum (maximum of 8,400 µg/L in Wetland D) lead (maximum of 8.1 µg/L in wetland D) and zinc (maximum of 51 µg/L in Wetland D) exceeded the freshwater chronic surface water screening levels provided in Table 3-5 and Table 7.3-1. Aluminum was consistently detected above the freshwater chronic screening level of 87 µg/L at Wetlands D, E, and K; lead exceeded the screening level at Wetlands D and K; and zinc exceeded the screening level at Wetland D. Note that aluminum, lead, and zinc are present in natural waters and that background concentrations for wetland surface waters in the area have not been established. Also, lead and zinc don't represent obvious site COPC based on evaluation of soil, sediment, and groundwater data.

Fluoride was consistently detected in surface water samples collected from the wetlands. For fluoride in surface water, freshwater chronic screening levels have not been established. Potentially relevant to the groundwater transport pathway, fluoride was consistently detected in wetland water samples and detected fluoride concentrations (maximum concentration of 8,700 µg/L in Wetland F) exceeded the drinking water MCL of 4,000 µg/L in water samples collected from Wetlands E, F, and K.

Cyanide, PCBs, and petroleum hydrocarbons were analyzed for and not detected in the collected water samples.

Inorganic chemicals detected in wetland surface water appear to be site-related, but may also result from other sources such as stormwater runoff from roadways, leased land uses, or natural background occurrences. Background concentrations for site-related chemicals in groundwater or surface water have not been established.

Table 7.3-1
Summary of Chemical Concentrations in Wetland Water Samples

Chemical	Surface Water Freshwater Chronic Ecologic Screening Level (µg/L)	Wetland D			Wetland E	Wetland F		Wetland K
		SW-D1	SW-D2 [a]	SWD-1	SW-E	WR-SW1	WR-SW2	SW-K
		5/30/2012	5/30/2012	3/23/2013	5/11/2012	3/8/2012	4/18/2012	5/24/2012
Aluminum	87	<100	**8,400**	**170**	**140**	NA	NA	**2,700**
Arsenic	190	4.5	7.9	<3.3	<3.3	<3	<3	<3.3
Barium	NE	23	110	<28	28	30	29	32
Chromium	57.2	<10	10	<11	<11	<10	<10	<11
Lead	0.54	<1	**8.1**	<1.1	<1.1	<1	<1	**1.4**
Zinc	32.3	28	**51**	NA	NA	NA	<10	NA
Fluoride	NE	490	460	440	6,300	3,300	8,700	4,600
2-Methylnaphthalene	NE	<0.1	<0.1	<0.1	<0.1	0.33	<0.1	<0.097
Acenaphthene	NE	<0.1	<0.1	<0.1	<0.1	0.19	<0.1	<0.097
Anthracene	NE	<0.1	<0.1	<0.1	0.19	<0.1	0.23	<0.097
Pyrene	NE	<0.1	<0.1	<0.1	<0.1	0.34	<0.1	<0.097
Benzo(a)anthracene	NE	<0.01	<0.01	<0.01	0.037	0.021	0.048	0.06
Chrysene	NE	<0.01	<0.01	<0.01	<0.01	0.014	0.025	0.065
Benzo(b)fluoranthene	NE	<0.01	<0.01	<0.01	<0.01	0.021	0.029	0.12
Benzo(k)fluoranthene	NE	<0.01	<0.01	<0.01	<00.1	<0.01	0.013	0.03
Benzo(a)pyrene	NE	<0.01	<0.01	<0.01	<0.01	0.011	0.01	0.081
Indeno(1,2,3-c,d)pyrene	NE	<0.01	<0.01	<0.01	<0.01	<0.01	0.014	0.051
Dibenz(a,h)anthracene	NE	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	0.014
Benzo(g,h,i)perylene	NE	<0.01	<0.01	<0.01	<0.01	0.01	0.014	0.054

a Duplicate sample.

Notes:

All concentrations in micrograms per liter (µg/L).

NA Not Analyzed

NE Not Established

Bolded/shaded values denote positive detection above surface water chronic screening levels.

7.3.4 Data Gaps Evaluation and Data Needs

The following potential data gaps are associated with the Wetland AOC:

- Sufficient soil or sediment quality data for wetlands sufficient to distinguish impacts from site operations from background occurrences.
- Sufficient background soil or sediment samples for evaluating potential contamination in wetland sediment.

7.4 RECTIFIER YARD

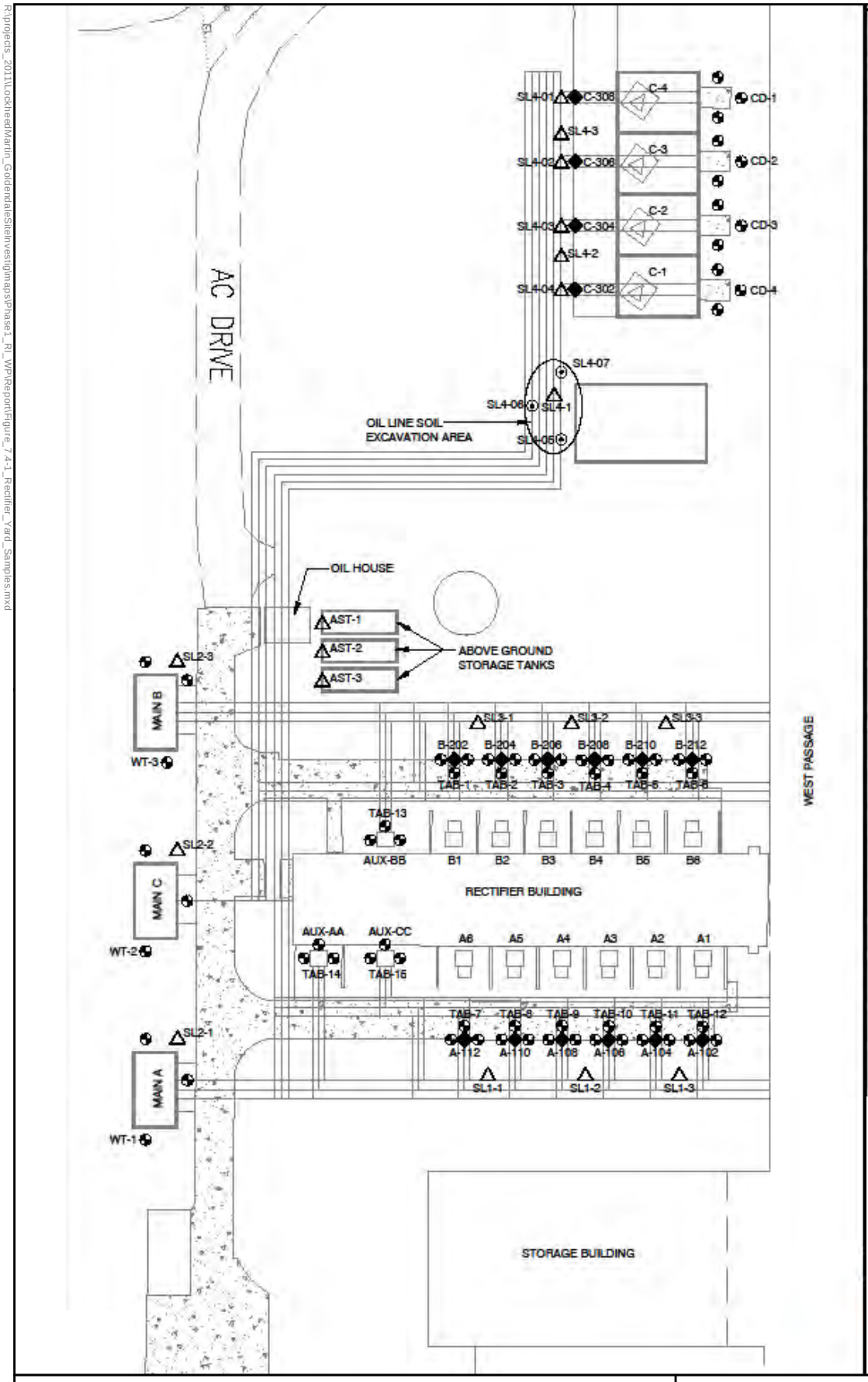
The Rectifier Yard AOC is defined in the Agreed Order as the area where rectifiers and transformers used in plant operations are located. Rectifiers, primary, and auxiliary transformers were located in an area bounded to the east by the west end of the production buildings, south by the plant entrance road, west by a Bonneville Power Administration (BPA) substation and to the north by the north plant access road. This AOC includes both the Rectifier Yard and the associated Rectifier Building. In addition, 27 smaller transformer substations (termed the Interior Transformer Substations) were located throughout the Production Area and are included in the Rectifier Yard AOC.

Site investigation of the Rectifier Yard was performed during 2011 and was performed in association with plant demolition activities. More detailed information regarding the Rectifier Yard and environmental investigation activities are summarized in PGG (2012b) and relevant supporting figures and tables from this report have been included in Appendix B-4.

7.4.1 Description of Features

The function of the Rectifier Yard was to convert electrical power from the BPA substation (alternating current or AC) into direct current (DC) and distribute and manage the DC power to the production buildings for aluminum reduction. Structures in this AOC include the rectifier building, main and auxiliary transformers, transformers for Production Buildings A through D, 27 interior transformer substations, three aboveground storage tanks (ASTs) for transformer oil storage, associated underground oil conveyance piping, and oil circuit breakers (OCBs) for servicing transformers (Figure 7.4-1).

Electricity entered the site through the three main transformers, Main A through Main C that are located at the eastern end of the Rectifier Yard. Power from the main transformers was routed through the Rectifier Building where conversion from AC to DC power occurred then through a series of primary transformers to the production buildings (Appendix B-4 and Figure 7.4-1).



LEGEND

SOIL SAMPLE TYPES

TAB-1	COMPOSITE SAMPLE SUBSAMPLES
SL1-1	DISCRETE SOIL SAMPLES
SL4-05	SOIL REMOVAL CONFIRMATION SAMPLES

PADS

	TRANSFORMER PADS
A-112	OIL CIRCUIT BREAKER PADS

SITE STRUCTURES

MAIN A, MAIN B, MAIN C	TRANSFORMERS ADJACENT TO BONNEVILLE POWER ADMINISTRATION (BPA) SUBSTATION
AUX-AA, AUX-BB, AUX-CC	AUXILIARY TRANSFORMERS FOR POWER PHASE ADJUSTMENT
A1 to A6	TRANSFORMERS SERVICING PRODUCTION BUILDING A
B1 to B6	TRANSFORMERS SERVICING PRODUCTION BUILDING B
CD1 to CD4	TRANSFORMERS SERVICING PRODUCTION BUILDINGS C & D
A-102 or B-202	OIL CIRCUIT BREAKER PAD NUMBERS

SAMPLE LABELS

WT-1 to WT-3	SOIL SAMPLES AT MAIN TRANSFORMERS
TAB-1 to TAB-12	SOIL SAMPLES AT RECTIFIER BUILDING OIL CIRCUIT BREAKERS
TAB-13 to TAB-15	SOIL SAMPLES AT AUXILIARY TRANSFORMER PADS
CD-1 to CD-4	SOIL SAMPLES AT BUILDING C/D TRANSFORMER PADS
SL1-1 to SL4-3	SOIL SAMPLES AT OIL CIRCUIT BREAKER OIL LINES
AST-1 to AST-3	SOIL SAMPLES AT ABOVE GROUND STORAGE TANKS (ASTs)
SL4-01 to SL4-04	SOIL SAMPLES AT BUILDING C/D TRANSFORMER PADS
SL4-05 to SL4-07	SOIL SAMPLES AT OIL LINE SOIL EXCAVATION AREA

Source: PGG 2012

Figure 7.4-1
Rectifier Yard
Sample Location Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Power from Main A was routed to Production Building A through transformers A1 through A6, power from Main B was routed to Production Building B through transformers B1 through B6, and power from Main C was routed to Production Buildings C and D through transformers C1 through C4. Three auxiliary transformers, AUX-AA through AUX-CC, were used for phase adjustments during plant operation, and were located on the north and south sides of the west end of the Rectifier Building.

A total of 27 small transformer substations [referred to as interior transformer substations in PGG (2012) are located primarily in the Production Area (refer to Figure 7.4-2). Two of these transformer substations (T11 and T19) were located in the Rectifier Yard: T11 was located south of transformers C1 through C4, and T19 was located near the southwest corner of the Rectifier Building. One of the transformer substations (T7) is located on the Columbia River by the NPDES outfall.

Three ASTs used for transformer oil storage were located northwest of the Rectifier Building and set on concrete supports (refer to Figure 7.4-1). Oil was delivered to transformers through the OCBs via underground piping. A-series OCBs are located adjacent to the A-series transformers, and likewise for the B- and C-series transformers.

Available maintenance records from 2004 through 2007 for transformers and OCBs were reviewed and indicate that PCBs were present in the transformer oils. Rectifier Building transformers contained PCBs at concentrations from not detected (no detection limit stated) to 6 mg/L, auxiliary transformers contained 2 to 3 mg/L and Buildings C/D transformers had no detectable PCBs (no detection limit stated). OCB records for 1993 showed concentrations of Aroclor 1242, 1254, and 1260 ranging from not detected (no detection limit stated) to 10 mg/L (PGG 2012b). Maintenance records note leakage for many of these transformers and oily staining was observed on some transformer pads (PGG 2012b). Concentration of PCBs in the interior transformer substations based on maintenance records exceeded 10 mg/L at several of the interior transformer substations (PGG 2012b).

The three mineral oil storage ASTs and associated pipelines were drained of oil, removed and recycled in late 2011 and early 2012. AST dimensions were approximately 8 feet in diameter and 33 feet in length with a per tank capacity of approximately 13,000 gallons.

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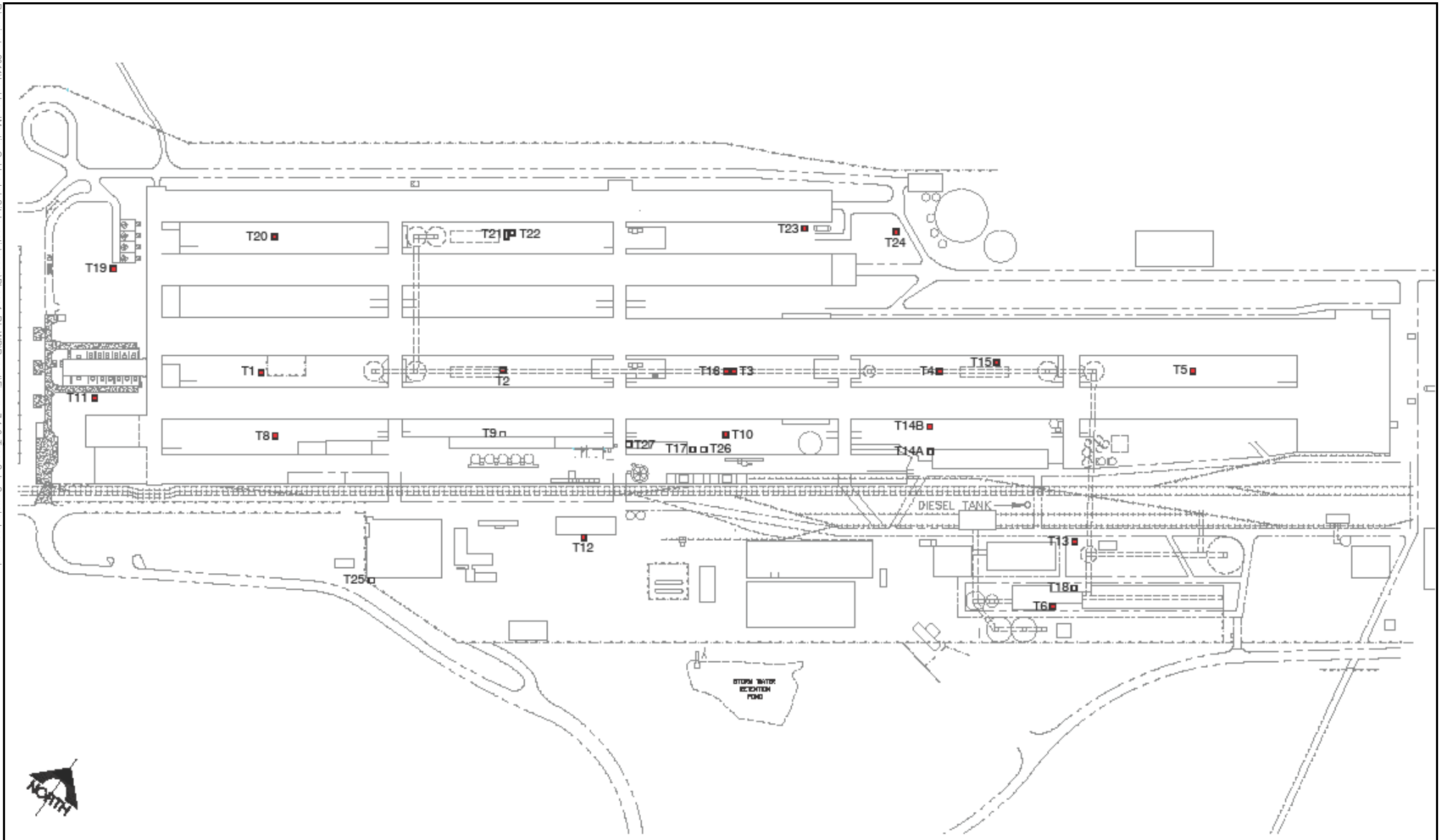


Legend

T1 TRANSFORMER SUBSATION SAMPLED. EACH SUBSTATION CONTAINS SIDES A AND B, EXCEPT FOR T14 WHERE A AND B ARE ON SEPARATE PADS, AND T24 WITH SIDES A, B AND C.SAMPLE LOGS ARE IN APPENDIX A.

T21 TRANSFORMER SUBSATION NOT SAMPLED (INACCESSIBLE OR NO SOIL).

Source: PGG (2012).

Figure 7.4-2
Transformer Substation
Sample Location Map

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

All Rectifier Yard transformers, rectifier, and OCB hardware had been removed at the time of site investigation in January 2011. The concrete pads for the transformers and majority of OCBs remained in-place (PGG 2012b).

Transformer Technologies of Salem, Oregon, removed oil from the ASTs and associated pipelines, and from Rectifier Yard transformers. Transformer Technologies shipped 23,960 gallons of used oil offsite to Hydrodec North America LLC, 2021 Steinway Boulevard, Canton, Ohio, for treatment and recycle. Elder Construction, the NSC plant demolition contractor, conducted the ASTs and associated pipelines removal. Neither BMEC nor PGG observed the pipeline removal and cannot confirm that all lines have been removed.

Pipeline removal included capping segments of pipe and moving the capped pipe segments to an onsite handling area. Once all residual oil was removed, the pipe was taken offsite for recycle. Tank and pipeline steel was taken offsite for metal recycling at Calbag Metals in Portland, Oregon.

During demolition of the plant, the northern portion of the Rectifier Yard (north of the ASTs) was used for storage of rebar. The Agreed Order states that any disposal site for demolition debris would be further evaluated under SWMU 21, Construction Rubble Storage Area. Because of physical proximity and for convenience in reporting, the northern portion of the Rectifier Yard used for storage during demolition of the plant will be addressed as part of the Rectifier Yard AOC.

7.4.2 Environmental Investigation History

During January 2011, an environmental investigation was conducted in the Rectifier Yard to determine whether site-related chemicals, particularly PCBs, were present in soil (PGG 2012b). The purpose of the investigation was to identify and characterize areas of contamination relevant to planned demolition activities. The main investigation work elements included characterization of surface soils near the main and auxiliary transformers, oil AST, oil conveyance lines, and 27 small interior transformer substations primarily within the area of the main plant.

During initial sampling along the oil conveyance pipelines, in January 2011, an area of visible soil staining was encountered on line 4 south of the Production Buildings C/D transformer pads near sample SL4-1 (Figure 7.4-1). Approximately 65 tons of soil was excavated at this location and three confirmation soil samples collected.

During decommissioning of transformers at interior transformer substation T5 during April 2012, an onsite demolition contractor caused a spill of transformer oil (PGG 2012b). About 25.4 tons of PCB and oil-contaminated soils were excavated and disposed of at the Columbia Ridge Landfill.

7.4.3 Previous Environmental Data

A total of 38 soil samples (22 composite and 16 discrete) were collected from the Rectifier Yard. In addition, 37 composite samples were collected from the 27 small interior transformer substations located mainly in the main production area. The types and locations of the samples are summarized as follows:

- **Main Transformers**: Three composite samples (WT-1 to WT-3).
- **Auxiliary Transformers:** Three composite samples (TAB-13 to TAB-15).
- **Rectifier Building OCBs for Transformers A1 through A6:** Six composite samples (TAB-7 to TAB-12).
- **Rectifier Building OCBs for Transformers B1 through B6:** Six composite samples (TAB-1 to TAB-6).
- **Transformers for Production Buildings C and D:** four composite samples (CD-1 to CD-4).
- **Oil Pipeline:** A total of 16 discrete samples from pipeline segments south of the Rectifier Building (SL1-1 to SL1-3), adjacent to main transformers (SL2-1 to SL2-3), north of the Rectifier Building (SL3-1 to SL3-3), west of the Building C/D transformers (SL4-1 and SL4-3), and four follow-up samples west of the Building C/D transformers (SL4-01 to SL4-04).
- **Interior Transformer Substations:** A total of 37 composite soil samples representing 18 of the 27 small transformer substations. In general, the composite samples represented three-point composite samples with two composite samples collected at each substation. Most of the transformer substations contained two transformers: one on each side of the pad with common controls in the center, and accordingly one composite soil sample was typically collected on each side of the pad.

A small track-mounted backhoe with 1-foot bucket was used to excavate shallow (1 to 3-foot deep) trenches for sample collection along the margins of the larger transformer pads and along the oil pipelines to below the bottom of the pipe. The soil samples were collected by hand following shallow excavation. For the interior transformer substations, the samples were most frequently collected by hand from the top 6-inches of soil adjacent to the substation pad.

The majority of the samples represent homogenized 3-point composite samples. Composite samples were collected to assess the overall or average concentrations at a particular area. Because the samples were physically homogenized at the time of collection and the COPC did not include VOCs, the samples were determined to be representative and directly compared with screening levels in this Phase 1 Work Plan. Discrete samples were typically collected from areas with visible signs of soil staining or at locations that a release would be more likely to occur (e.g., pipe joints).

Shallow subsurface oil at the Rectifier Building transformer pads could not be sampled during 2011 because the structure of the transformer bays precluded access to soil.

Soil sample results have been compared against MTCA Method B and Method C screening levels in this Work Plan with the exception of TPH results. Based on a preliminary evaluation of potential future land use, adoption of Method C industrial soil screening levels at this AOC is likely appropriate.

TPH results have been compared against MTCA Method A soil screening levels for Unrestricted Land Use and Industrial Land Use (which are the same numeric value of 2,000 mg/kg). MTCA Method A Soil TPH screening levels are based in part on prevention of accumulation of petroleum product on groundwater. MTCA Method C TPH screening levels are not listed in the MTCA Regulation and determination of MTCA Method C TPH screening levels will require further evaluation and calculations that may be performed as part of the RI.

7.4.3.1 Rectifier Yard Transformer Soil Sample Results

Twenty-two composite soil samples were collected at each location and analyzed for petroleum hydrocarbons, PCBs as Aroclors, and PAHs. Table 7.4-1 summarizes detected chemicals that exceed one or more soil screening levels. Complete analytical results are provided in Appendix B-4.

Four chemicals were detected at maximum concentrations that exceed MTCA Method B screening levels, including three carcinogenic PAHs [benzo(b)fluoranthene, benzo(a)pyrene, dibenz(a,h) anthracene], and Aroclor 1260. None of the detected chemicals exceeded MTCA Method C screening levels.

Table 7.4-1
Summary of Chemical Concentrations in Transformer Pad Soil Samples

Chemical	MTCA Method B Soil Screening Level	MTCA Method C Soil Screening Level	Minimum Detected Concentration	Maximum Detected Concentration	Sample with Maximum Concentration
Benzo(b)fluoranthene	1.37	180	0.011	**2.7**	TAB-11/12
Benzo(a)pyrene	0.137	1,800	0.54	**1.5**	TAB-11
Indeno(1,2,3-c,d)pyrene	1.37	18	0.011	1.3	TAB-11
Dibenz(a,h)anthracene	0.137	180	0.01	**0.64**	TAB-2
Aroclor 1260	0.5	18	NA[a]	**0.87**	TAB-14

a PCBs were only detected in one sample.
All concentrations in milligrams per kilogram (mg/kg).
Bold/shaded concentrations denote positive detections that exceed one or more screening levels.

PCB as Aroclor 1260 was detected only in sample TAB-14 (auxiliary transformer AUX-AA), at concentrations above MTCA Method B screening levels, but below MTCA Method C screening levels. Mineral oil was detected in 16 of 22 samples, but did not exceed the MTCA Method A TPH screening level.

7.4.3.2 AST Soil Sample Results

Three discrete soil samples were collected adjacent to the west end of the three ASTs where leakage was most likely to occur at piping leading from the tanks. The samples were analyzed for PCBs only and low concentrations of PCBs (Aroclor 1260) were detected (range of 0.12 to 0.43 mg/kg) in all three of the samples. The detected concentrations were below MTCA Method B formula values.

7.4.3.3 Oil Conveyance Pipeline Soil Sample Results

Sixteen discrete soil samples were collected along the oil conveyance pipelines leading from the ASTs to the OCBs (Figure 7.4-1). Twelve initial samples were analyzed for PAHs and petroleum hydrocarbons and four follow-up samples located along the pipeline near the Buildings C/D transformers were analyzed for mineral oil only. Table 7.4-2 summarizes the detected chemicals that exceed one or more soil screening levels. Complete analytical results for the OCB conveyance pipeline samples are provided in Appendix B-4.

Table 7.4-2
Summary of Chemical Concentrations in Transformer Oil Pipeline Soil Samples

Chemical	MTCA Method B Screening Level	MTCA Method C Screening Level	Minimum Detected Concentration	Maximum Detected Concentration	Sample with Maximum Concentration
Benzo(a)anthracene	1.37	180	**1.4**	**14**	SL2-3
Benzo(b)fluoranthene	1.37	180	**1.4**	**20**	SL2-3
Benzo(a)pyrene	0.137	18	**0.26**	**19**	SL2-3
Indeno(1,2,3-c,d)pyrene	1.37	180	0.017	**14**	SL2-3
Dibenz(a,h)anthracene	0.137	18	0.054	**4.4**	SL2-3
Mineral Oil(a)	2,000	2,000[a]	120	**25,000**	SL4-3
Lube Oil Range (a)	2,000	2,000[a]	83	**2,900**	SL2-3

a Soil screening level represents MTCA Method A Industrial Screening Level, which in part is based on prevention of free product accumulation on groundwater. MTCA Method C for TPH is determined through calculation and is not listed.

All concentrations in milligrams per kilogram (mg/kg).

Bold/shaded values denote positive detections that exceed one or more screening levels.

PAHs were detected in all 12 initial samples with mineral oil and lube oil range chemicals detected in the majority of samples. Non-carcinogenic PAHs were not detected above MTCA Method B screening levels. Five carcinogenic PAHs [benzo(a)anthracene, benzo(b)fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, and dibenz(a,h)anthracene] were detected in 10 of the 12 initial samples at concentrations that exceed MTCA Method B screening levels. The highest concentrations of carcinogenic PAHs were detected in sample SL2-3 near main transformer B. With the exception of benzo(a)pyrene in sample SL2-3, none of the samples results exceeded Method C screening levels for PAHs. Seven of the 12 pipeline soil samples exceeded the MTCA Method A TPH screening level of 2,000 mg/kg.

During initial sampling along the oil conveyance pipelines, in January 2011, an area of visible soil staining was encountered on line 4 south of the Production Buildings C/D transformer pads near sample SL4-1 (Figure 7.4-1). Approximately 65 tons of soil was excavated at this location and three confirmation soil samples collected. The confirmation soil samples were analyzed for petroleum hydrocarbons and resulted at no detections with detection limits of 27 to 28 mg/kg that are below the MTCA Method A TPH screening level. The excavated soil was stockpiled inside the east end of Production Building B, and then transported and disposed of at Columbia Ridge Landfill.

7.4.3.4 Interior Transformer Substation Soil Sample Results

Thirty-seven composite soil samples were analyzed for PAHs, PCBs and petroleum hydrocarbons. Appendix B-4 includes the complete sample results from PGG (2012). Figure 7.4-2 shows the

interior transformer substation locations. Table 7.4-3 summarizes the results. Carcinogenic PAHs were detected in the vast majority of the samples at concentrations above MTCA Method B formula values. Concentrations of benzo(a)pyrene also exceeded MTCA Method C formula values in 22 of 37 samples and other carcinogenic PAHs (e.g., benzo(b)fluoranthene and dibenz(a,h)anthracene were also detected above MTCA Method C formula values is some samples. Aroclor 1260 exceeded the MTCA Method B screening level in 7 of 37 samples with none of the detected concentrations above the MTCA Method C industrial formula value. Lube-oil range petroleum hydrocarbons and diesel-range hydrocarbons exceeded the 2,000 mg/kg MTCA Method A soil screening level in 22 of 37 samples and 16 of 37 samples, respectively.

Table 7.4-3
Summary of Chemical Concentrations in Interior Transformer Soil Samples

Chemical	MTCA Method A or B Screening Level	MTCA Method C Screening Level	Number of samples Exceeding One or More Screening Levels/Total samples	Maximum Detected Concentration	Sample with Maximum Concentration
Benzo(a)anthracene	1.37	180	27/37	**950**	T13A
Benzo(b)fluoranthene	1.37	180	33/37	**1,500**	T13A
Benzo(k)fluoranthene	13.7	1,800	21/37	**1,100**	T13A
Benzo(a)pyrene	0.137	18	35/37	**1,500**	T13A
Chrysene	137	18,000	11/37	**1,200**	T13A
Indeno(1,2,3-c,d)pyrene	1.37	180	25/37	**940**	T13A
Dibenz(a,h)anthracene	0.137	18	34/37	**290**	T13A
Aroclor 1260	0.5	63.5	7/37	**4.8**	T8A
Diesel-Range	2,000	2,000 (a)[a]	22/37	**55,000**	T13B
Lube Oil Range	2,000	2,000 (a)	16/37	**13,000**	T13B

a Soil screening level represents MTCA Method A Industrial Screening Level, which in part is based on prevention of free product accumulation on groundwater. MTCA Method C for TPH is determined through evaluation and calculation process and is not listed in the MTCA regulation.

All concentrations in milligrams per kilogram (mg/kg).
Bold/shaded values denote positive detections that exceed one or more screening levels.

As noted previously in Section 7.4.1, there was a spill near transformer T5A during demolition activities in April 2011. Soil samples were collected and Aroclor 1260 was detected at concentrations ranging from 0.63 mg/kg to 27 mg/kg and mineral oil was also detected at concentrations ranging between 30,000 mg/kg and 260,000 mg/kg. After 25.4 tons of contaminated soils were removed, 5 confirmation samples were collected. Aroclor 1260 was detected in one of the five samples at a low concentration of 0.11 mg/kg, which is below the MTCA Method B formula value; petroleum hydrocarbons were not detected in the confirmations samples. However, as noted in PGG (2012), contaminated soils above screening levels were documented on the eastern side of

the common control unit (at transformer T5B) as well as at transformer T5A, but these soils were not removed. Refer to Appendix B-4 for a figure showing the sampling locations and soil removal area at transformer substation T-5 as well as a table summarizing the T-5 soil characterization and confirmation sample results.

7.4.4 Data Gaps Evaluation and Data Needs

Identified data gaps for the Rectifier Yard AOC are summarized below:

- Collection of soil samples where feasible in areas that were previously inaccessible. The Rectifier Building foundation, Rectifier transformer bays, main transformer pads and Buildings C/D transformer pads remain in place. If feasible, the rectifier transformer bays will be removed to provide access to subsurface soil.

- Additional characterization of surface and near surface samples for a more comprehensive suite of site COPC. This effort will include resampling of: 1) selected previous transformer sampling locations and with chemical analyses of metals and petroleum hydrocarbons; 2) selected previous oil pipeline sampling locations with chemical analyses for metals and PCBs; 3) sample transformer substations not previously sampled in areas where PCBs were detected in soil and 4) selected previous AST sampling locations with chemical analyses of metals, fluoride, cyanide, PAHs and petroleum hydrocarbons.

- Further evaluation of the vertical and horizontal extent of petroleum hydrocarbon contamination in soil near the oil conveyance lines and at the interior transformer substations.

- Further evaluation of the horizontal and vertical extent of PAH soil contamination at the transformers and oil conveyance lines. Verification that all oil conveyance lines have been removed.

- Characterization of subsurface soils beneath Rectifier Building A- and B-series transformer locations, and beneath the Rectifier Building foundation with the chemical sampling program to include metals, PAHs, PCBs and petroleum hydrocarbons.

- Characterization of soil concentrations at the oil house to include chemical analyses of metals, PAHs, PCBs and petroleum hydrocarbons for selected samples.

- Characterization of surface soils in the northern portion of the Rectifier Yard used for storage of demolition debris with the chemical sampling program to include metals, fluoride, cyanide, PAHs, PCBs, and petroleum hydrocarbons.

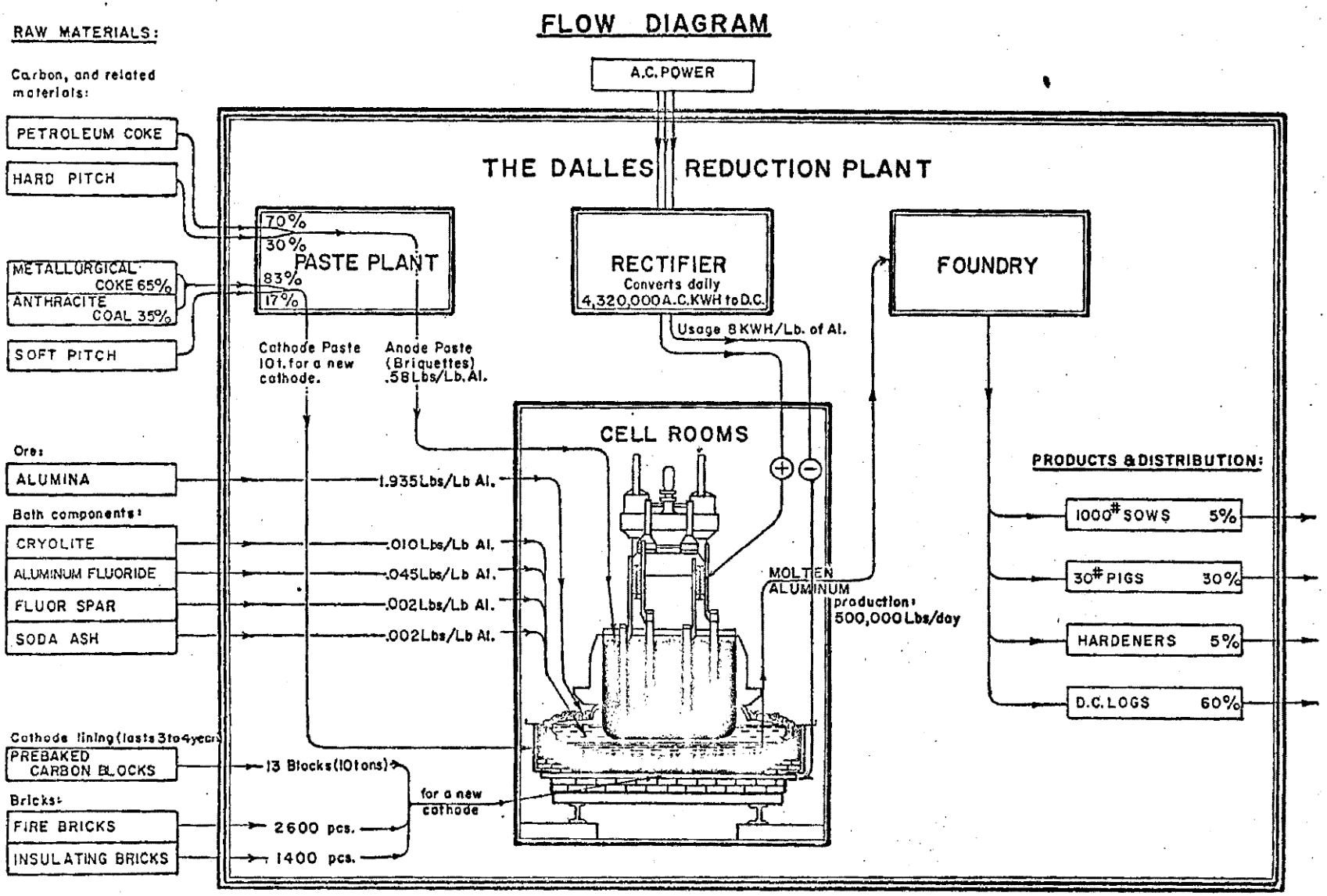
- Additional evaluation of Transformer Substation T5B to determine if additional soil removal is warranted.

7.5 PLANT AREA AOC

Aluminum was produced at the Goldendale facility by the vertical stud Soderburg Process that was later augmented with Sumitomo technology. Figure 7.5-1 shows the materials and processes associated with The Dalles Reduction Plant which represents an aluminum smelting operation similar to the Columbia Gorge Aluminum Smelter facility. During the aluminum production/smelting process, the refined ore (aluminum oxide or alumina) is dissolved in a molten bath of consisting of cryolite (a salt composed of sodium, aluminum, and fluoride), aluminum fluoride, fluor spar, and soda ash and the aluminum metal is disassociated from the oxide by electrolysis. The cathode container in which the smelting occurs and the molten materials are contained is made of a combination of ceramic and carbon brick and is referred to as a "pot." The anodes of the electrolytic cells are composed of carbon and they rest in a mixture of carbon briquettes that is referred to as anode paste. The oxygen released from the electrolysis combines with the anode carbon material to form carbon dioxide gas. The anode carbon material, both anode studs and anode paste, are consumed during smelting and need to be continually replenished (Landau 1995).

Primary raw materials used in the aluminum production process at the site included alumina (aluminum oxide ore), calcined petroleum coke, and coal tar pitch (Landau 1995). Secondary raw material for the production process included cryolite, aluminum fluoride and soda ash. The secondary raw materials are not directly consumed by the process but were used to maintain the proper composition of the baths for the electrolytic process used to smelt the aluminum. The carbon materials commonly contained PAHs and the bath material contained fluoride and some metals associated with the ore. PAHs and fluoride represent some of the main site COPC.

The Plant Area AOC consists of an area in the vicinity of the Paste Plant, Production Buildings, Cast House and ancillary features where materials containing site COPC including PAHs (that were present in the carbon anodes as a binder material) as well as fluoride (that was present in the cryolite used as bath material within the reduction cells) were used, routinely handled, and temporarily stored. Note that several of these features do not appear to meet the definition of a RCRA SWMU under the regulations and guidance at the time of plant operations (or presently), but represent features that need further evaluation to complete the RI/FS.



Source: Martin Marietta, 1975

Figure 7.5-1
Aluminum Reduction Materials and Processes
Flow Diagram

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Historical operations within the plant footprint had a potential to create fugitive emissions or dust not captured by the air pollution control systems, which may have been deposited on the ground on the courtyard soils within the Plant Area AOC footprint. Additionally, plant operations required practices using mobile units within the Plant Area AOC such as transport trucks and temporary material storage facilities. These temporary storage and handling operations and associated locations are difficult to clearly define, but could have potentially contributed to contamination of the soils within the Plant Area AOC.

Many of the buildings and structures in the former production area were demolished during 2010 through 2012. Foundations and concrete slabs remain in many locations. The major focus of investigation in the Plant Area AOC is surface and subsurface soils. Relevant buildings that remain at the time of preparation of this Work Plan include: the Coke and Pitch Unloading Structure, the Hard Pitch Storage Building, the Pitch Building, the Bath Reclaim Building, the Bath Storage Building, Industrial Sump and Industrial Lines, the Compressor Building, and the Plant Laboratory in the administration building (also termed the Change House). A listing of wastes encountered during demolition of the Cast House and Production Building A through D (BMEC 2014) is relevant to investigation of Plant Area AOC features and is provided in Appendix B-4.

7.5.1 Description of Main Focus Categories

This section summarizes and defines the focus categories for RI investigation of the Plant Area AOC. The focus areas for the Plant Area AOC include: 1) Carbon Manufacturing, Handling and Storage Features, 2) Cryolite and Bath Handling and Storage Features, and 3) the Cast House, Production Buildings, and Ancillary Features.

7.5.1.1 Carbon Manufacturing, Handling, and Storage

Several SWMUs are associated with carbon manufacturing, handling, and storage, including the Paste Plant Recycle Water System (SWMU 9), the Paste Plant Spill (SWMU 30) and these two sites will be considered individually in Work Plan development. The Agreed Order also includes the Decommissioned Air-Pollution Control Equipment (SWMU 7), the Carbon Waste Roll-Off Areas (SWMU 24), the Solid Waste Collection Bin and Dumpsters (SWMU 25) and the HEAF Filter Roll-Off Bin (SWMU 26). Because the exact locations of these SWMUs are not well documented, and/or

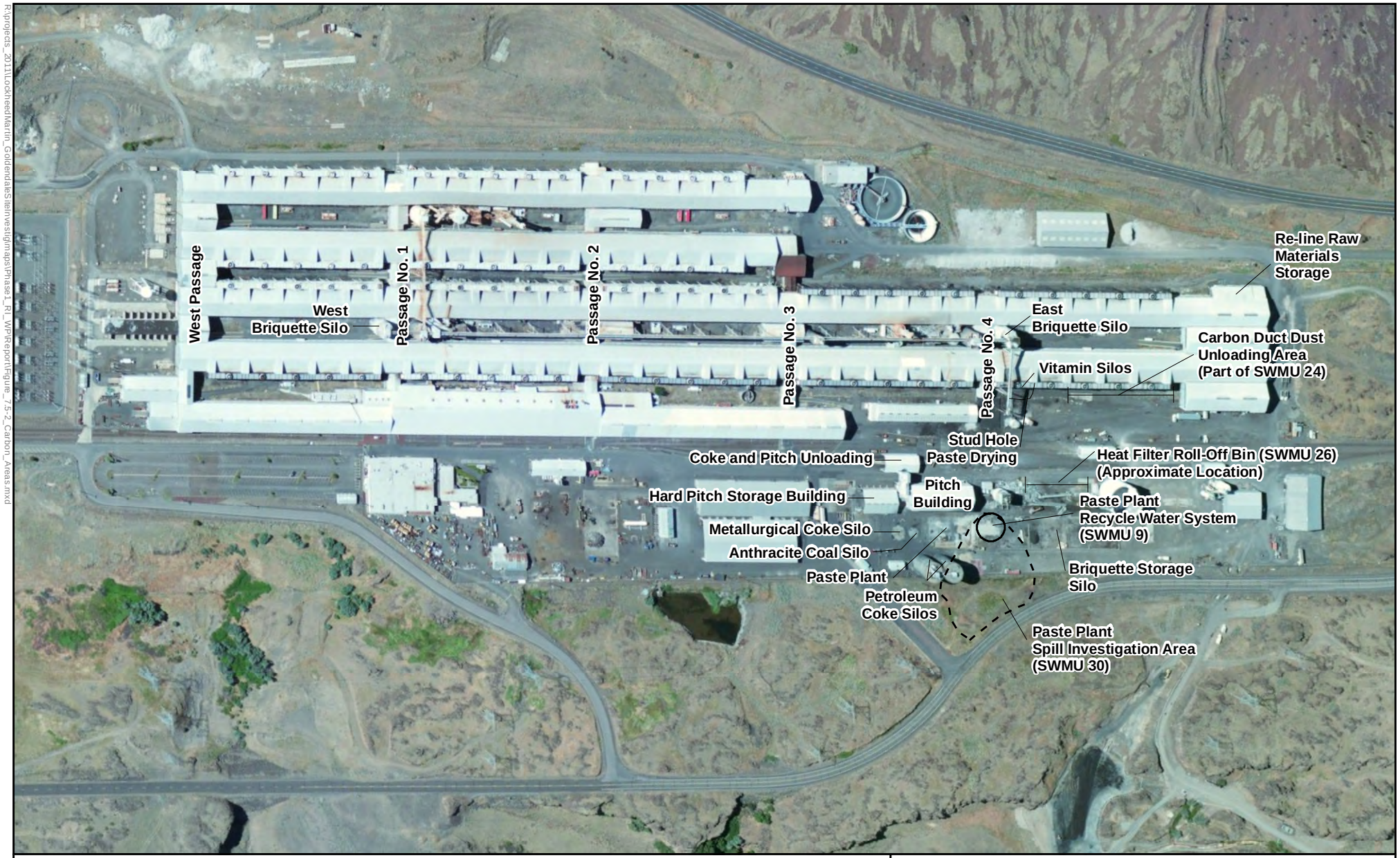
may have changed through time, these SWMUs will be addressed under the Plant Area AOC sampling program. Refer to Section 6.2.12 for descriptions of these SWMUs.

However, there are other potential sources of fugitive discharges from carbon manufacturing, handling, and storage that are considered part of the Plant Area AOC, including the Hard Pitch Storage Building, the Pitch Building, the Coke and Pitch Unloading Building, the Paste Plant, two Petroleum Coke Silos, Metallurgical Coke Silo, the Anthracite Coal Silo, Briquette Storage Slab, and HEAF Building. The carbon manufacturing, handling, and storage features to be addressed as part of the Plant Area AOC (along with nearby SWMUs associated with carbon handling) are shown on Figure 7.5-2. Many of these features have been present since the original construction of the plant and PAH containing materials were used, handled, and stored at these locations.

In the Paste Plant, calcined petroleum coke was crushed, screened, and blended with coal tar pitch, then heated to melt the pitch and mixed in large mixers to ensure an even coating of all coke particles with the liquid pitch (Landau 1995). This mixture was then extruded through plates to form briquettes which were then water-quenched to form hard briquettes which were then stored or conveyed to areas of the plant where needed. The hard briquettes were also referred to as anode paste which surrounded the anode studs during the smelting process.

Individual anode carbon briquettes that formed the anode paste mixture averaged 5 inches in length and 2 inches in width. The objective during the smelting process was for the anode paste mixture to flow freely into the voids when spent anode studs were periodically removed. To optimize aluminum production and minimize the consumption of anode paste, the blend of "wet" anode paste (briquettes with more coal tar pitch) versus "dry" anode paste (less coal tar pitch) was varied depending on weather conditions and other factors. The process of adding wet or dry anode paste was referred to as the addition of "vitamins" where the wet and dry anode paste briquettes were stored in separate "vitamin silos" in close proximity to the production lines (refer to Figure 7.5.2 for the location of vitamin solos and associated paste handling area).

Cathode ramming paste was manufactured at the Paste Plant during the 1970s and this activity caused several spills in and outside the Paste Plant (BMEC, personal communication, November 2014). Facilities at the Paste Plant included: a coke heater on the west side of the building, batch mixers on the second floor, screens on third floor, and a soft pitch tank on the fourth floor.



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0 125 250 500
Feet

Imagery Source: Microsoft Bing Imagery, 2010.

Figure 7.5-2
Carbon Manufacturing, Handling and Storage Area
Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

R:\projects_2011\LockheedMartin_GoldendaleSite\investigMaps\Phase1_RI_WP\Report\Figure_7.5-2_Carbon_Areas.mxd

The mixing process at the soft pitch tank caused spillage problems. Coal tar pitch and creosote were mixed to create the soft pitch that was used a binder. At times, the mixing process caused boil overs with material running down to the ground floor. After mixing was completed the hot paste would then be transported to the cell reline area. The cathode ramming paste manufacturing process was stopped in early 1981, and cold ramming paste was then purchased from Alcoa until plant shutdown (BMEC, personal communication, November 2014).

Further details regarding these carbon handling features are as follows:

- Undocumented spills reportedly occurred during the 1970s and 1980s in and around the Paste Plan (BMEC, personal communication, November 2014). Some of the spills were reportedly related to the cathode paste manufacturing process as described previously.

- A briquette spill was noted at the East Briquette Storage Silo during a 1995 Ecology Dangerous Waste Inspection (Ecology 1995d). During a separate 1990 inspection, briquette spills were noted at both the East and West Briquette Storage silos and a small sprinkler/cooling water stream was observed discharging over the east silo and discharging into a nearby storm water grate (Ecology 1990a).

- The Pitch Storage Buildings were reportedly most recently used for bath storage (PGG, personal communication, November 2014). Some pitch is currently present in the Hard Pitch Building pitch building between the aluminum siding and the concrete foundation (BMEC, personal communication, November 2014).

- The Coke and Pitch Unloading Structure is an open-sided building with an associated conveyor system that was used for unloading of carbon material from rail cars. Portions of the structure are below ground. The below ground portion of the structures was reportedly cleaned in 2012 (PGG, personal communication, May 2014). A groundwater dewatering sump was reportedly present (CDM Smith, personal communication, August 27, 2014).

- The HEAF Building housed the HEAF unit used to control air emissions from the Paste Plant. An Ecology 1995 (Ecology 1995d) inspection noted that the HEAF Building floor was equipped with containment troughs containing a small amount of oil. Drums of "coal tar pitch from containment and rags" and "floor dry (contaminated)" were observed. The HEAF Building was noted as a satellite accumulation area. An order was issued in 1995 for failure to conduct annual tests and inlet testing of the HEAF unit during the early 1990s (Pollution Control Hearings Board 1995). The HEAF Building was in close proximity to the Paste Plant and the HEAF Roll-Off Box.

7.5.1.2 Bath Handling and Storage

Bath materials include cryolite, aluminum fluoride, fluor spar, and soda ash. The cryolite and other bath materials used in the reduction cells contained fluoride, which is one of the main site COPC for groundwater. Identified bath handling and storage features include the Bath Reclaim Building, Bath Storage Building, Bulk Cryolite Tank/Silo, Aluminum Fluoride Silo, Treated Alumina Silos, and Bath Crusher. Figure 7.5-3 shows the location of these features.

The Bath Reclaim Building was used for the cleaning and recycling of bath residual (PGG, personal communication, November 2014). It was also reportedly used for unloading of cryolite prior to 2003.

The Bath Storage Building was constructed between 1987 and 1994 and used for the storage of reclaimed bath material. In 2011, sediment from the cleanout of the stormwater line system was stored in the Bath Storage Building prior to offsite disposal (PGG, personal communication, November 2014). The Bath Storage Building was constructed within the footprint of the former East SPL Storage Area (SWMU 12) that was operated prior to construction of the Bath Storage Building.

Raw alumina was enriched with fluoride prior to addition to the reduction cells (Landau 1995). This process served to remove hydrogen fluoride from the pot liner exhaust gases and return it to the cells. The fluoride-enriched alumina ore was then stored in silos (Treated Alumina Silos) prior to delivery and use of the ore at the reduction cells (refer to Figure 7.5-2). The Bath Crusher and Bulk Cryolite Tank/Silo appears to have been present since at least the mid-1990s and the treated alumina silos were in service since the 1970s, Dry scrubbers were installed in the treated alumina silos between 1978 and 1980.

Historically, the cryolite and bath materials were considered “environmentally inert” (Goldendale Aluminum 2002b) and little environmental information about these features is available.

7.5.1.3 Cast House, Production Buildings, and Ancillary Features

Relevant AOC features associated with the Cast House and Production Buildings include the following categories: 1) Cast House (foundry) Building, 2) Production Buildings footprint (Cell lines), 3) Industrial Lines, 4) Petroleum Handling and Storage, 4) Shop, maintenance, and repair

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0 125 250 500
Feet

Imagery Source: Microsoft Bing Imagery, 2010.

Figure 7.5-3
Cryolite and Fluoride Handling and Storage Areas
Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

facilities, 5) Miscellaneous facilities including the Laboratory, Dross Building, and Compressor Building. These features are shown on Figure 7.5-4.

Cast House

The Cast House Building served as the foundry at the site. The Cast House Building has been demolished. According to NSC Smelter LLC, the Cast House Foundation are planned to remain in place.

Molten metal from the cell rooms was transported in refractory-lined steel crucibles to the Cast House, where it was alloyed cast in large, gas-fired casting furnaces, into various primary aluminum products (Landau 1995). Metals in the alloys used at the Cast House (e.g., copper, iron, manganese, nickel, chromium, silicon, and zinc) were typically stored and used in their pure metallic state or as master alloys and not in a reactive form (Landau 1995). The crucibles and furnaces in the Cast House needed periodic repair and reconstruction, which was performed in the western portion of the Cast House Building. Due to fire-related safety concerns at the Cast House, storage of appreciable quantities of oils or hazardous chemicals in this area was not permitted (Golden Aluminum Company 2002b).

Five holding furnaces, one tilting furnace, and three casting pits were located in the Cast House (PGG, personal communication, November 2014). The casting pits have deep hydraulic cylinders set to approximately 40 feet below ground surface. Reportedly, the hydraulic cylinders may have contained PCB compounds in the oil (PGG, personal communication, November 2014). The cylinders operated a platform that moved up and down with whatever is being chilled. The pits contained water as part of their function. Contact cooling water was used during metal casting into the Direct Chill (DC) casting pits and for mold cooling in the ingot casters.

According to the Spill Control Plan (Golden Aluminum Company 2002b), there was limited potential for accidental contamination at the DC Casting Pits during active operations. The pits were located between the molten metal holding furnaces within the Cast House. The pits extended downward from the operating floor and were surrounded by a steel curbing that extended 10 to 12 inches above the operating floor, limiting the potential for materials on the operating floor to drain into the casting pits. A hydraulic system was located in the casting pits. A drain system was reportedly present that drained to the Industrial Sump.

Legend

- Approximate Location of Fuel AST or UST

N
W
E
S

0 125 250 500
Feet

Imagery Source: Microsoft Bing Imagery, 2010.

Figure 7.5-4
Cast House, Production Buildings and Ancillary Areas
Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

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During Cast House demolition activities between January and April of 2012, removal of all hydraulic fluids, associated hydraulic equipment, piping, auxiliary attachments, petroleum products, and batch chemicals was completed. Approximately 5,200 gallons of hydraulic fluids and petroleum products were removed. The pumping and cleaning of all water and sludge from various sumps and the removal of three large hydraulic cylinders was also completed at this time.

Due to limited access, the sub-floor area below the Cast House floor could not be investigated. This area still contains pipe runs, electrical wiring, and utility lines. The open pits were covered with plywood and heavy gauge corrugated metal to prevent accidents. A listing of the wastes generated during demolition of the Cast House (as well as other areas of the plant) is included in Appendix B-5.

Production Buildings

Production Buildings A, B, C, and D housed the reduction cells used in the smelting process. Pot liners, bath material, and carbon anode materials were routinely used and handled in these buildings. The Production Buildings have been demolished. According to NSC Smelter LLC, the Production Building foundations are planned to remain in place.

The Production Buildings were constructed with two lines of pots set on pads in the "basement" or building foundation. The buildings were constructed to accommodate and access the vertical rods using upper floor "balconies" set on piers (PGG, personal communication, November 2014). Cell line fume collection effluent piping reportedly was located in concrete trenches beneath the production building floors.

In addition, bag houses, and ducts associated with air pollution control systems were present and their operation and maintenance included handling of wastes. A "basement" was reportedly present that housed the ducts for the primary air emission equipment (Columbia Aluminum Corporation 1995c). The cell-line "basement" areas were routinely and promptly cleaned (BMEC, personal communication, November 2014): metal spills were removed so there would not be electrical grounding issues, bath ore spillage was removed to prevent traffic and reduction cell access problems. A sweeper vehicle was signed to the basements on a full-time basis.

According to a 1995 Ecology inspection (Ecology 1995d), two large "super sucker" vacuum trucks were used to clean settled dust from the primary emission duct work in the basement of the pot

rooms (Ecology 1995d). This carbon waste material reportedly represented a state-only dangerous waste based on fish bioassay testing results The dust was off-loaded into large roll-off containers south of Production Building A. The Ecology inspector noted that this roll-off bin loading area had historically been a problem for spilled primary emission carbon dust and that the area had been recently paved at the time of the 1995 inspections. Based on this description, the activities in this area were likely part of the Carbon Waste Roll-Off Area (SWMU 24). Because the specific location of these activities (and the rest of SWMU 24 that includes other locations where similar waste handling activities occurred) is not well-defined, these areas will be addressed under the Plant Area AOC.

Industrial Sewer Lines

The industrial sewer (or process waste water) lines, sanitary sewer lines, and a subset of the groundwater collection lines are shown in Figure 7.5-5. The industrial lines include both industrial and monitoring lines as well as lines labelled as "SE" (interpreted as Scrubber Effluent) on design plans (Goldendale Aluminum Company 1996e). The SE lines primarily include the electrostatic precipitator (EP) lines associated with the original primary wet scrubber air pollution system at Cell Lines A and B. The EP lines reportedly were constructed of wood because of the corrosive nature of the effluent and actively operated only during the early years of plant operations in the 1970s. The EP lines were not actively used for discharge of effluent following the change to a dry scrubber system and the plant expansion in 1978.

The industrial and monitoring lines consist of wastewater lines that historically routed effluent such as contact cooling water and scrubber blowdown to either the water treatment plant or the industrial sump.

The sanitary sewer lines are shown on Figure 7.5-5 for completeness and planning purposes and *not* because they are thought to represent potential sources of environmental contamination.

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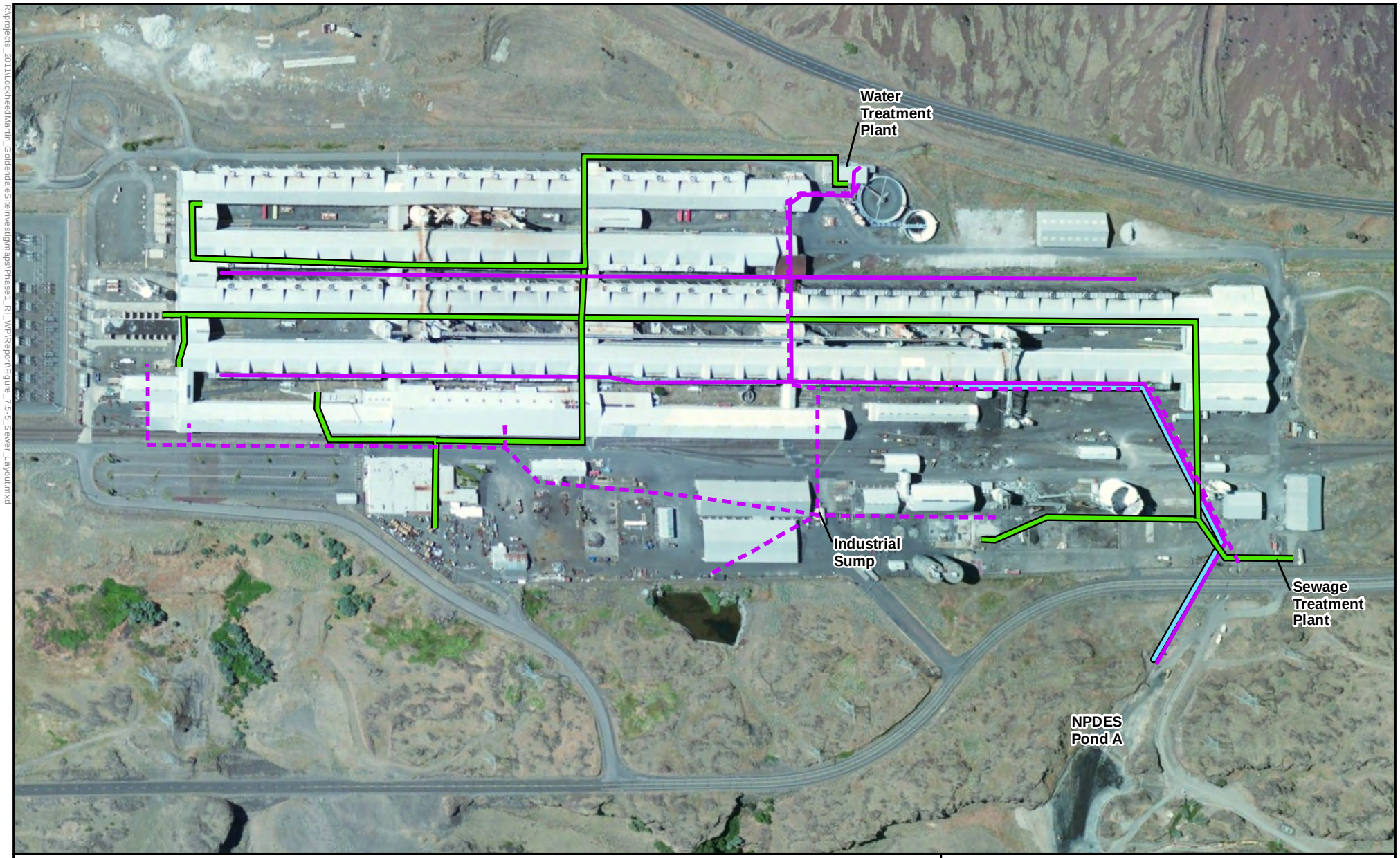


Legend

Groundwater Collection Network
(Figure only includes eastern line drainage to NPDES Pond A.
See Figure 6.2.18-1 for remainder of groundwater collection system.)

Industrial and Monitoring

Scrubber Effluent (Includes Electrostatic Precipitator Lines)

Sanitary Sewer

N W E S

0 125 250 500
Feet

Imagery Source: Microsoft Bing 2010.
Source of Sewer Layout: Goldendale Aluminum Company, 1996e.

Figure 7.5-5
Industrial and Sanitary Sewer Layout
Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Petroleum Storage and Handling Areas

This focus category includes former underground storage tanks (USTs), above-ground storage tanks (ASTs), and fuel handling areas at the site. In the mid-1990s, five ASTs and dispensers were located around the site (Goldendale Aluminum Company 1996d) (refer to Figure 7.5-3). The locations of the AST were determined from the 1996 and 2002 Spill Control Plans (Goldendale Aluminum Company 1996d, 2002b) as well as an underground storm water and sanitary sewer drawing (Goldendale Aluminum Company 1996e).

Three ASTs and an oil-water separator were found in the Cast House Maintenance Area and/or nearby Machine Shop. Refer to Appendix B-5 for the plant demolition waste inventory summary. These features included: 1) a bulk tank containing 1,000 gallons of motor oil, 2) a bulk tank containing 1,000 gallons of hydraulic fluid, and 3) a bulk tank containing 1,500 gallons of waste oil (BMEC 2014). An oil-water separator containing about 100 gallons of sludge and water was cleaned using a vacuum truck. These AST were emptied, decommissioned, and shipped offsite for appropriate disposal (BMEC 2014). Additional former AST locations have been documented and are shown on Figure 7.5.3. These AST are no longer present, but documentation of their decommissioning and removal has not been found. No environmental investigations of soils in the vicinity of the ASTs have been performed. The transformer oil ASTs and associated oil conveyance lines included in the discussion of the Rectifier Yard AOC.

The former USTs were located near the BPA substation at the west of the Production Area and at the west end of the Compressor Building (Figure 7.5-3). One 1,000-gallon gasoline UST was present near the BPA substation. Two 5,000-gallon diesel USTs and one 5,000-gallon gasoline UST were present at west end of the Compressor Building. The USTs were decommissioned and removed in 1990 and confirmation and stockpile soil sampling was conducted (Westinghouse 1990).

An oil room that was used for the storage of hydraulic oils was located on the north side of the furnaces and DC Casting Pits (refer to Figure 7.5-4).

Shops, Maintenance, and Repair Areas

Various shops, maintenance, and repair areas were present around the plant and included the following: the Machine Shop in far western end of the Cast House Building, Cast House Maintenance Area, the Paste Plant Shop, the Crane Repair Areas (North and South Crane Bays), the

Cruce (likely abbreviation for crucible) Cleaning Room, the Stud Cleaning and Repair Areas, the Carpenter Shop, and the Paste Plant Maintenance Shop (refer to Figure 7.5-3).

Satellite waste accumulation points were established at several of these areas. For example, during a 1995 Ecology inspection (Ecology 1995d) waste accumulation points were noted:

- The auto shop paint booth that was located in or near the Machine Shop. During 1990 and 1995 inspections (Ecology 1990a, 1995d), paint solvents were observed in this area.
- The North and South Crane Bays included a Safety Kleen station where heavy petroleum naphtha was stored. Drums of 1,1,1-TCA waste oil were also reportedly generated from the crane bays (Ecology 1995d).

The Cast House Maintenance Area was used for repair and maintenance of equipment located in the larger Cast House Building. Various machinery and repair stations, petroleum hydrocarbon drum storage, and AST were located in this area (PGG, personal communication, November 2014). Sumps and an oil-water separator were also present in this area (BMEC 2014).

An oil-change pit and equipment wash station was located near the Machine Shop and western end of the Cast House Maintenance Area (refer to Figure 7.5-4). The oil change pit reportedly connected to a sump at the southern edge of the Cast House Foundation (PGG, personal communication, November 2014). The equipment wash station reportedly occupied a large square area that was sloped toward a central drain (PGG, personal communication, November 2014). Refer to Appendix B-5 for further location information and photographs of these features.

The Stud Cleaning and Repair Areas were used for the cleaning and repair of the anode studs. Stud cleaning was performed using a "wheelabrator" machine in the cell lines that removed iron oxide scaling. No solvents were used in the cleaning process. Stud repair/re-tipping was performed in a building south of Production Building A. Cell repair work including anode and cathode cell refurbishing were all done in the Production Services area the east end of Production Buildings A and B (BMEC, personal communication, November 2014) (refer to Figure 7.5-4).

A friction weld press vault was located in the former building east of the Cast House where stud repair was performed (refer to Figure 7.5-4). The press pit is about 2 feet deep and contained oily water after the building was removed and the pit was exposed to rainfall (PGG, personal communication, November 2014).

Ancillary Features

There are a few miscellaneous features in the production area (refer to Figure 7.5-3) that do not fit into the other categories including:

- **Plant Laboratory**. The centralized plant laboratory located in the same building as the main administration building (also termed the Change House) in the southwestern part of the plant performed testing of: 1) raw material and process chemical parameters, and 2) air emissions, and 3) discharge water quality and other laboratory tests typical for a large industrial facility (Goldendale Aluminum Company 1996d). Laboratory chemicals stored and used at the laboratory in excess of 5 gallons included: 2-propopinol, acetone, acetonitrile, mercury, methyl alcohol, methylene chloride, petroleum ether, quinoliene, and toluene (Goldendale Aluminum Company 1996d). There is no evidence of a dry well or septic drain field associated with this feature. The plant laboratory was connected to the sanitary sewer system.

- **Dross Storage Area**. Molten aluminum in the furnaces was fluxed to remove dissolved gasses and to settle particulates carried in suspension. The dross that forms on the surface of the metal was skimmed from the metal, cooled, and stored in the Dross Storage Building and eventually shipped off site to processors to reclaim the metal content (Landau 1995). The dross contained various impurities that likely included aluminum oxide, metals, and fluoride. A 1995 Ecology inspection (Ecology 1995d) noted that dross was stored under a covered, three sided structure then shipped to Utah or Oklahoma for further processing and or/disposal. The inspector noted that dross chunks and dust littered the ground in front of the storage building. Historically, "sweat" furnace dross reportedly designated as a dangerous waste due to high fluoride content. The cast furnace dross that was being generated in 1995 reportedly did not designate as dangerous waste (Ecology 1995d).

- **Compressor Building**. This building served as the generation/source for compressed air for operation of pneumatic equipment at the plant. Lube oils, hydraulic oils, and solvents were potentially historically used at this location. USTs were present on the west end of the building and were removed in 1990. ASTs were later used for fuel storage in this same location (PGG, personal communication, May 2014).

- **Battery Storage Areas**. These include covered buildings/shop areas used for the charging and storage of batteries. Four locations were historically used for battery storage including:1) the Cast House Maintenance Area, 2) covered area in Passage 1, 3) covered storage/charge areas in each cell line, and 4) the Battery Storage Building (BMEC, personal communication, November 2014; Goldendale Aluminum Company 1996e, Drawing A1/1752) (refer to Figure 7.5-4). COPC for the battery storage areas include metals.

7.5.2 Environmental Investigation History and Previous Environmental Data

This section summarizes the environmental investigation history and previous environmental data associated with features included in the Plant Area AOC.

7.5.2.1 Carbon Manufacturing, Handling, and Storage Areas

Environmental investigations have not been performed with respect to the specific carbon manufacturing, handling, and storage features areas identified in Section 7.5.1. Environmental data has been collected associated with the Paste Plant Spill (SWMU 20) that suggest a potential for PAH contamination in soil near the Paste Plant to extend beyond the Paste Plant Spill area (refer to Sections 6.2.4 and 6.2.15).

7.5.2.2 Bath Handling and Storage

With the exception of the Bath Storage Building, which is the same location as the East SPL Storage Area (SWMU 12), no environmental investigations have been performed and no data has been collected specifically related to the identified features (refer to Section 7.5.1).

7.5.2.3 Cast House, Production Buildings, and Ancillary Features

Environmental investigations of this focus area have been performed and include the following: 1) Courtyards adjacent to the Production Buildings and Cast House and Production Buildings (PGG 2010), 2) Cast House and Cell Building Interior Sampling, 3) Cleaning and sampling of a portion of industrial lines and catch basins (PGG 2012b) 4) Industrial sump water sampling, 5) Sampling of the industrial line/groundwater drain line outfall at NPDES Pond A (PGG 2013b, ARI 2010), 6) Sampling of water and hydraulic oil associated with the Cast House Cylinder Pits, 7) UST decommissioning and removal (Westinghouse 1990), and 8) sampling at the oil change pit and friction weld press vault.

The other specific features associated with this focus category that have not been specifically investigated include: the 1) the Cast House Building footprint, 2) Production Buildings A-D footprint, 3) Petroleum AST and other petroleum storage areas 4) Shops, Maintenance, and Repair Areas, and 5) miscellaneous features including the Plant Laboratory, Dross Building, and Compressor Building.

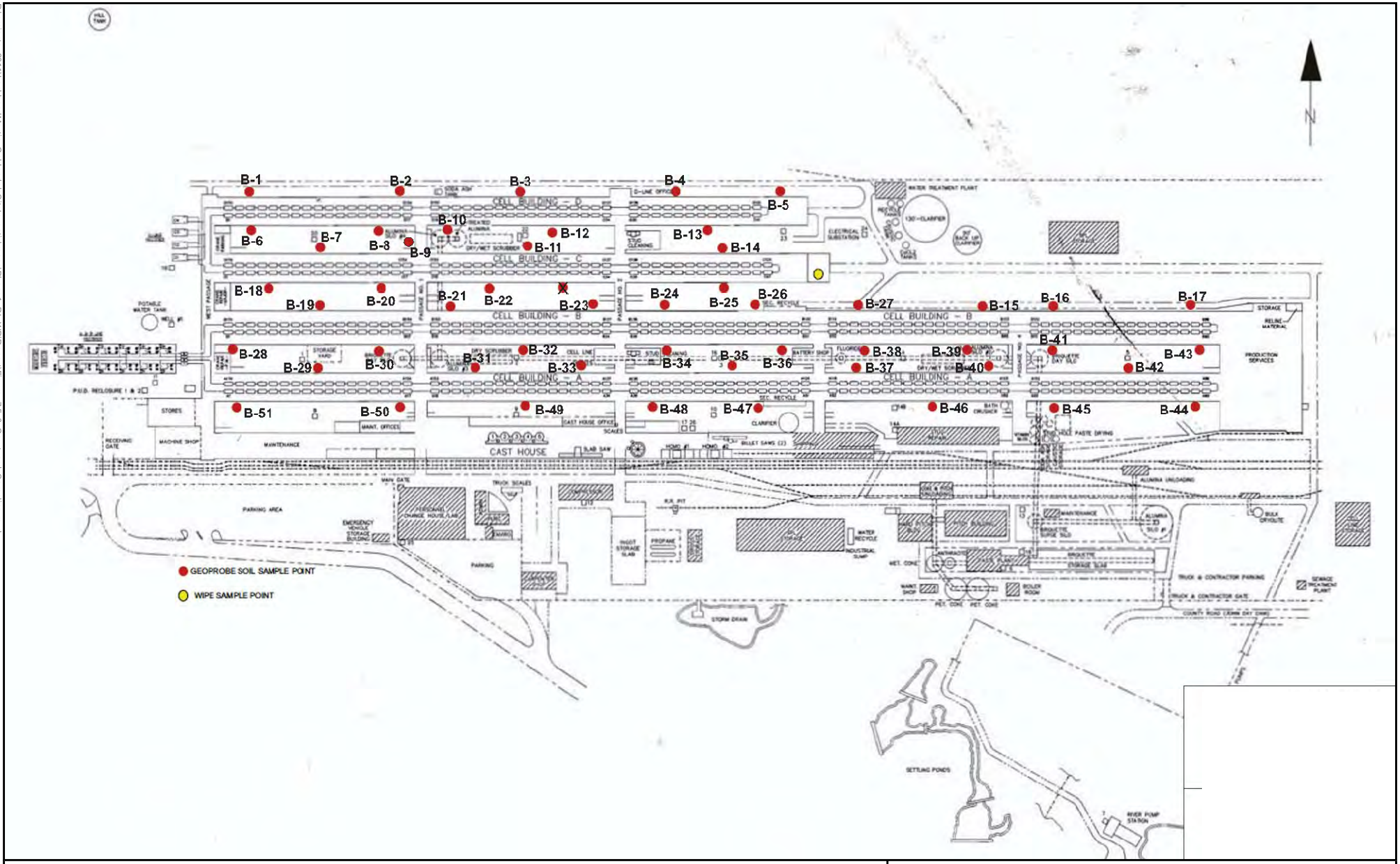
Courtyards

An initial investigation of the production area courtyards was performed during 2010 (PGG 2010) prior to start of demolition activities. Data summary tables and associated figures from the preliminary investigation are included in Appendix B-5. A total of 51 borings were installed in the Courtyards and 142 soil samples were collected as part of this investigation. The boring locations are shown on Figure 7.5-6.

Soil samples were collected using a direct-push probe. Soil samples were generally collected at the ground surface, 3 feet bgs, and 6 feet bgs. Refusal at basalt bedrock was reported in several borings above the 6-foot targeted depth. In about 15 of 51 borings, the deepest interval was reported as wet or damp, suggesting that perched water may be present in some areas.

Soil samples were analyzed for metals, fluoride, total and free cyanide, and carcinogenic PAHs, and are summarized in Table 7.5-1. Selected samples were also analyzed for TCLP metals. Results are summarized as follows:

- Total and free cyanide were detected at low concentrations below the MTCA Method B formula value for unrestricted land use.
- Fluoride was detected in all of the borings (and depths) at concentrations below the MTCA Method B formula value for unrestricted land use of 3,200 mg/kg. Fluoride was typically detected in the range of hundreds to low thousands parts per million. Soil screening levels for protection of groundwater have not yet been developed.
- Arsenic (maximum of 41 mg/kg) was detected at concentrations above MTCA Method B formula value for unrestricted land use (0.0667 mg/kg) and the MTCA Method A screening level for unrestricted land use that is based on protection of groundwater for drinking water use of 20 mg/kg. Arsenic was not detected above the MTCA Method C Industrial formula value of 87 mg/kg.
- Cadmium (maximum of 18 mg/kg) was detected above the MTCA Method A screening level for unrestricted land use that is based on protection of groundwater for drinking water use of 2 mg/kg, but below the MTCA Method B formula value for unrestricted land use of 80 mg/kg.



Source: PGG (2010).

Figure 7.5-6
Pre-Demolition Courtyard Soil Sampling Locations,
Plant Area AOC

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington

Table 7.5-1
Summary of 2010 Pre-Demolition Chemical Concentrations in Courtyards Soil

Chemical	MTCA Method A or B Screening Level	MTCA Method A or Method C Industrial Screening Level	Number of Samples Exceeding One or More Screening Levels/Total Samples	Maximum Detected Concentration	Sample with Maximum Concentration
Arsenic	20 (Method A)(a) 0.667 (Method B)	20 (Method A)(a) 87 (Method C)	11/142	**41**	B-19-1
Cadmium	2 (Method A)(a) 80 (Method B)	2 (Method A)(a)	21/142	**18**	B-21-1
Fluoride	3,200	140,000	0/142	2,900	B-24-1
Total cyanide	48	3,200	0/142	0.0006	B-4-1
Free cyanide	48	3,200	0/142	0.49	B-39-3
Benzo(a)anthracene	1.37	180	21/142	**31**	B-45-1
Benzo(b)fluoranthene	1.37	180	28/142	**54**	B-45-1
Benzo(k)fluoranthene	13.7	1,800	2/142	**34**	B-45-1
Benzo(a)pyrene	0.137	18	95/142	**510**	B-45-1
Chrysene	137	18,000	0/142	4.1	B-45-1
Indeno(1,2,3-c,d)pyrene	1.37	180	16/142	**34**	B-45-1
Dibenz(a,h)anthracene	0.137	18	37/142	**11**	B-45-1
Total PAH (TTEC)	0.137	18	98/142	**678.1**	B-45-1

a Screening level represents MTCA Method A soil screening level for protection of groundwater for drinking water use.
b Screening level represents MTCA Method A soil screening level for total PCBs as Aroclors.
All concentrations in milligrams per kilogram (mg/kg).
Bold/shaded values denote positive detections that exceed one or more screening levels.
TTEC Total toxic equivalent concentration

- Carcinogenic PAHs were detected in all of the collected samples with results exceeding MTCA Method C Industrial formula value (18 mg/kg TTEC) in 18 of 142 samples. Carcinogenic PAHs exceeded the Method B formula value (0.137 mg/kg TTEC) in 98 of 142 samples.

- Results for the TCLP metals analyses showed that the sampled soils did not exhibit the toxicity characteristic (for waste disposal purposes).

In general, highest chemical concentrations were detected in the samples collected from the shallowest interval in each boring. In some cases, chemical concentrations above screening levels extended to the deepest interval sampled above the bedrock contact. Some of the highest concentrations of PAHs at the site (refer to boring B-45) were detected on the southern side of Production Building A in the general area of carbon duct waste unloading area noted by Ecology inspectors in 1995 that appears to represent part of SWMU 24.

Cast House and Production Building Interiors

The Cast House Building and Production Building interiors were sampled prior to demolition in 2010 (PGG 2010). Both dust and concrete samples were collected. Dust samples contained elevated levels of carcinogenic PAHs (maximum of 92.5 mg/kg TTEC), arsenic (maximum of 73 mg/kg, cadmium (maximum of 1,400 mg/kg), lead (maximum of 1,200 mg/kg), and fluoride (maximum of 210,000 mg/kg). Cyanide concentrations in the dust and concrete were below screening levels. The cell building dust reportedly exhibited the characteristics of toxicity for cadmium based on TCLP testing (72 mg/L) (PGG 2010).

Industrial Lines

Portions of the industrial lines and industrial line catch basins were sampled along with the stormwater lines during 2011 (PGG 2013b). The industrial lines, monitoring lines, and the industrial sump were not characterized or cleaned during the 2011 work effort. The EP lines and catch basins do not appear to have been cleaned during the 2011 work effort.

Samples were collected from both soils/sediment and wood from the EP lines. The EP catch basin soil/sediment samples were analyzed for metals, fluoride, total and free cyanide, PAHs, and PCBs with a subset of the samples analyzed for TCLP metals and SPLP cyanide. Analytical results and associated figures are included in Appendix B-5. The EP catch basin sediment results are summarized in Table 7.5-2.

Arsenic, cadmium, and lead were detected at concentrations above MTCA Method A soil screening levels for unrestricted land use. Fluoride and cyanide concentrations were below screening levels for unrestricted land use. Carcinogenic PAHs were consistently detected above screening levels for unrestricted land use and most carcinogenic PAHs were also detected above MTCA Method A and Method C industrial screening levels. The TCLP metals results and SPLP cyanide results were below groundwater screening levels.

Samples of the wood from the EP lines generally contained a similar list of COPC as the soils/sediment at lower concentrations. These wood sample results will be further considered if the EP lines are decommissioned and/or removed at some future date.

Table 7.5-2
Summary of Chemical Concentrations in EP Catch Basin Soil/Sediment Samples

Chemical	MTCA Method A or B Screening Level	MTCA Method A or Method C Screening Level	Number of Samples Exceeding One or More Screening Levels/Total Samples	Maximum Detected Concentration	Sample with Maximum Concentration
Arsenic	20 (Method A)(a) 0.667 (Method B)	20 (Method A)(a) 87 (Method B)	4/4	**120**	EPL-A1
Cadmium	2 (Method A)(a) 80 (Method B)	2 (Method A)(a)	4/4	**15**	EPL-B2
Lead	250	1,000	1/4	**340**	EPL-B2
Fluoride	3,200	140,000	0/4	2,200	EPL-A2 and EPL-B2
Total cyanide	48	3,200	0/4	0.08	EPL-A2
Benzo(a)anthracene	1.37	180	4/4	**440**	EPL-B2
Benzo(b)fluoranthene	1.37	180	4/4	**1,900**	EPL-B2
Benzo(k)fluoranthene	13.7	1,800	4/4	**330**	EPL-B2
Benzo(a)pyrene	0.137	18	4/4	**190**	EPL-A1
Chrysene	137	18,000	4/4	**1,800**	EPL-B2
Indeno(1,2,3-c,d)pyrene	1.37	180	4/4	**350**	EPL-B2
Dibenz(a,h)anthracene	0.137	18	4/4	**110**	EPL-B2
Aroclor 1254	1 (Method A)(b), 0.5 (Method B)	10 (Method A) (b), 65.6 (Method C)	2/4	**1.1**	EPL-A1
Aroclor 1260	1 (Method A)(b), 0.5 (Method B)	10 (Method A) (b), 65.6 (Method C)	0/4	0.18	EPL-B1

a Screening level represents MTCA Method A soil screening level for protection of groundwater for drinking water use.
b Screening level represents MTCA Method A soil screening level for total PCBs as Aroclors.
All concentrations in milligrams per kilogram (mg/kg).
Bold/shaded values denote positive detections that exceed one or more screening levels.

Industrial Sump

A water sample was collected from the Industrial Sump on June 25, 2012. The sump water sample was analyzed for selected metals, PAHs, TPH, VOCs, and PCBs. Results are summarized in Table 7.5-3. The results have been compared with MTCA Method A or B groundwater screening and ecological chronic surface water screening levels from a potential transport pathway perspective. Note that the Industrial Sump is part of a NPDES permitted drainage feature and water concentrations in the sump are not representative of either groundwater or surface water.

Results are as follows:

- Aluminum (660 µg/L) was detected above the ecological chronic screening level of 87 µg/L.
- Zinc was detected at a low concentration (87 µg/L) below screening levels. Other metals analyzed for were not detected.

- Fluoride was detected at a concentration (7,700 µg/L) above the MCL and the MTCA Method B groundwater formula value.

- Carcinogenic PAHs including benzo(b)fluoranthene, benzo(a)pyrene, and dibenzo(a,h) anthracene were detected at concentrations above MTCA Method B groundwater formula values.

- TPH, VOCs, and PCBs were not detected.

Table 7.5-3
Summary of Detected Chemical Concentrations in Industrial Sump

June 25, 2012 Sampling Round

Chemical	MTCA Method A or B Groundwater Screening Level	Ecological Chronic Surface Water Screening Level	Detected Concentration
Aluminum	16,000	87	**660**
Zinc	4,800		87
Fluoride	640, 4,000 (MCL)	NE	**7,7000**
Anthracene	4,830	NE	0.27
Fluoranthene	640		0.13
Benzo(a)anthracene	0.12	NE	0.093
Benzo(b)fluoranthene	0.12	NE	**0.18**
Benzo(j,k)fluoranthene	1.2	NE	0.045
Benzo(a)pyrene	0.012		**0.053**
Benzo(g,h,i)perylene	NE	NE	0.08
Chrysene	12		0.14
Dibenz(a,h)anthracene	0.012		**0.03**
Indeno(1,2,3-cd)anthracene	0.12		0.095

All concentrations in micrograms per liter (µg/L).
Bold/shaded values denote positive detections that exceed one or more screening levels.
MCL Maximum Contaminant Level
NA Not applicable
NE Not established
U Chemical was not detected. Associated value represents the reporting limit.

Discharge Line to NPDES Pond A

Based on review of the industrial line map (refer to Figure 7.5-4), the EP lines and groundwater drainage lines at the east end of the Production Area daylight at NPDES Pond A. During the NPDES ponds cleanup in May 2010, relatively large volumes of water (thousands of gallons) were observed discharging into NPDES Pond A shortly following rain events during the initial part of the soil removal project (CDM Smith, personal communication, 2014).

The exact configuration of the current underground lines in this area is unclear because some undocumented modifications likely have occurred related to the construction of the county road in

this area (CDM Smith, personal communication, 2014). A figure showing line configuration (CDM Smith 2010) is included in Appendix B-5. A die test was conducted by CDM during the NPDES Pond Cleanup. A die was introduced to the EP sump, but did not appear in the NPDES Pond A discharge (CDM Smith, personal communication, 2014). The results were not considered to be conclusive due to uncertainties regarding the piping layout and test design.

The discharge into Pond A appears to represent a combination of groundwater and stormwater drainage. It's unclear the degree to which the wooden EP lines contribute to the discharge or serve as a preferential flow path.

The pipe discharge outlet has been sampled during 2010 (ARI 2010) and 2011-2012 (PGG 2013b). During the May 19, 2010 sampling event, the discharge was analyzed for: total cyanide, free cyanide, selected anions (including fluoride, sulfate, and chloride), total metals, SVOCs, and VOCs. Sample results for the May 2010 sampling round are summarized as follows:

- Total cyanide and free cyanide were not detected.
- For conventional water quality parameters, fluoride was detected at a concentration of 13,800 µg/L, which is above the MCL or 4,000 µg/L. Sulfate (205,000 µg/L), chloride (17,400 µg/L), and TSS (2,300 µg/L) were detected at concentrations below water quality screening levels.
- For total metals, barium (29 µg/L) and nickel (10 µg/L) were detected at low concentrations below water quality screening levels. Aluminum (1,220 µg/L) was detected at a concentration above the surface water chronic ecologic screening level of 87 µg/L. Note that this discharge point is into a NPDES permitted drainage feature and not into surface water. The screening level is provided for comparison from a potential transport pathway perspective only.
- VOC and SVOC compounds (including PAHs) were not detected.

Three rounds of samples were collected from the NPDES Pond A samples during 2011 and 2012 with a duplicate sample collected during the first round in March 2011 (four samples total) (PGG 2013b). The samples were analyzed for total metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, selenium, silver, and zinc), fluoride, total and free cyanide, PAHs, PCBs, VOCs, and petroleum hydrocarbons. Analytical results for the three rounds of sampling during 2011-2012 are summarized in Table 7.5-4. The analytical results for the (PGG 2013b) discharge line water sampling are included in Appendix B-5.

Table 7.5-4
Summary of Detected Chemical Concentrations in Discharge Line Water Samples to NPDES Pond A
2011 and 2012 Sampling Rounds

Chemical	MTCA Method A or B Groundwater Screening Level	Ecological Chronic Surface Water Screening Level	Number of Samples Exceeding One or More Screening Levels/Total Samples	Range of Detected Concentration	Sample Round with Maximum Concentration
Aluminum	16,000	87	3/3	**150**	NA
Fluoride	640, 4,000 (MCL)	NE	4/4	**7,400 to 23,000**	3/17/2011
Anthracene	4,830	NE	0/4	<0.094 U to 0.13	12/1/2011
Benzo(a)anthracene	0.12	NE	0/4	<0.0094 U to 0.03	12/1/2011
Benzo(b)fluoranthene	0.12	NE	0/4	<0.0094 U to 0.026	3/17/2011
Benzo(k)fluoranthene	1.2	NE	0/4	<0.0094 U to 0.099	3/17/2011
Benzo(g,h,i)perylene	NE	NE	0/4	<0.0094 U to 0.012	3/17/2011
Chrysene	12	NE	0/4	<0.0094 U to 0.027	3/17/2011

All concentrations in micrograms per liter (µg/L).
Bold/shaded values denote positive detections that exceed one or more screening levels.
MCL Maximum Contaminant Level
NA Not applicable
NE Not established
U Chemical was not detected. Associated value represents the reporting limit.

The results were similar to the 2010 round of sampling with aluminum and fluoride being detected above ecological chronic surface water and/or groundwater screening levels. Low levels of PAHs were detected below screening levels in the discharge line water samples.

Cast House DC Casting Pits

The three DC Casting Pits were sampled during March 2012 following removal of the hydraulic cylinders (PGG, personal communication, November 2014). Results, photographs, and location information in provided in Appendix B-5. After the removal of the hydraulic cylinders, water (potential groundwater) was observed in the pits. Water samples were collected from each of the three pits and analyzed for petroleum hydrocarbons and PCBs. Table 7.5-5 summarizes the March 2012 sampling results for the Casthouse DC Hydraulic Cylinder Pits. Results are summarized as follows:

- Aroclor 1242 was detected in the eastern casting pit at a concentration of 0.59 µg/L; which is above the MTCA Method A Groundwater Screening Level of 0.1 µg/L.
- Diesel-range TPH was detected below MTCA Method A Groundwater Screening Level in the western casting pit at a concentration of 7.1 µg/L; Lube-oil-range TPH was detected at concentrations below 10 µg/L in the central and western casting pits.

- Lube oil-range TPH was detected at a concentration of 850 µg/L in the eastern casting pit, which is above the MTCA Method A Groundwater Screening Level of 500 µg/L.

- Water was reportedly pumped from the pits following collection of these samples.

Table 7.5-5
Summary of Water Samples from Cast House DC Casting Pits After Removal of the Hydraulic Cylinders

March 1, 2012 Sampling Round

Chemical	MTCA Method A Groundwater Screening Level	Number of Samples Exceeding Screening Level	Maximum Detected Concentration	Sample with Maximum Concentration
Aroclor 1242	0.1	1/3	0.59	3-1-EP-03
TPH-Dx	500	1/3	850	3-1-EP-03

3-1-EP-03 sample collected from eastern of three deep hydraulic cylinders in the Cast House.
Concentrations in µg/L.
Bold values denote positive detection that exceeds screening level.

About one month later water seeped in, and a second sample was obtained eastern casting pit and analyzed for diesel-range petroleum hydrocarbons. Low levels of TPH-Dx (1.4 µg/L) were detected at concentrations below the MTCA Method A Cleanup Level of 500 µg/L. The source of water accumulating in the pits was reportedly rainwater, but may also have been shallow groundwater. The degree of hydraulic connection between the pits and groundwater remains unclear.

The first water sample collected from the eastern casting pit contained PCBs above MTCA Method A Groundwater Screening Levels and the source of the PCBs detected in the water sample is unclear. Because the hydraulic oil in the cylinders could not be sampled, four samples were collected from the bulk oil stored in the "oil room" adjacent to the furnaces and pits. 1,2-dichlorobenzene was detected at 10 mg/L in one sample, and no PCBs were detected. These results suggest that the recently used oil in the hydraulic cylinders does not appear to represent a source of PCB contamination.

Underground Storage Tanks

USTs were located in two areas of the site: 1) the western end of the Compressor Building (Site 1), and 2) west of the BPA facility (Site 2). At Site 1, there were two 5,000-gallon diesel USTs, and one 5,000-gallon gasoline UST and associated piping, and at Site 2 there was one 1,000-gallon

gasoline UST (Westinghouse 1990). Appendix B-5 contains relevant figures and associated data tables for the tank removal activities.

Petroleum product was pumped from all of the USTs at the two sites and the USTs were removed. The USTs were reportedly in good condition at the time of their removal. At Site 1, petroleum contaminated soils were found during removal of a fuel dispenser island near the rail road tracks. About 3 cubic yards of petroleum contaminated soil (PCS) was removed. Ten soil confirmation samples were collected from beneath the USTs and at the fuel dispenser island near the tracks at Site 1, one confirmation samples were collected from the UST excavation at Site 2, and one soil sample was collected from the PCS soil stockpile associated with the fuel dispenser. All of the samples were analyzed for BTEX, total lead, and TPH. Analytical results for the confirmation samples were below screening levels used at that time as well as current MTCA screening levels. BTEX was not detected in any of the samples.

Oil Change Pit and Friction Weld Press Vault.

One sludge and water sample was collected from the oil change pit and a water sample was collected from the friction weld press vault. Documentation, photographs, and analytical results for these features are included in Appendix B-5. The samples were analyzed for selected metals, fluoride, PAHs, and petroleum hydrocarbons.

In the sludge sample collected from the oil change pit, arsenic (27 mg/kg) and cadmium (18 mg/kg) were detected at concentrations above the MTCA Method A Industrial Soil Cleanup Levels that are based on protection of groundwater for drinking water use. Carcinogenic PAHs including benzo(a) pyrene (42 mg/kg) and dibenz(a,h)anthracene (45 mg/kg) exceeded the MTCA Method C Industrial formula value of 18 mg/kg. Concentrations of diesel-range petroleum hydrocarbons (155,000 mg/kg) exceeded the MTCA Method A Industrial Cleanup level of 2,000 mg/kg. Note that this result represents a sludge sample that is contained within an engineered structure.

The water sample collected from the oil change pit contained antimony (34 µg/L), arsenic (69 µg/L), cadmium (120 µg/L), chromium (610 µg/L), lead (1,100 µg/L) above MTCA Method A and/or B groundwater formula values. Several carcinogenic PAHs were also detected above the MTCA Method B groundwater formula values including: benzo(a)anthracene (5.9 µg/L), chrysene

(19 µg/L), benzo(b)fluoranthene (19 µg/L), benzo(a)pyrene (3.5 µg/L), indeno(1,2,3-cd)pyrene (4.8 µg/L), and dibenz(a,h)anthracene (1.1 µg/L).

Chemical concentrations in the Friction Weld Press vault water sample were significantly lower than the sample collected from the oil change pit. Metals concentrations did not exceed groundwater screening levels. Carcinogenic PAHs including: benzo(a)anthracene (0.31 µg/L), benzo(b)fluoranthene (0.73 µg/L), benzo(a)pyrene (0.2 µg/L), indeno(1,2,3-cd)pyrene (0.24 µg/L), and dibenz(a,h)anthracene (0.52 µg/L).

7.5.3 Data Gaps Evaluation and Data Needs

Identified data gaps and data needs for the Plant Area AOC are summarized by major focus area. Data gaps and needs associated with the carbon manufacturing, manufacturing, and storage focus area include the following:

- Characterization of surface and subsurface soil chemical concentrations at the identified carbon handling, storage, and manufacturing potential source areas. Several of these features are located in the general vicinity of the Paste Plant and none have been specifically targeted for environmental investigation. This sample collection data need will be planned in conjunction with Plant Area AOC-wide soil sampling activities and SWMU-specific sampling activities in the Production Area.

- Inspection and evaluation of the construction of the subsurface portion of the Coke and Pitch Unloading Structure. Sampling of media at the groundwater collection sump if this structure is still present and accessible.

Data gaps and data needs with respect to the cryolite and bath handling and storage focus area include the following:

- Characterization of surface and subsurface soil chemical concentrations at the newly identified cryolite and bath storage and handling features. With the exception of the Bath Storage Building (that also represents the East SPL Storage Area, SWMU 12) environmental investigations have not been performed at these locations.

- Fluoride represents the main COPC associated with cryolite and bath handling and storage activities. Fluoride is of particular concern for groundwater given its widespread use at the former plant, relatively high solubility in water, and the recent lowering of the MTCA Method B formula value for fluoride in groundwater. For fluoride, development of a soil screening level under MTCA that is protective of groundwater for drinking water use represents a RI data evaluation need.

Data gaps and data needs associated with the Cast House, Production Buildings, and Ancillary Features include the following:

- **Cast House and Production Buildings Foundation Footprint.** Characterization of chemical concentrations in soils within the footprint of the Cast House and Production Buildings represents a data gap and data need for the RI. In particular, low lying structures beneath building foundations where waste, effluent, or direct contact cooling water may have accumulated should be characterized (e.g., sumps, subsurface ducts, under-floor trenches, DC casting pits). Further information regarding the casting pit(s) design and construction represents a data gap and data need to determine the potential for these subsurface structures to affect groundwater occurrence and flow. Characterization of shallow groundwater in the vicinity of the DC casting pits represents a data gap and data need.

- **Courtyards**. Supplemental characterization of soils to determine the extent of soil contamination and for additional COPC represents a RI data gap and data need. Confirmation of current post-demolition chemical concentrations for surface and near surface soils also represent an RI data gap and need for the Courtyards. Determination of the extent of PAH contamination above MTCA Method C formula values represents a FS data need.

- **Industrial Sump.** Characterization of chemical concentrations in subsurface soil and shallow groundwater in the vicinity of the Industrial Sump represents an RI data gap and data need. Characterization of chemical concentrations in sump sludge/sediments, and estimation of sludge/sediment volumes in the Industrial Sump represent remediation data needs.

- **Industrial Lines**. Verification that the lines and associated catch basins have been cleaned to maximum extent practicable now that site demolition activities (that previously limited access to the lines) have been completed. Further cleaning of the lines should be performed as appropriate.

- **Discharge Line to NPDES Pond A**. Determination of current concentrations of COPC in the discharge line water represents a RI data gap and data need. Chemical characterization of soil/sediment at the discharge point near Pond A represents a data gap and data need to evaluate the potential for re-contamination of NPDES Pond A soil.

- **Hydrologic Characterization of EP lines/Groundwater Collection Line.** Hydrologic evaluation of the groundwater collection system including estimation of the relative contribution of groundwater and EP line water conveyed by the piping systems to NPDES Pond A. Evaluation of the effects of the EP lines and groundwater collection system on shallow groundwater occurrence, flow, and groundwater contaminant concentrations represents a RI data gap and data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.

- **Fuel Handling and Storage Areas.** Characterization of current COPC concentrations in surface and subsurface soils in UST and AST areas represents a RI data gap and data need.

- **Shops, Maintenance, and Repair Areas.** Characterization of COPC concentrations in surface and subsurface soil represents a RI data gap and data need. Additional characterization of subsurface soils and shallow groundwater represents a data gap and data need for the equipment wash station, oil change pit, and friction weld press pit.

- **Ancillary Features.** Data gaps and data needs include characterization of COPC concentrations in surface and subsurface soils.

Characterization of groundwater occurrence, chemical concentrations, and flow represents an RI data need that will be addressed under the Groundwater in the Uppermost Aquifer AOC.

Section 8
Identified Data Gaps and Data Needs

This section summarized the identified data gaps and data needs for the site SWMUs and AOC. The overall purpose of this Phase 1 Work Plan is to define data gaps/data needs and broad, high-level, investigation objectives. The Phase 2 Work Plan will further develop and refine investigation objectives, the scope of work for field data collection activities, data quality objectives, and include a sampling and analysis plan (SAP) and Quality Assurance Project Plan (QAPP).

Tables 8-1 and 8-2 summarize the identified data gaps and data needs as well as investigation objectives for each SWMU and AOC, respectively. For more details regarding the data gaps and data needs, refer to Sections 6.0 for summaries of individual SWMUs, and Section 7.0 for summaries of the site AOC.

Table 8-1
Solid Waste Management Units Data Needs and Investigation Objectives Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
(Page 1 of 8)

SWMU Designation	Cleanup Status and Data Needs Summary	Investigation Objectives
SWMU #1 NPDES Ponds	Independent soil removal action completed to MTCA Method B soil screening levels for PAHs in 2010 (ARCADIS 2011a). Potential for re-contamination of soil at Pond A from runoff will be addressed as part of the data needs for the stormwater pond and appurtenant facilities SWMU (SWMU 32) and Plant Area AOC. Groundwater data needs for this area of the site will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Determination of current soil concentrations at mouth of pipe that discharges to Pond A. Characterization of current groundwater conditions and extent of groundwater contamination in this area.
SWMU #2 East Surface Impoundment (ESI)	The unit was closed under RCRA and an Engineered cap was installed in 1987. A long-term OMM program is ongoing that includes groundwater monitoring. Groundwater chemical concentrations for some constituents have been detected above screening levels. Groundwater data needs this area of the site (e.g. current conditions and extent of groundwater contamination) will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Characterization of current groundwater conditions and down gradient extent of groundwater contamination.
SWMU #3 Intermittent Sludge Disposal Ponds	Independent soil removal action was completed to MTCA Method A Industrial Soil screening levels for PAHs in 2007 (URS 2008b). The appropriateness of industrial cleanup levels for this SWMU based on future land use considerations should be confirmed. No groundwater data needs have been identified.	No further investigation is proposed.
SWMU #4 West Surface Impoundment	The impoundment was closed under RCRA and an engineered cap was installed in 2005. A long-term OMM program is ongoing that includes groundwater monitoring. Groundwater chemical concentrations for some constituents have been detected above screening levels. Groundwater data for needs will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Characterization of current groundwater conditions and down gradient extent of groundwater contamination.
SWMU #5 Line A Secondary Scrubber Recycle Station	No environmental investigations have been conducted. Characterization of chemical concentrations in surface and subsurface soil represents a data gap and data need. Limited characterization of current shallow groundwater conditions represents a data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Determination if a release has occurred from the unit. Characterization of COPC concentrations in surface and subsurface soil and shallow groundwater.
SWMU #6 Line B, C, D Secondary Scrubber Recycle Stations	No environmental investigations have been conducted. Characterization of chemical concentrations in surface and subsurface soil represents a data gap and data need. Limited characterization of current shallow groundwater conditions at this unit and the nearby Tertiary Treatment Plant (SWMU 8) represents a data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Determination if a release has occurred from the unit. Characterization of COPC concentrations in surface and subsurface soil and shallow groundwater.

Table 8-1
Solid Waste Management Units Data Needs and Investigation Objectives Summary

Columbia Gorge Aluminum Smelter Site
Goldendale, Washington
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SWMU Designation	Cleanup Status and Data Needs Summary	Investigation Objectives
SWMU #7 Decommissioned Air Pollution Control Equipment	SWMU represents 20 roof-top units associated with Production Buildings A and B that were removed in the late 1990s.Surface soil samples were collected in the courtyards near the WESP units during an initial investigation of the Production Area in 2010 (PGG 2010). This soil sampling effort did not specifically target the individual WESP units and other potential sources are present at the Courtyards. Soil chemical conditions in the Courtyards and Production Area will be addressed as part of the Plant Area AOC.	No SWMU-specific investigation is planned. COPC chemical concentrations in soils will be characterized as part of the Plant Area AOC.
SWMU #8 Tertiary Treatment Plant	No environmental investigations have been conducted. Characterization of COPC concentrations in surface and subsurface soil represents a data gap and data need. Limited characterization of current shallow groundwater conditions at this unit and the nearby Line B, C, D Secondary Scrubber Recycle System (SWMU 6) represents a data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Determination if a release has occurred from this unit. Characterization of COPC concentrations in subsurface soil and shallow groundwater.
SWMU #9 Paste Plant Recycle Water System	Spills from this unit were documented in 1990 and the system was upgraded. No environmental investigation of the recycle sump (briquette cooling sump), settling tanks, or other appurtenant facilities has been performed. Inspection of the Recycle Water System Sump and facilities that are part of Paste Plant Recycle Water System with targeted sludge and soil sampling to characterize current PAH concentrations. Shallow groundwater characterization in the sump vicinity to be addressed under the Groundwater in the Uppermost Aquifer AOC.	Determination of COPC concentrations in surface and subsurface soils and sump sludge.
SWMU #10 North Pot Liner Soaking Station	Soil and groundwater at the North and South Pot liner Soaking Stations were investigated as part of an independent RI/FS in 2008(URS 2008e). PAH soil contamination was found above MTCA Method C screening levels. A soil removal action was recommended as the preferred remedial alternative. Characterization of the full extent of soil contamination represents a data need, but could also be performed during the remedial action. No groundwater investigation needs have been identified other than additional sampling of the existing shallow well in the site vicinity that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Confirmation of the extent of soil contamination associated with this SWMU.
SWMU #11 South Pot Liner Soaking Station	Refer to SWMU 10 because the North and South Pot Liner Soaking Stations are located in close proximity and previously investigated together.	Refer to SWMU 10.
SWMU #12 East SPL Storage Area	This SWMU was investigated as part of an independent RI/FS during 2008 (URS 2008c). PAHs were found in site soils above MTCA Method C screening levels and selenium was detected above MTCA terrestrial ecological screening level values. A soil removal action was recommended as the preferred remedial alternative. Characterization of the full extent of soil contamination represents a data need, but could also be performed during the remedial action. Groundwater data need for this SWMU will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Confirmation of the extent of soil contamination associated with this SWMU.

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SWMU Designation	Cleanup Status and Data Needs Summary	Investigation Objectives
SWMU #13 West SPL Storage Area	The West SPL Storage Area was closed in 1988 under the solid waste regulations in effect at that time and still contains SPL. An engineered cap was constructed in 1988. The site was under a long-term OMM program that ceased when the responsible party went bankrupt. Groundwater monitoring was performed from 1990 to 2008 and groundwater chemical concentrations above screening levels have been detected. Characterization of current groundwater conditions will be conducted as part of the Groundwater in the Uppermost Aquifer AOC.	Confirmation of the extent of groundwater contamination.
SWMU #14 North SPL Storage Containment Building	This unit was cleaned closed under RCRA during July 2009 (CH2M Hill 2009). Soil sampling program was limited to cyanide and fluoride for a small number of samples. It is also unclear if the soil screening levels used for closure are protective of groundwater. Data gaps and data needs include: Determination of a fluoride and cyanide-containing waste and soil screening level that is protective of groundwater consistent with MTCA requirements. Current chemical concentrations of PAHs and selected metals in soil. Collection of subsurface soil samples beneath the liner. Investigation of shallow groundwater that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Supplemental characterization of COPC concentrations in soil. Development of soil screening levels protective of groundwater consistent with MTCA requirements. Characterization of shallow groundwater COPC concentrations
SWMU #15 South SPL Storage Building	This unit was cleaned closed under RCRA during 1996 (Golder 1996a). Closure soil sampling program was limited to cyanide and fluoride for a small number of samples. It is also unclear if the soil screening levels used for closure are protective of groundwater. Data gaps and data needs include: Determination of a fluoride and cyanide-containing waste and soil screening level that is protective of groundwater consistent with MTCA requirements. Current chemical concentrations of PAHs and selected metals in soil. Verification of the presence and condition of the liner with potential soil sampling beneath the liner depending on the results of verification activities. Investigation of shallow groundwater that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Supplemental characterization of COPC concentrations in soil. Development of soil screening levels protective of groundwater consistent with MTCA requirements.

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SWMU Designation	Cleanup Status and Data Needs Summary	Investigation Objectives
SWMU #16 SPL Handling Containment Building	This unit was cleaned closed under RCRA during 2011 (PGG 2011). Closure soil sampling program included additional chemical analyses (PAHs, metals, and PCBs) and collection of several more soil samples than during closure of the other SPL units. Contaminated soils were removed based on the detected PAH concentrations in soil above MTCA Method B screening levels. No data needs for soil have been identified No SWMU-specific groundwater data needs have been identified.	No investigation activities are proposed.
SWMU #17 East End Landfill	The EELF was investigated in 1991 and again 2008 as part of an independent RI/FS (URS 2008a). Elevated concentrations of PAHs were detected above MTCA Method C screening levels in landfill materials and in the underlying soils. Remedial excavation and disposal was identified as the preferred remedial alternative at the site. Additional investigation (Tetra Tech 2011a) was planned in this area because some documentation was found that indicated potential SPL disposal in this area and additional potential sources were identified. Additional landfill material and soil characterization and refinement of contaminated material volumes represent data needs for this SWMU. Groundwater data needs in this area of the site (e.g. current conditions, occurrence of groundwater, interaction with groundwater drainage/collection lines, extent of groundwater contamination) will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Supplemental characterization of the nature and extent of landfill materials and soil contamination. Refinement of estimates of waste and contaminated soil volumes. Characterization of groundwater occurrence and conditions and interaction with groundwater drainage/collection lines.
SWMU #18 West End Landfill	An independent soil and groundwater RI/FS was performed in 2008 (URS 2008f). Maximum concentrations of PAHs, oil-range petroleum hydrocarbons, and a few metals (arsenic, cadmium, selenium) exceeded MTCA Method A screening levels for industrial use in the landfill wastes. Low levels of arsenic, cadmium, chromium, lead, and cyanide were detected in groundwater above MTCA groundwater screening levels. However, it's unclear if the detected groundwater concentrations were representative of groundwater conditions or attributable to the WELF. An engineered cap was the recommended remedial alternative and a cap was designed (Tetra Tech 2010, 2012). No additional data needs have been identified for the soils and wastes. Groundwater data needs this area of the site (e.g. current conditions and extent of groundwater contamination) will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	No data needs have been identified for landfill wastes or soils. Characterization of current groundwater conditions and extent of groundwater contamination in this area.
SWMU #19 Plant Construction Landfill	No environmental investigations have been performed. A geotechnical investigation (Fujitani Hilts & Associates 2001) suggest that the construction rubble is primarily basalt cobbles and gravel (likely from initial plant blasting and grading activities). Characterization of COPC in site surface and subsurface soils represents a data need. Verification and inspection of the existing piezometer has been identified as a data need. Current groundwater conditions will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Characterization of COPC concentrations in soil.

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SWMU Designation	Cleanup Status and Data Needs Summary	Investigation Objectives
SWMU #20 Drum Storage Area	This SWMU was characterized as part of an independent site investigation during 2008 (URS 2008d). Results show the presence of PAHs in soil above MTCA Method B and below MTCA Method C Industrial screening levels. The appropriateness of industrial cleanup levels for this SWMU based on future land use considerations should be confirmed. No data gaps or data needs have been identified.	No environmental investigation activities are proposed.
SWMU #21 Construction Rubble Storage Area	No investigation of the Construction Rubble Area (SWMU 21) that is located west of the Drum Storage Area has been performed. This SWMU also includes recently generated debris from plant demolition. The concrete construction rubble stockpiles remaining at the site have been investigated (PGG 2012c, 2014c). Results show the presence of PAHs above Method B screening levels and below Method C screening levels. Fluoride and cyanide concentrations were below Method B screening levels, but it is unclear if these concentrations are protective of groundwater. Characterization of chemical concentrations of soil in Construction Rubble Area west of the Drum Storage area represents a data gap and data need. Further evaluation of potential reuse of the crushed concrete material stored onsite represents a data evaluation need for the overall project. Additional RI-related data gaps and data needs have not been identified for the crushed concrete. The Rebar Storage Area near the Rectifier Yard will be addressed as part of the Rectifier Yard AOC.	Characterization of chemical concentrations in soil for the Construction Rubble Area located west of the Drum Storage Area (SWMU 21). Further investigation of crushed concrete from site demolition activities does not represent an RI-related data need and is not proposed. Potential site reuse of the crushed concrete will be further evaluated during the FS.
SWMU #22 Wood Pallet Storage Area	The Wood Pallet Storage Area was inspected in 2012 (PGG 2012a) and a burn pile was found that contained materials other than wood. Environmental sampling has not been conducted at this area. Waste profiling with potential sampling of the underlying soils represents a data need for this SWMU. No SWMU-specific groundwater data needs have been identified	Characterization of COPC chemical concentrations in waste and underlying soil.
SWMU #23 Reduction Cell Skirt Storage Area	The Reduction Cell Skirt Storage Area located northwest of the Production Building D was reportedly cleaned up at the time of closure, but soil sample results have not been documented. Characterization of surface and subsurface COPC concentrations in soil represents a data gap and data need for this SWMU. No SWMU-specific groundwater data needs have been identified.	Characterization of COPC chemical concentrations in surface and subsurface soil.
SWMU #24 Carbon Waste Roll-off Area	The specific locations of the carbon waste roll-off boxes associated with the production lines are unclear and likely changed over the period of plant operations. These areas likely included the courtyards adjacent to and/or between the Production Buildings. Characterization data for soil have been collected from the Courtyards (PGG 2010) and show PAH concentrations above MTCA Method C screening levels in some areas. Further characterization of carbon manufacturing, handling, and storage facilities represents a data need that will be addressed as part of the Plant Area AOC.	No SWMU-specific investigation is planned. Characterization of the nature and extent of soil contamination for the courtyards and other carbon handling areas near the Production Buildings is an objective for the Plant Area AOC.

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SWMU Designation	Cleanup Status and Data Needs Summary	Investigation Objectives
SWMU #25 Solid Waste Collection Bin and Dumpsters	The exact locations of the solid waste collection bins and dumpsters in the former production area are unclear and likely changed during the period of plant operations. Soil chemical concentrations in the courtyards and other areas of the former plant represents a data gap and data need that will be addressed as part of the Plant Area AOC.	No SWMU-specific environmental investigation is proposed. Data needs for soil characterization in this area will be addressed as part of Plant Area AOC.
SWMU #26 HEAF Filter Roll-Off Bin	No environmental investigations have been performed. The likelihood of release is low based on the period and nature of this storage operation. The specific location of this roll-off bin near the Paste Plant is unclear. Carbon handling, manufacturing, and storage facilities (including those near the Paste Plant) will be characterized and addressed as part of the Plant Area AOC.	No environmental investigation activities are proposed.
SWMU #27 Tire and Wheel Storage Area	This SWMU was reportedly cleaned up following a 1994 brush fire that consumed the existing tires and wheels stored in this area. This SWMU is co-located with Drum Storage Area (SWMU 20). Soils in the vicinity of this SWMU where investigated as part of the 2008 Drum Storage Area RI performed by Lockheed Martin (URS 2008d). No data gaps or additional data needs are identified for this SWMU; however, the appropriateness for the use of industrial cleanup levels in site soils based on future land use considerations should be confirmed.	Refer to Drum Storage Area (SWMU 20).
SWMU #28 90-Day Drum Storage Area	No environmental investigations have been performed. The likelihood of release is low based on construction, relatively recent period of operations, and the record keeping and inspection program that was implemented. No data needs have been identified.	No environmental investigation activities are proposed.
SWMU #29 Caustic Spill	The area was inspected (Ecology 1990 e,f) and some soils were reportedly excavated due to high pH in response to this NaOH spill that occurred in 1990. Characterization of COPC concentrations in soil and groundwater was not performed. Subsurface soil chemical characterization for site COPC represents a data need for this SWMU. Limited groundwater sampling of the spill area represents a data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Characterization of COPC concentrations in subsurface soil in the spill area. Determination of whether a release to groundwater has occurred.
SWMU #30 Paste Plant Spill	Environmental investigation of the Paste Plant Spill occurred in 1991 (Technico Environmental Services 1991a,c). PAH concentrations in soil exceeded MTCA Method C industrial screening levels in the area near the fenceline south of the Paste Plant. A soil removal action was performed and confirmation sample results showed additional contaminated soils remaining. Additional areas of waste disposal and potential sources of contamination (e.g., East End Landfill) were identified. Subsurface soil sampling beneath concrete and asphalt in the area of the Paste Plant Spill to characterize PAH concentrations. Current concentrations of site COPC in soil and shallow groundwater represent a data gap and data need for this SWMU. Groundwater characterization needs will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Supplemental characterization of the nature and extent of soil and shallow groundwater contamination in the spill area.

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SWMU Designation	Cleanup Status and Data Needs Summary	Investigation Objectives
SWMU #31 Smelter Sign Area	Evidence of SPL and other aluminum reduction was discovered and reported to Ecology in 2011. Work plans for site characterization were prepared in 2011 (Tetra Tech 2011b, c). Data needs and data gaps include waste characterization as well as characterization of COPC concentrations in surface and subsurface soils. Characterization of shallow groundwater COPC chemical concentrations and water-level elevations in the NESI subarea near the wetlands represents a data gap and data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Nature and extent of waste and soil contamination in the Smelter Sign Area.
SWMU #32 Stormwater pond and appurtenant facilities	Sediments in the stormwater pond were investigated in 1991 (Technico Environmental Services 1991b) and contained PAHs above the state EHW designation criteria of one percent. Stormwater catch basins have been sampled and were found to consistently contain PAHs above MTCA Method C screening levels for soil. Accessible lines and catch basins at the time have been cleaned (PGG 2012b). A series of groundwater collection lines have been documented that drain into the storm water pond (Columbia Gorge Aluminum 2011). Data gaps and data needs include the following: • Characterization of current chemical concentrations of PAHs and other site COPC in stormwater retention pond sediments. Characterization of the vertical and horizontal extent of contamination. • Estimation of the volume of contaminated sediments and the anticipated waste designations. • Verification of the groundwater collection system layout and construction. • Hydrologic evaluation of the groundwater collection system and its effect on shallow groundwater occurrence and flow beneath the production area. • Verification that stormwater lines and catch basins have been cleaned to the maximum extent practicable now that plant demolition activities have been completed and site access has become easier. • Characterization of shallow groundwater COPC chemical concentrations and water-level elevations near the stormwater pond and in the main production area represents a data gap and data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Supplemental characterization of the nature and extent of contamination in the storm water pond sediment. Hydrologic characterization of the groundwater collection system and its effect on shallow groundwater occurrence and flow.
Other Potential Source (Northwestern Area) - Research And Development Laboratory Septic Drain Field	This area was investigated in 2012 (PGG 2013a). Elevated concentrations of PAHs, metals (e.g., arsenic, cadmium), and low levels of a few VOCs were detected primarily in septic tank sludge for the newer septic system. The tank sludge was removed and appropriately disposed of offsite and the septic system was decommissioned. Shallow groundwater sampling was not performed and it's unclear if contaminants could have impacted shallow groundwater. No characterization needs for soil have been identified. Limited groundwater sampling of the drain field represents a data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC.	Determination of whether a release to groundwater has occurred.
Other Potential Source (Western Area) – Upper Fluoride Area	This area was investigated in 2012 (PGG 2013a). No evidence of a release or waste handling/disposal was found. No data gaps or data needs have been identified.	No environmental investigation activities are proposed

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Notes

AOC	Area of Concern	RCRA	Resource Conservation and Recovery Act
COPC	Chemical of Potential Concern	RI/FS	Remedial Investigation/Feasibility Study
EELF	East End Landfill	SPL	Spent Pot Liner
EHW	Extremely Hazardous Waste	SWMU	Solid Waste Management Unit
MTCA	Washington State Model Toxics Control Art	VOCs	Volatile Organic Compound
NESI	North of the East Surface Impoundment	WELF	West End Landfill
PAH	Polynuclear Aromatic Hydrocarbon		

Table 8-2
Areas of Concern Data Needs and Investigation Objectives Summary

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Areas of Concern	Investigation Area(s)	Data Gaps and Data Needs Summary	Investigation Objectives
Columbia River Sediments	Columbia River, Boat Basin, and Intermittent Drainages.	Current information and/or data regarding sediment transport in Boat Basin and the reach of the Columbia River near the site (e.g., depositional rate, areas of re suspension, degree of connection and circulation, and potential dredging areas).	Characterize physical processes and properties that may affect sediment quality concentrations and potential remedial alternatives analysis.
		Chemical characterization of surface (0-6 inch) sediment in the Boat Basin and Columbia River to determine current conditions for site COPC. Because anticipated land and water use is assumed to remain the same, subsurface sediments will remained covered with no exposure to potential receptors. For this reason, characterization of subsurface sediments is not necessary.	Characterize current sediment quality in surface sediments to evaluate potential exposure.
		Chemical characterization of sediment and surface water in the two intermittent streams draining into the Boat Basin to determine current conditions for site COPC.	Characterize potential contaminant transport to the Boat Basin and Columbia River.
		Further characterization and evaluation of background sediment concentrations for site COPC to determine current conditions.	Characterize naturally occurring background concentrations and potential contribution from other upstream sources.
Groundwater in the Uppermost Aquifer	Site-Wide	Confirm and update the site hydrogeologic conceptual site model to reflect current conditions. Additional site-wide investigation is needed. Detailed hydrostratigraphic characterization of the UA, BAU, and BAL, including occurrence of groundwater, lithology, and continuity of permeable zones within the basalt. Evaluation of aquifer characteristics for the UA, BAU, and BAL aquifer zones including: groundwater flow directions, horizontal and vertical gradients, hydraulic conductivity, and aquifer interconnection within the underlying basalt aquifer system. Characterization of current groundwater quality for site COPC, geochemistry, and background concentrations for the UA, BAU, and BAL aquifer zones. Better definition and refinement regarding the lateral extent of contamination for various aquifer zones to evaluate the groundwater to surface water pathway.	Better understand groundwater occurrence, flow, and contaminant distribution to evaluate potential transport and exposure pathways.
		Development of soil screening levels protective of groundwater for fluoride and cyanide consistent with the requirements of MTCA. Development of an appropriate groundwater screening level for sulfate.	Establish necessary soil screening levels to adequately assess the potential for ongoing releases to groundwater. Better evaluate potential human health risks from exposure to sulfate in groundwater
		Verification of the physical condition of the wells and ancillary equipment (e.g., pumps). Evaluation of the construction details for existing wells to determine which wells are appropriate from a construction standpoint for inclusion in the RI sampling program. Verification of well elevation and location information. These data needs should be addressed before completion of the Phase 2 Work Plan. Identification of wells that may serve as potential pathways for contaminant migration that may require physical modification or decommissioning as appropriate.	Determine and ensure that representative groundwater RI data will be collected. Eliminate potential well-related groundwater transport pathways.
	Production Area	Characterization in the production area to determine hydrogeology and water quality concentrations. Further characterization at the east end of the plant in the area of the filled drainage channel and associated NPDES drainage. There is a general lack of groundwater characterization in these areas.	Characterize nature and extent of groundwater contamination and hydrogeologic conditions.
	SWMU-Specific	Evaluation of potential releases to groundwater for SWMUs and other source areas that have not been characterized.	

Table 8-2
Areas of Concern Data Needs and Investigation Objectives Summary

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Areas of Concern	Investigation Area(s)	Data Gaps and Data Needs Summary	Investigation Objectives
Wetlands	Wetlands west and south of the former smelter and excluding NPDES Ponds	Soil or sediment quality data wetlands sufficient to evaluate impacts from site operations via air deposition. Sufficient background soil or sediment samples for evaluating potential contamination in wetland sediment. Further evaluation of COPC list for wetlands soil/sediment characterization and characterization of background concentrations.	Characterize nature and extent of soil/sediment contamination in the wetlands related to former smelter emissions.
Rectifier Yard	Rectifier Yard and Rectifier Building	Collection of soil samples where feasible in areas that were previously inaccessible. Additional characterization of surface and near surface samples for a more comprehensive suite of site COPC. This effort will include resampling of: 1) selected previous transformer sampling locations and with chemical analyses of metals and petroleum hydrocarbons; 2) selected previous oil pipeline sampling locations with chemical analyses for metals and PCBs; 3) sample transformer substations not previously sampled in areas where PCBs were detected in soil and 4) selected previous AST sampling locations with chemical analyses of metals, fluoride, cyanide, PAHs and petroleum hydrocarbons. Further evaluation of the vertical and horizontal extent of petroleum hydrocarbon contamination in soil near the oil conveyance lines and at the interior transformer substations. Further evaluation of the horizontal and vertical extent of PAH soil contamination at the transformers and oil conveyance lines. Verification that all oil conveyance lines have been removed. Characterization of subsurface soils beneath Rectifier Building A- and B-series transformer locations, and beneath the Rectifier Building foundation with the chemical sampling program to include metals, PAHs, PCBs and petroleum hydrocarbons. Characterization of soil concentrations at the oil house to include chemical analyses of metals, PAHs, PCBs and petroleum hydrocarbons for selected samples. Characterization of surface soils in the northern portion of the Rectifier Yard used for storage of demolition debris (rebar) with the chemical sampling program to include metals, fluoride, cyanide, PAHs, PCBs, and petroleum hydrocarbons. Additional evaluation of Transformer Substation T5B to determine if additional soil removal is warranted.	Characterization of the nature and extent of soil contamination. Evaluation of potential for releases from site features to subsurface soil and shallow groundwater.

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Areas of Concern	Investigation Area(s)	Data Gaps and Data Needs Summary	Investigation Objectives
Plant Area	Potential Sources in the Plant Area AOC that are not included as existing SWMUs and AOC	The Plant Area AOC has been subdivided into three main categories of features: 1) Carbon Handling, Storage, and Manufacturing. 2) Bath Handling and Storage, and 3) Cast House, Production Building, and Ancillary Features. SWMUs 7, 24, 25, and 26 will also be addressed under the Plant Area AOC because of their indeterminate locations. Data gaps and data needs include the following: **Carbon Manufacturing, Handling and Storage Features.** Characterization of surface and subsurface soil chemical concentrations at the identified carbon handling, storage, and manufacturing potential source areas. Inspection and evaluation of the construction of the subsurface portion of the Coke and Pitch Unloading Structure. Sampling of the groundwater collection sump if this structure is still present and accessible. **Bath Handling and Storage Features.** Characterization of surface and subsurface soil chemical concentrations at the newly identified bath storage and handling features. With the exception of the Bath Storage Building (that also represents the East SPL Storage Area, SWMU 12) environmental investigations have not been performed at these locations. Particularly for bath handling and storage features, development of a fluoride soil screening level under MTCA that is protective of groundwater for drinking water use represents a RI data evaluation need. **Cast House and Production Buildings Foundation Footprint**. Characterization of chemical concentrations in soils within the footprint of the Cast House and Production Buildings represents a data gap and data need for the RI. In particular, subsurface soils associated with low lying structures beneath building foundations where waste, effluent, or direct contact cooling water may have accumulated should be characterized (e.g., sumps, subsurface ducts, under-floor trenches, DC casting pits). Specific data gaps and data needs include the following: • **Casting Pits.** Further information regarding the casting pit(s) design and construction represents a data gap and data need to determine the potential for these subsurface structures to affect groundwater occurrence and flow. Characterization of shallow groundwater in the vicinity of the Casting Pits represents a data gap and data need. • **Courtyards.** Supplemental characterization of soils to better define the extent of contamination and for additional COPC represents a RI data gap and data need. Confirmation of current post-demolition chemical concentrations for surface and near surface soils also represent an RI data gap and need for the Courtyards. Determination of the extent of PAH contamination above MTCA Method C formula values represents a FS data need. • **Industrial Sump.** Characterization of chemical concentrations in subsurface soil and shallow groundwater in the vicinity of the Industrial Sump represents an RI data gap and data need. Characterization of chemical concentrations in sump sludge/sediments, and estimation of sludge/sediment volumes in the Industrial Sump represent remediation data needs.	Characterization of the nature and extent of soil contamination. Evaluation of potential for releases from site features to subsurface soil and shallow groundwater. Evaluation of potential contaminant transport pathways. Characterization of potential hydrologic interaction between subsurface features and shallow groundwater.

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Areas of Concern	Investigation Area(s)	Data Gaps and Data Needs Summary	Investigation Objectives
Plant Area (Continued)	Potential Sources in the Plant Area AOC that are not included as existing SWMUs and AOC	• **Industrial Lines.** Verification that the lines and associated catch basins have been cleaned to maximum extent practicable now that site demolition activities (that previously limited access to the lines) have been completed. Further cleaning of the lines should be performed as appropriate. • **Discharge Line to NPDES Pond A.** Determination of current concentrations of COPC in the discharge line water represents a RI data gap and data need. Chemical characterization of soil/sediment at the discharge point near Pond A represents a data gap and data need to evaluate the potential for re-contamination of NPDES Pond A soil. • **Hydrologic Characterization of EP lines/Groundwater Collection Line**. Hydrologic evaluation of the groundwater collection system including estimation of the relative contribution of groundwater and EP line water conveyed by the piping systems to NPDES Pond A. Evaluation of the effects of the EP lines and groundwater collection system on shallow groundwater occurrence, flow, and groundwater contaminant concentrations represents a RI data gap and data need that will be addressed as part of the Groundwater in the Uppermost Aquifer AOC. • **Fuel Handling and Storage Areas.** Characterization of current COPC concentrations in surface and subsurface soils in UST and AST areas represents a RI data gap and data need. • **Shops, Maintenance, and Repair Areas.** Characterization of COPC concentrations in surface and subsurface soil represents a RI data gap and data need. Additional characterization of subsurface soil and shallow groundwater represents a data gap and data need for the Equipment Wash Station, Oil Change Pit, and Friction Weld Press Pit. • **Ancillary Features.** Data gaps and data needs include characterization of COPC concentrations in surface and subsurface soils. Characterization of groundwater occurrence, chemical concentrations, and flow in the Production Area represents an RI data need that will be addressed under the Groundwater in the Uppermost Aquifer AOC.	

Notes:
AOC Area of Concern

Section 9
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APPENDIX A— SWMUS SUPPORTING DOCUMENTATION

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APPENDIX B— AOCS SUPPORTING DOCUMENTATION

B-1 COLUMBIA RIVER SEDIMENTS AOC

B-2 GROUNDWATER IN THE UPPERMOST AQUIFER AOC

B-2.1 WELL LOGS

B-2.2 CROSS-SECTIONS

B-2.3 GEOLOGIC MAP

B-3 WETLANDS AOC

B-4 RECTIFIER YARD AOC

B-5 PLANT AREA AOC

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