

Baseline Ecological Risk Assessment Work Plan

**Columbia Falls
Aluminum Company
Columbia Falls
Flathead County, Montana**

**Prepared for:
Columbia Falls Aluminum Company LLC**

**2000 Aluminum Drive
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ACRONYMS

2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
AOC	Agreement and Order on Consent
AST	aboveground storage tank
ATP	adenosine triphosphate
AUF	area use factor
AVS	acid volatile sulfides
BAF	bioaccumulation factor
BAZ	biologically active zone
BCF	bioconcentration factor
bgs	below ground surface
BERA	Baseline Ecological Risk Assessment
BLM	biotic ligand model
BSAF	biota-sediment accumulation factors
BTEX	benzene, toluene, ethylbenzene, and xylene
BTV	background threshold values
CBR	critical body residue
CEC	cation exchange capacity
CFAC	Columbia Falls Aluminum Company, LLC
COPC	constituent of potential concern
COPEC	constituent of potential ecological concern
CSM	conceptual site model
DOC	dissolved organic carbon
DQO	data quality objectives
DSR	Data Summary Report
DU	decision unit
Eco-SSL	ecological soil screening levels
ECSM	ecological conceptual site model
EDD	estimated daily dose
EHS Support	EHS Support, LLC
EPC	exposure point concentration
EqP	equilibrium partitioning
ERA	ecological risk assessment
ERAGS	Ecological Risk Assessment Guidance for Superfund
ESB	Equilibrium Partitioning Sediment Benchmarks
ESBTU	equilibrium partitioning sediment benchmark toxic units
ESV	ecological screening value
FCV	final chronic value
f_{oc}	fraction of organic carbon
FS	Feasibility Study
GSD	geometric standard deviation
GW	groundwater
HHRA	Human Health Risk Assessment
HMW	high molecular weight
HQ	hazard quotient
IPaC	Information for Planning and Consultation
ISS	incremental soil sampling
LANL	Los Alamos National Laboratory
LMW	low molecular weight
LOAEL	lowest observed adverse effects level

LOEC	lowest observed effect concentration
MATC	maximum acceptable toxicant concentration
MDEQ	Montana Department of Environmental Quality
MDL	method detection limit
MPDES	Montana Pollutant Discharge Elimination System
MSBI	Montana State Background Investigation
NaF	sodium fluoride
NHD	National Hydrography Dataset
NOAA	National Oceanic and Atmospheric Agency
NOAEL	no observed adverse effects level
NOEC	no observed effect concentration
NRWQC	National Recommended Water Quality Criteria
ORNL	Oak Ridge National Laboratory
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
RAIS	Risk Assessment Information System
RI	Remedial Investigation
RSL	Regional Screening Levels
Roux	Roux Associates, Inc.
SAP	Sampling and Analysis Plan
SEDTOX	sediment toxicity
SEM	simultaneously extracted metals
SLERA	Screening-Level Ecological Risk Assessment
SMDP	scientific management decision points
SPL	spent potliner
SQT	Sediment Quality Triad
SVOC	semi-volatile organic compound
SW	surface water
TEC	Toxicity Equivalence Concentrations
TEQ	Toxicity Equivalency Quotient
TRV	toxicity reference value
UCL	upper confidence limit
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UST	underground storage tank
UV	ultraviolet
VOC	volatile organic compound
Work Plan	BERA Work Plan
WQB	water quality benchmark

1.0 INTRODUCTION

On behalf of Roux Environmental Engineering and Geology, D.P.C. (referred to herein as Roux) and Columbia Falls Aluminum Company, LLC (CFAC), EHS Support, LLC (EHS Support) has prepared this Baseline Ecological Risk Assessment (BERA) Work Plan (Work Plan) as part of the ongoing Remedial Investigation/Feasibility Study (RI/FS) of the former CFAC aluminum reduction facility (commonly referred to as an aluminum smelter) Superfund Site located in Flathead County, Montana (Site). The RI/FS is being conducted pursuant to the Administrative Settlement Agreement and Order on Consent (AOC) dated November 30, 2015, between CFAC and the United States Environmental Protection Agency (USEPA) (CERCLA Docket No. 08-2016-0002).

As part of the RI/FS, a site-wide ecological risk assessment (ERA) is being conducted in accordance with *Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments* (ERAGS; USEPA, 1997a). Per USEPA (1997a) the functions of the ERA are to:

- Document whether actual or potential ecological risks exist at the Site
- Identify which contaminants present at the Site pose an ecological risk
- Generate data to use in evaluating cleanup options

In addition to ERAGS, other relevant guidance documents that may be consulted to support the ERA process at the Site include, but may not be limited to:

- *Determination of the Biologically Relevant Sampling Depth for Terrestrial and Aquatic Ecological Risk Assessments* (USEPA, 2015a)
- *Considerations for Developing Problem Formulations for Ecological Risk Assessments Conducted at Contaminated Sites Under CERCLA* (USEPA, 2004)
- *The Role of Screening-Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments* (USEPA, 2001a)
- *Guidance for the Data Quality Objective Process* (USEPA, 2000)
- *Principles for Ecological Risk Assessment and Risk Management* (USEPA, 1999)
- *Guidelines for Ecological Risk Assessment* (USEPA, 1998)
- *Role of the Ecological Risk Assessment in the Baseline Risk Assessment* (USEPA, 1994)

ERAGS prescribes an eight-step process for the assessment of ecological risk to support risk management decision-making. The eight-step process includes several scientific management decision points (SMDPs) for the risk manager and risk assessment team to evaluate and approve or redirect the process (USEPA, 1997a). The eight-step ERA process is conducted in a tiered-approach consisting of two phases of risk assessment:

- Screening-Level Ecological Risk Assessment (SLERA): The SLERA includes Steps 1 and 2 of the ERAGS process and represents a preliminary and conservative assessment of potential ecological risks to determine if additional steps in the ERAGS process are warranted.
- BERA: The BERA includes Steps 3 through 8 of the ERAGS process. A BERA is conducted to further characterize site-specific ecological risks and to support risk management and remedial decision-making for the protection of ecological receptors.

Roux prepared a SLERA (ERAGS Steps 1 and 2) for the Site based on data generated during the Phase I Site Characterization (Roux Associates, 2017a). A Draft SLERA Report was submitted to the USEPA and Montana Department of Environmental Quality (MDEQ) on February 27, 2017 and comments on the Draft SLERA Report were received from USEPA and MDEQ on April 14, 2017. A revised SLERA that incorporated USEPA and MDEQ comments was submitted on September 15, 2017 (Roux Associates,

2017b). Based on conservative exposure assumptions, the SLERA identified constituents of potential ecological concern (COPECs) in surface water, sediment, or soil from exposure areas at the Site and concluded that there was insufficient information to dismiss potential ecological risk. The SLERA recommended further data gathering or analysis as part of a BERA to better understand ecological risk at the Site.

In addition to Site-wide ecological risk assessment activities, CFAC proposed an expedited risk assessment of the South Percolation Pond Area in a letter to the USEPA dated September 6, 2017 and a subsequent sampling and analysis plan dated October 20, 2017. High water conditions within the Flathead River during 2017 caused significant erosion of the dam on the east side of the South Percolation Ponds. While the dam is currently stable, and CFAC is in the process of undertaking measures to further stabilize the dam, future high-water conditions in the Flathead River will cause additional erosion and ultimately could potentially compromise the dam. The objective of the expedited activities is to better understand environmental conditions in the South Percolation Pond Area, and any human health or ecological risks that may be associated with its current condition, on an expedited time frame.

This BERA Work Plan incorporates revisions to the Draft BERA Work Plan submitted to USEPA and the MDEQ on November 17, 2017. The Draft BERA Work Plan was revised based on USEPA and MDEQ review and subsequent comments received by CFAC. On behalf of CFAC, Roux and EHS Support submitted written responses to USEPA and MDEQ comments. A summary of correspondence on the BERA Work Plan is provide below:

USEPA/MDEQ Comments		CFAC Response-to-Comments	
Date	Author	Date	Author
January 4, 2018	CDM Smith on behalf of USEPA	February 13, 2018	Roux/EHS Support on behalf of CFAC
January 9, 2018	MDEQ		
January 16, 2018	USEPA		
February 28, 2018	CDM Smith on behalf of USEPA	March 19, 2018	Roux/EHS Support on behalf of CFAC

In addition to the correspondence listed above, a meeting was held between the USEPA, MDEQ, CDM Smith, the United States Fish and Wildlife Service (USFWS), CFAC, Roux, and EHS Support on January 17, 2018 to discuss the comments on the BERA Work Plan. A subsequent conference call was held between USEPA, CDM Smith, USFWS, Roux and EHS Support on January 30, 2018 to further discuss the BERA Work Plan. This revised BERA Work Plan incorporates the resolution of USEPA, MDEQ, USFWS, and CDM Smith comments as documented in the correspondence described above.

1.1 Purpose and Objectives

The purpose of this BERA Work Plan is to develop a conceptual investigation framework, consistent with ERAGS, to evaluate whether environmental conditions associated with historical smelting operations at the Site pose an unacceptable risk to ecological receptors. The conceptual framework presented in the BERA Work Plan will be used to support the development of a detailed study design and sampling plan in the Phase II Site Characterization Sampling and Analysis Plan (SAP), which will be submitted for agency review and comment following approval of the BERA Work Plan and the baseline Human Health Risk Assessment (HHRA) Work Plan being submitted under a separate cover.

Specific objectives of this BERA Work Plan include:

- Present a baseline problem formulation to re-evaluate the screening-level problem formulation in the context of new information and findings of analyses conducted as part of the Phase I Site Characterization and the SLERA.
- Update ecological conceptual site model (ECSM) and ecological exposure areas of the Site and identify if data gaps exist that require additional collection of information during the Phase II Site Characterization Program.
- Refine the list of COPECs identified in the SLERA to identify those COPECs that are most likely to drive risk management decision-making for the Site to focus and streamline the BERA process.
- Develop a conceptual study design based on the preliminary BERA problem formulation to identify key data objectives for the BERA in the Phase II Site Characterization.
- Present a risk analysis plan to guide risk calculations and risk characterization in the BERA using data and observational information generated as part of the Phase I Site Characterization and the Phase II Site Characterization.

1.2 Work Plan Framework

The framework of this BERA Work Plan is comprised of the following components:

- **Section 2.0** – Site Background, which consists of the Site and environmental settings.
- **Section 3.0** – Baseline Risk Assessment Problem Formulation, which includes descriptions of the nature and extent of contamination at the Site, summary of the SLERA, the ECSM, refinement of the COPECs, and assessment endpoints, risk questions, and measurement endpoints.
- **Section 4.0** – BERA Conceptual Study Design, which includes an overview of the SLERA data gaps, the conceptual BERA investigation framework, and data quality objectives that will be addressed during the development of the Phase II Site Characterization SAP.
- **Section 5.0** – BERA Risk Analysis Plan, which includes key components of the effects analysis, exposure analysis, risk calculation, uncertainty analysis, and risk characterization that will be investigated as part of the BERA.
- **Section 6.0** – References.

2.0 SITE BACKGROUND

Site background for the Columbia Falls aluminum reduction facility is provided in this section. Section 2.1 describes the site setting, which includes information about the site location and a summary of the operational history of the facility. Section 2.2 details the environmental setting, which includes information about regional climatic conditions, localized hydrogeology, and aquatic, terrestrial, and transitional habitats identified at the Site.

2.1 Site Setting

The location and operational history of the CFAC Site is discussed below.

2.1.1 Site Location

The Site is located at 2000 Aluminum Drive in Columbia Falls, Montana (**Figure 1**). The Site is situated in the central portion of Flathead County, approximately two miles northeast of the City of Columbia Falls. The Site is accessed by Aluminum Drive via North Fork Road (County Road 486). The BERA study area consists of approximately 1,340 acres, which includes the former aluminum reduction facility and the surrounding area. The Site is generally bounded by the Cedar Creek Reservoir Overflow Ditch to the north, Teakettle Mountain to the east, Flathead River to the south, and Cedar Creek to the west (**Figure 1**).

2.1.2 Operational History

The Site was operated as a primary aluminum reduction facility (commonly referred to as an aluminum smelter) from 1955 until 2009. The facility began with two potlines in 1955 and an annual capacity of 67,500 tons per year (using 120 pots per potline). A third potline was added in 1965, and the fourth and fifth potline were added in 1968, increasing total aluminum production capacity at the Site to 180,000 tons per year. Aluminum production at the Site was suspended in 2009 and CFAC announced the permanent closure of the facility in March 2015. A detailed description of the operational history at the Site is provided in Section 2.7.2 of the RI/FS Work Plan (Roux Associates, 2015).

Buildings and industrial facilities remaining at the Site at the start of the Phase I Site Characterization included offices, warehouses, laboratories, mechanical shops, the Paste Plant, coal tar pitch tanks, pump houses, the Casting Garage, and the Potline Facility. The Site also includes seven closed landfills, one inactive landfill (not closed), material loading and unloading areas, two closed leachate ponds, and several wastewater percolation ponds. By October 2017, many structures on Site had been removed as part of ongoing decommissioning efforts. Structures removed include: West Rectifier, Rod Mill Building, Paste Plant, Quonset Hut, West Aluminum Unloader, Compressor Building, Laboratory, Pot Rooms 1 and 2 of Building 1 (the Main Plan), and Change House. **Figure 2** illustrates the locations of site features pertinent to the BERA investigation.

2.2 Environmental Setting

The Site is situated within the Stillwater-Swan Wooded Valley ecoregion (Woods et al., 2002). This level four ecoregion is positioned west of the Canadian Rockies in the Northern Rockies area. The valley floor sits at an elevation of approximately 3,300 feet above mean sea level (ft-amsl). This section includes descriptions of the regional climatic conditions, localized hydrogeology, and descriptions of the aquatic, terrestrial, and transitional habitats present at the Site.

2.2.1 Regional Climatic Conditions

The Site is located at a latitude of 48° 23' N. The elevation of the Site ranges from approximately 3,008 ft-amsl along the Flathead River to the south to 3,270 ft-amsl at the base of Teakettle Mountain to the east. Its mid-hemisphere latitude and intermontane setting results in wide seasonal climatic swings. Average annual precipitation in the region ranges from about 14 inches (in) to 25 in depending on the year. Greater precipitation at higher elevations is common; much of the precipitation is stored as snow. The regional climate is considered modified maritime (i.e., much of the precipitation regime is influenced by moist air masses from the Pacific Ocean traveling from west to east). Dry, cold air masses often move in the north to south direction from Canada. Mean annual temperature for nearby Kalispell, Montana is 43.25 °F (6.25 °C).

2.2.2 Localized Hydrogeology

The following sections describes the regional and site-specific features that influence surface water and groundwater flow in the region and the Site.

2.2.2.1 Surface Water Hydrology and Watershed Characteristics

The Site is located within the Flathead River watershed. As discussed above, the Site is bordered by surface water features of varying hydrology on each side, including the Flathead River to the south, Cedar Creek to the west, and intermittent Cedar Creek Reservoir Overflow Ditch to the east (**Figure 3**).

The Flathead River is a tributary to the Columbia River, which flows into the Pacific Ocean. The North Fork of the Flathead River originates in the province of British Columbia, Canada. The Middle Fork of the Flathead River originates in the Bob Marshall Wilderness located south of Glacier National Park. The confluence of the North Fork and Middle Fork of the Flathead River is approximately 10 miles upstream of the Site, north of Coram, Montana. The South Fork joins the main stem of the Flathead River at the entrance of Badrock Canyon located approximately two miles upstream of the Site. The Flathead River flows west through Badrock Canyon towards the City of Columbia Falls where its course is then southerly toward Flathead Lake. At the Site, the drainage area of the Flathead River is approximately 4,470 square miles (mi²), which includes the drainage area of Cedar Creek to the west.

The United States Geological Survey (USGS) maintained three gauging stations on the Flathead River in the general vicinity of the Site. The closest station was located approximately 3 miles southwest of the Site near Columbia Falls (USGS Station #12363000). Two stations are located approximately 10 miles north-northeast of the Site: the north fork station on the Flathead River and the middle fork station immediately west of Glacier National Park (USGS Stations #12355500 and #12358500, respectively). For the period of record at the Columbia Falls USGS station, October 1951 to September 2016, mean monthly discharge was lowest in August with an average flow rate of 5,340 ft³/s. Mean monthly discharge was greatest in June with an average flow rate of 24,900 ft³/s. The increased discharge in June corresponds to the period when average precipitation in the region is greatest. Meltwater from high elevation snowpack also contributes to the increased discharge in May and June.

Cedar Creek originates north of the Site in the area contributing to the Cedar Creek Reservoir. At the outlet of the Cedar Creek Reservoir, the upgradient catchment area is 12.5 mi². From the reservoir outlet, Cedar Creek flows approximately three miles southwest towards the City of Columbia Falls. The elevation of Cedar Creek is higher than groundwater elevations within the Site, indicating that Cedar Creek is a losing stream rather than a gaining stream. According to the USGS National Hydrography Dataset (NHD), a tributary to Cedar Creek is mapped that bisects the northern area of the Site. This intermittent feature is

shown to be situated along the eastern side of the Industrial Landfill and joins Cedar Creek approximately 0.5 miles to the southwest of the Industrial Landfill. This feature was not observed during Site reconnaissance; however, surface water ponding and wetland vegetation were observed in the area south and southeast of the Industrial Landfill. Based on field observations, the source of the ponding seemed to be from the nearby cliff. This feature was generally mapped by Roux field personnel and is identified on **Figure 2** as the Northern Surface Water Feature. At the western Site boundary, Cedar Creek drains an additional 1.5 mi², predominately from the western two-thirds of the Site.

The Cedar Creek Reservoir Overflow Drainage flows intermittently in the spring and regulates flow for Cedar Creek and the Cedar Creek Reservoir (Hydrometrics, 1985). Based upon proximity and land surface topography, some surface water runoff from the eastern side of the Site, originating from the East and Sanitary Landfills, as well as runoff from western flank of Teakettle Mountain, flows to the Cedar Creek Reservoir Overflow (**Figure 2**). Excluding potential upgradient contributions from the Cedar Creek Reservoir, the Cedar Creek Reservoir Overflow has a catchment area of approximately 2.0 mi². About 20 percent of this catchment area originates on-Site and the remaining catchment extends to the peak of Teakettle Mountain to the east. Like Cedar Creek, the elevation of Cedar Creek Reservoir Overflow is higher than surrounding groundwater elevations within the Site, indicating that the Cedar Creek Reservoir Overflow drainage is a losing stream.

2.2.2.2 Site Hydrogeological Units

The stratigraphic units underlying the Site form a complex hydrogeologic framework that influences groundwater elevations, groundwater flow, and potential constituents of potential concern (COPC) migration beneath the Site. Three major stratigraphic units were identified during the Phase I Site Characterization and are described in the *Phase I Site Characterization Data Summary Report* (Phase I DSR; Roux Associates, 2017a). The three stratigraphic units consist primarily, from land surface down, of:

- Layer of glaciofluvial and alluvial coarse-grained soils, varying in vertical extent and grain size depending on the vicinity to the Site features (i.e., Teakettle Mountain, Flathead River, etc.)
- Layer of dense, poorly sorted glacial till with interbedded deposits of glaciolacustrine clays and silts
- Bedrock

The coarse-grained glacial outwash and alluvium deposits that are found above the glacial till are collectively referred to as the “upper hydrogeologic unit” at the Site (Roux Associates, 2017c). The coarse-grained glacial deposits that comprise the upper hydrogeologic unit account for the main water bearing unit beneath the Site. The glacial tills found below the upper hydrogeologic unit were typically characterized as containing a higher percentage of fines that were denser and drier than the overlying outwash and alluvium deposits. The till deposits were often characterized as stiff and moist or dry. These observations indicate that the till deposits likely have a lower hydraulic conductivity than the overlying outwash and alluvium deposits in the upper hydrogeologic unit. The bedrock beneath the till has been metamorphosed over time, resulting in a tightly compacted, low porosity and low permeability unit. Based upon the conceptual site model, bedrock is considered to define the bottom of the hydrogeologic system beneath the Site.

2.2.2.3 Groundwater Occurrence and Flow

Groundwater flow in the region tends to follow surface topography (USEPA, 2011). Groundwater is typically recharged from direct infiltration and surface water sources, which include reservoirs, ponds, streams, and lakes (LaFave et al. 2004). Groundwater in the region may also discharge to surface water bodies, depending on the season and localized conditions.

Groundwater occurrence and movement was evaluated during the Phase I Site Characterization described in the Phase I DSR (Roux Associates, 2017a) and the *Groundwater and Surface Water Data Summary Report* (GW/SW DSR; Roux Associates, 2017c). Sixty-four monitoring wells were visited on the following dates to measure depth to groundwater across the Site: August 30, 2016; November 29, 2016; March 14-15, 2017; and June 16, 2017. Pressure transducers were also installed in selected wells at the beginning of the Phase I Site Characterization to monitor groundwater elevations throughout the Phase I Site Characterization. The elevation data collected from gauging and with the pressure transducers indicate that groundwater elevations fluctuate seasonally at varying magnitudes depending on the area of the Site, and what hydrogeologic unit the well is screened within. Additionally, groundwater elevations measured in monitoring well clusters, where there is a well screened within the upper hydrogeologic unit and an adjacent deep well screened below the upper hydrogeologic unit, indicates a downward vertical gradient exists. However, the differences in elevations between the glacial till and the upper hydrogeologic unit is typically greater than 25 ft, and in some cases, exceeds 50 ft. This large difference is indicative of limited (if any) hydraulic connectivity between the two water bearing zones.

Groundwater flow across the Site in the upper hydrogeologic unit is generally in the south-southwest direction towards the Flathead River. While the southerly flow direction is consistent across the Site, the discussion of the hydraulic gradient can be divided into three distinct areas:

1. Near Teakettle Mountain and in the landfill area of the Site, the groundwater hydraulic gradient is steep (approximately 0.059 ft/ft) and generally mirrors the steeper topography in that portion of the Site.
2. Groundwater elevations in the center of the Site (near the North Percolation Ponds, former Operational Area, and northern half of the Main Plant Area) are consistent over long distances (typically within 1 foot over distances greater than 1,000 feet), indicating a relatively flat groundwater hydraulic gradient (approximately 0.0045 ft/ft) across the center of the Site.
3. The gradient then increases in the southern area of the Site between the Main Plant Area and the Flathead River (approximately 0.031 ft/ft), which is also consistent with the steep drop in topography between the Railroad and the River.

The gradients above and the elevations measured in the Flathead River generally indicate that the groundwater in the upper hydrogeologic unit appears to discharge to the Flathead River.

2.2.3 Description of Aquatic, Terrestrial, and Transitional Habitats

Aquatic, terrestrial, and transitional habitats are present within the Site. This section describes the general physical, hydrological, or vegetative characteristics that describe habitats within the Stillwater Swan Wooded Valley ecoregion where the Site is located in Montana (Woods et al., 2002). Note that the actual classification of unique habitat types on-Site is provided in the identification and description of ecological exposure areas in **Section 3.3.1**.

Aquatic habitats are characterized by perennial or near-perennial inundation with water and physical habitats that can support aquatic receptor species in both lotic (flowing streams and rivers) or lentic (stillwater lakes and ponds) systems. Lotic and lentic systems must have appropriate basal resources (i.e., organic matter, macronutrients) to support flora and fauna. Aquatic vegetation communities (e.g., periphyton, aquatic macrophytes, and/or phytoplankton) can also be present.

In lotic aquatic habitats, flow conditions are suitable for the establishment of fish and invertebrate communities, as well as semi-aquatic birds or mammals that rely on aquatic flora or fauna as a food resource. Two lotic aquatic habitats exist within and around the Site (i.e., large river habitats and headwater stream habitats). The Flathead River is considered a large river by the MDEQ. Large rivers are non-

wadeable and almost always seventh-order or higher according to the Strahler stream order index (Strahler, 1964). Key physical habitat features of the Flathead River include cobble or gravel substrate; deep, fast-flowing water; and, depending on valley dimensions, multi-thread channels. Given the absence of extensive agriculture or other non-anthropogenic nutrient sources upgradient, the Flathead River is considered oligotrophic, which means that it lacks macronutrients, such as phosphorus. Glacial flour from headwater glacial streams at its origins contributes to its rich blue color. Other smaller headwater stream habitats in the region can be distinguished primarily by their hydrologic regime. Montane headwater streams that originate in the high-elevation peaks have characteristically high spring and early summer flows, the spring freshet, due to snow melt. These systems are also often oligotrophic.

In lentic habitats, localized hydrology and geophysical characteristics must sustain standing water capable of supporting fish and invertebrate communities, as well as semi-aquatic birds or mammals that rely on aquatic flora or fauna as a food resource. Many lakes in the region are oligotrophic, or limited in nutrients. Deep lakes or ponds can be stratified, where the epilimnion, or top of the lake exhibits different thermal regime than the hypolimnion, or bottom of the lake. Shallow lakes are typically well-mixed by winds and do not stratify.

Terrestrial habitats are dry, upland areas that may support aboveground and/or belowground terrestrial flora and fauna. Soils considered terrestrial habitat are limited to the vadose, or unsaturated, zone of the soil profile. Vegetation type is another key characteristic of physical terrestrial habitats. There are four primary terrestrial habitats on the Site, which are characterized predominately by the type of vegetation present. These habitats include: mixed conifer forest, riparian forest, deciduous shrubland, and open grassland. Detailed descriptions of each terrestrial habitat type and associated flora and fauna is described in the SLERA.

Transitional habitats are characterized by intermittent or seasonal surface water inundation. Transitional habitats can potentially support aquatic receptor species during certain life stages (e.g., juvenile herpetofauna), as well as terrestrial species during dry periods.

As noted above, ecological exposure areas are identified and described in detail in **Section 3.3.1**, and are distinguished based on the presence of aquatic, terrestrial, or transitional habitat characteristics.

3.0 BASELINE RISK ASSESSMENT PROBLEM FORMULATION

The purpose of the baseline problem formulation is to re-evaluate the screening-level problem formulation in the context of new information and findings of analyses conducted as part of the Phase I Site Characterization and the SLERA. The baseline problem formulation establishes risk assessment goals, characterizes ecological effects of primary COPECs, and updates the preliminary ECSM. The refined ECSM will be used to define assessment endpoints, risk questions, and measurement endpoints to guide the development of the conceptual BERA study design. The following sections present the preliminary baseline problem formulation based on the outcome of the SLERA and Phase I Site Characterization. The preliminary baseline problem formulation will be refined based on new information obtained to support the BERA in the Phase II Site Characterization.

3.1 Nature and Extent of Contamination

In 2013, Weston Solutions, Inc. (Weston) completed an investigation at the Site on behalf of the USEPA Region 8. The results were summarized in the April 2014 report titled *Site Reassessment for Columbia Falls Aluminum Company Aluminum Smelter Facility, Columbia Falls, Flathead County, Montana prepared for United States Environmental Protection Agency Region 8* (Weston, 2014). As part of the investigation, a total of 68 groundwater, surface water, sediment, and soil samples were collected at the Site during the investigation. Results were used by the USEPA to establish if an observed release had occurred at the Site as that term is defined in the USEPA Hazardous Ranking System Guidance Manual. The data collected during the Weston investigation was considered when developing the Scope of Work for the Phase I Site Characterization that was completed by Roux, on behalf of CFAC, in 2016/2017.

The Phase I Site Characterization program was designed to identify and/or confirm source areas and broadly characterize the nature and extent of associated chemicals of concern across the Site and around Site features. Based on the preliminary conceptual site model (CSM) presented in the RI/FS Work Plan, the nature and extent of contamination was evaluated from the following site features identified as potential source areas (**Figure 2**):

- Landfills (including the closed Wet Scrubber Sludge Pond and the closed leachate ponds)
- Former Drum Storage Area
- Percolation ponds
- Waste and raw materials storage and handling areas
- Plant drainage system including drywells and associated discharge points
- Underground storage tanks (USTs) and aboveground storage tanks (ASTs)

The results of the Phase I Site Characterization indicated that cyanide, fluoride, and polycyclic aromatic hydrocarbons (PAHs) are the primary COPCs identified within the potential source areas and site features (Roux Associates, 2017a). A summary of key findings regarding the nature and extent of contaminants as it relates to the baseline problem formulation include:

- Elevated cyanide and fluoride concentrations in groundwater within the upper hydrogeologic unit appear to originate immediately to the west of the Wet Scrubber Sludge Pond, with maximum concentrations immediately downgradient of the West Landfill and Wet Scrubber Sludge Pond. The Center Landfill also appears to be a source of cyanide and fluoride in groundwater. Cyanide and fluoride concentrations in groundwater to the east and northeast of these site features, and downgradient of other site landfills, are generally orders of magnitude lower.
- Soils adjacent to the West Landfill contained elevated concentrations of cyanide, fluoride, and PAHs.

- Elevated cyanide and fluoride concentrations were observed in soil and groundwater in the Former Drum Storage Area, located immediately to the west of the West Scrubber Sludge Pond and West Landfill.
- Concentrations of PAHs and cyanide in the Percolation Ponds were typically greatest in soil and sediment in the North-East Pond and its influent ditch, followed by the effluent ditch, North -West Pond, and West Pond; concentrations of COPCs decreased with increasing depth in the Percolation Ponds.
- COPCs detected in soil and sediment in the South Percolation Ponds were similar to the other percolation ponds, but concentrations were generally much lower than the other ponds.
- Cyanide, fluoride, and PAHs were the primary COPCs detected in soils throughout the Main Plant Area.
- Low level detections of benzene, toluene, ethylbenzene, and xylene (BTEX) were the primary volatile organic compounds (VOCs) in soils across the Site. The presence of BTEX may be related to petroleum coke and pitch materials used at the Site.
- Naturally-occurring metals were detected in soil and sediment samples across the Site. Concentrations of some metals are consistent with regional estimates of background concentrations; however, the areal distribution and magnitude of metals concentrations around certain site features (e.g., North Percolation Ponds and associated ditches) indicate that some metals may be present as a result of site operations.
- Pesticides were not detected in any soil samples collected during the Phase I Site Characterization; however, mean and median method detection limits (MDLs) for some pesticides exceeded the lowest screening criteria.
- Polychlorinated biphenyls (PCBs) were not detected in discrete samples in the site-wide soil dataset; however, PCBs were detected in four decision units (DUs) within the central portion of the Operation Area.
- Consistent with the preliminary CSM, soil and groundwater results from the Phase I Site Characterization indicate low potential for soil vapor exposure based on low VOC concentrations detected in soil and groundwater.

3.2 Summary of Screening-Level Ecological Risk Assessment

A SLERA was conducted using the results of the Phase I Site Characterization to provide a preliminary assessment of potential risks to ecological receptors that may be exposed to Site constituents in soil, sediment, and surface water (Roux Associates, 2017b). The SLERA problem formulation included a preliminary ECSM that was developed for aquatic and terrestrial exposure areas. The preliminary ECSM described potential sources of constituents, release mechanisms, exposure media, representative receptor groups, and the complete exposure pathways for each receptor/medium combination.

Based on the review of the historical processes and data collected during the SLERA, COPECs were identified in surface water, sediment, and surface soil to which ecological receptors could potentially be exposed (Roux Associates, 2017b). COPECs were identified in the exposure analysis presented in the SLERA, which assumed maximum exposure scenarios based on comparisons of maximum exposure point concentrations to the most conservative ecological screening values (ESVs) (i.e., the minimum ESV) from a list of screening criteria sources developed in discussions with USEPA.

Comparisons of maximum exposure concentrations to minimum screening criteria resulted in a low probability of false negatives in the SLERA screening process (i.e., eliminating COPECs that may cause adverse effects due to exposure). However, the conservative assumptions of the SLERA exposure analysis could not be used to conclude that unacceptable does not risk exist. Rather, the findings of the exposure analysis indicated that certain COPECs and associated exposure pathways require further evaluation.

Based on these results, the SLERA concluded that there was a potential for adverse ecological effects and a more thorough assessment was warranted (USEPA, 1997a). Given the uncertainties in the exposure analysis described above, it was recommended that the ecological risk assessment process proceed to ERAGS Step 3 (Baseline Risk Assessment Problem Formulation). The following section presents a refined ECSM based on the SLERA and additional information developed since the submittal of the SLERA. The approach for refinement of preliminary COPECs identified in the SLERA (ERAGS Step 3A) is presented in **Section 3.4**.

3.3 Ecological Conceptual Site Model

Based on the findings of the SLERA and Phase I Site Characterization, the preliminary ECSM developed in the SLERA was refined to incorporate new information fundamental to the effective and efficient design of additional data collection activities to support the BERA. Key elements of the preliminary ECSM that were refined in the BERA problem formulation include:

- Exposure areas: Ecological exposure areas were re-defined based on the outcome of the SLERA to represent the habitat types (aquatic, transitional, and terrestrial) and receptor groups that may be present and exposed to site constituents.
- Ecological receptor categories: Additional ecological receptor categories and representative receptor species, including updated queries of special status species (e.g., rare, threatened, and endangered species), were identified in the refined ECSM.
- Exposure pathways: Potential exposure pathways were re-evaluated based on the SLERA findings to assess fate and transport properties of COPECs that may influence mobility and/or exposure routes to receptor categories.
- Bioavailability: The refined ECSM includes an evaluation of the site characteristics that may influence the bioavailability of primary COPECs in site exposure media.
- Bioaccumulation/biomagnification: The relative importance of COPECs that bioaccumulate or biomagnify were evaluated in the refined ECSM to identify potential data gaps that may be addressed in the BERA.

The following sections present the refined ECSM for the BERA problem formulation.

3.3.1 Ecological Exposure Areas

Ecological exposure areas presented in the SLERA were refined to represent primary habitat types and receptor groups that may be exposed to site constituents. Ecological exposure areas were grouped into three broad categories based on habitat types:

- Aquatic Exposure Areas
- Transitional Exposure Areas
- Terrestrial Exposure Areas

The following sections describe the categories of ecological exposure areas identified for the BERA problem formulation. The spatial extents of ecological exposure areas are illustrated in **Figure 3**.

3.3.1.1 Aquatic Exposure Areas

Aquatic exposure areas consist of perennially wetted habitats and include the Flathead River and Cedar Creek (**Figure 3**). These exposure areas border the Site to the south and northwest, respectively. Site-related constituents from features identified as potential source areas may be present in environmental media, including surface water and sediment, in the aquatic exposure areas. Primary constituent migration pathways from potential source areas to the aquatic exposure areas may include groundwater discharge to

surface water and overland stormwater runoff associated with precipitation or snowmelt events. Habitats provided by the aquatic exposure areas may support multiple aquatic receptor groups, including plants, invertebrates, fish, herptiles, and semi-aquatic birds and mammals. These receptor groups may use the aquatic exposure areas for foraging and reproduction. In addition to aquatic receptors, aquatic exposure areas may also provide drinking water sources for terrestrial receptors, such as herptiles, birds, and mammals.

3.3.1.2 Transitional Exposure Areas

Transitional exposure areas consist of intermittently or seasonally wetted habitats and include the North Percolation Pond Area, South Percolation Pond Area, Cedar Creek Reservoir Overflow Ditch, and Northern Surface Water Feature. Site-related constituents from features identified as potential source areas may be present in environmental media, including surface water, sediment, and soil, in the transitional exposure areas. Primary constituent migration pathways from potential source areas to the transitional exposure areas may include overland stormwater runoff associated with precipitation or snowmelt events and direct discharges of stormwater and formerly wastewater (e.g., North and South Percolation Pond Areas). Habitats provided by transitional exposure areas range from aquatic to terrestrial depending on seasonal climatic and hydrogeologic conditions, and may also range in quality depending on historical site operations. For instance, the North Percolation Ponds were constructed for wastewater management and were not designed to provide wildlife habitat. Therefore, the North Percolation Ponds may support lesser numbers of the aquatic and terrestrial receptor groups identified in **Section 3.3.6** due to the marginal habitat conditions provided. Based on the intermittent nature of aquatic habitats in these transitional exposure areas, it is unlikely that permanent aquatic communities would be established. These areas may be important for the reproduction of amphibians and may also provide drinking water sources for terrestrial receptors during wet periods of the year.

3.3.1.3 Terrestrial Exposure Areas

Terrestrial exposure areas consist of upland habitats and include the Main Plant Area, Central Landfills Area, Industrial Landfill Area, Eastern Undeveloped Area, North-Central Undeveloped Area, Western Undeveloped Area, and Flathead River Riparian Area (**Figure 3**). The primary habitat types within the terrestrial exposure areas include mixed conifer forest, riparian forest, deciduous shrubland, and open grassland. Conifer forests are predominantly found to the north and west of the Main Plant Area and are mostly bordered by riparian woodlands. Several areas of deciduous shrubland are located northeast and east of the Main Plant Area. Open grasslands are located immediately north and west of the Main Plant Area, between the Main Plant Area and the mixed conifer and riparian forests.

Site-related constituents from features identified as potential source areas may be present in environmental media, specifically soil, in the terrestrial exposure areas. Current primary constituent migration pathways from potential source areas to terrestrial exposure areas may include overland stormwater runoff associated with precipitation or snowmelt events. Historically, localized atmospheric deposition was also a potential constituent migration pathway from Site emission sources. Habitats provided by the terrestrial exposure areas may support multiple terrestrial receptor groups, including plants, invertebrates, herptiles, birds, and mammals. The ecological relevance of these habitats may vary among the terrestrial exposure areas based on the degree of historical site operations and infrastructure, such as buildings and impervious surfaces (e.g., Main Plant Area). Receptors may use the terrestrial exposure areas for foraging and reproduction. Terrestrial exposure areas do not provide aquatic or transitional habitats; and therefore, do not support aquatic receptors.

3.3.2 Source Areas

Based on the preliminary CSM presented in the RI/FS Work Plan and updated in the Phase I DSR, the nature and extent of contamination was evaluated from the following site features that were identified as potential source areas:

- Landfills (including the closed Wet Scrubber Sludge Pond and the closed leachate ponds)
- Former Drum Storage Area
- Percolation ponds
- Waste and raw materials storage and handling areas
- Plant drainage system including drywells and associated discharge points
- USTs and ASTs

The potential source areas associated with each ecological exposure area were identified in the refined ECSM as presented in **Figure 4** for aquatic exposure areas, **Figure 5** for transitional exposure areas, and **Figure 6** for terrestrial exposure areas.

3.3.3 Fate and Transport Pathways

The fate and transport of site-related constituents released into the environment depends on the physicochemical properties of the constituent and environmental media, and the physical characteristics of the migration pathway. Constituents may partition in various environmental media, such as surface water, sediment, and soil, which affects the potential ecological risks posed to aquatic and terrestrial receptors. The primary constituent migration pathways from the site features identified as potential source areas presented in **Section 3.3.2** to the ecological exposure areas described in **Section 3.3.1** may include groundwater discharge to surface water, overland stormwater runoff associated with precipitation or snowmelt events, and direct discharges of stormwater and formerly wastewater.

Groundwater discharge to surface water occurs in the Flathead River. Groundwater from the upper hydrogeologic unit beneath the Site is not known to discharge to surface water in any other aquatic or transitional exposure areas. Groundwater elevations are lower than the elevations of Cedar Creek and the Cedar Creek Overflow Ditch; therefore, these systems are considered to be losing systems with surface water recharging groundwater. The Northern Surface Water Feature is an intermittent feature that appears to be fed by seeps located to the north and west. It is believed that snowmelt and increased seasonal precipitation create an elevated water table which feeds these seeps during Spring.

Shallow groundwater from the upper hydrogeologic unit beneath the Site discharges to the Flathead River, as authorized by Montana Pollutant Discharge Elimination System (MPDES) permit number MT-0030066. A groundwater seep has been identified along the Flathead River in the Backwater Seep Sampling Area of the Site (**Figure 2**). Cyanide and fluoride are the primary constituents of concern identified in the groundwater seep.

Constituents in groundwater discharged to surface water may remain in dissolved form, adsorb to suspended particulates, or partition to fine-grained sediments within the receiving exposure areas. Cyanide and metal-cyanide anions, as well as dissolved metals, may adsorb to oxide minerals or clays with high anion exchange capacities, which may influence their bioavailability and potential ecological risks posed to ecological receptors.

Overland stormwater runoff associated with precipitation or snowmelt events is another potential constituent migration pathway from site features identified as potential source areas to ecological exposure areas. Stormwater may transport constituents in dissolved form or adsorbed to suspended sediment or soil

particles. Dissolved forms are subject to the processes described above, while constituents adsorbed to soil or sediment particles being transported by stormwater will eventually settle in depositional areas of the given ecological exposure area, whether aquatic, transitional, or terrestrial. The age of contaminants within soils also affects the fate and transport processes described above. The likelihood of dissolved-phase transport and bioavailability often decreases with increased time since the contaminant entered the soil. Smolders et al. (2009) evaluated 10 percent inhibition endpoints for plants, invertebrates, and microbial processes exposed to metals in aged versus freshly contaminated soils. The findings of the evaluation indicated that total soil metal concentrations resulting in 10 percent inhibition endpoints in freshly amended soils were up to 100-fold lower than total soil metal concentrations resulting in 10 percent inhibition in aged or field-contaminated soils (Smolders et al., 2009).

Several transitional exposure areas received direct wastewater and stormwater discharges from historical Site operations, including the North Percolation Pond Area and South Percolation Pond Area. Although wastewater is no longer discharged to these exposure areas, the site stormwater conveyance system still discharges to these exposure areas. Stormwater may transport site-related constituents as previously described.

3.3.4 Exposure Media and Exposure Pathways

The Phase I Site Characterization Report indicated that site-related constituents are present in environmental media at the Site (Roux Associates, 2017a). The type(s) of impacted environmental media varies among the different ecological exposure areas and associated habitats, and may include surface water, sediment (including pore water), and soil. Ecological receptor exposure pathways to constituents within the impacted environmental media include ingestion (direct and incidental), and to a lesser extent (based on the COPECs identified), direct contact and inhalation. The exposure media and pathways identified in the refined ECSM are presented in in **Figure 4** for aquatic exposure areas, **Figure 5** for transitional exposure areas, and **Figure 6** for terrestrial exposure areas.

3.3.4.1 Direct Contact

Direct contact is considered a complete exposure pathway for select aquatic and terrestrial receptors (including plants, invertebrates, fish, and amphibians) that may be exposed to constituents in sediment and surface water through direct contact via absorption through plant tissue, gills, or skin. Select terrestrial receptors (including plants and soil invertebrates) may be exposed to constituents in surficial soil through direct contact via absorption through plant tissue or skin. Other semi-aquatic and terrestrial receptors may be exposed to constituents in surface water, sediment, or soil through direct contact; however, this exposure pathway is considered secondary to ingestion pathways for these receptors. Dermal contact exposure pathways to birds and mammals are not considered significant exposure pathways due to the presence of fur on mammals, feathers on birds, and scales on reptiles that mitigate direct dermal exposure (USEPA, 2005b). Therefore, the direct contact exposure pathway will only be evaluated quantitatively for plants, invertebrates, fish, and amphibians (**Figures 4 to 6**).

3.3.4.2 Ingestion – Direct and Indirect

Ingestion of impacted environmental media, including direct ingestion of dietary items and surface water and indirect ingestion of sediment and soil, is the primary exposure pathway of concern for most aquatic and terrestrial receptors. Direct ingestion of dietary items may be an important exposure pathway if environmental media are impacted by persistent, bioaccumulative constituents. Persistent, bioaccumulative constituents in sediment, surface water, and soil may be assimilated by lower trophic level species,

bioaccumulated in tissues, and transferred to higher trophic level species which consume lower trophic level species.

Exposure through ingestion varies based on the food habits and foraging range of the receptor. For instance, some receptors have small home ranges and feed within a localized area for their entire lifetime, while others, such as migratory receptors, may only feed in a specific area for a brief period before leaving to forage elsewhere. Incidental ingestion of impacted environmental media, such as soil or sediment, while grooming or foraging may also occur, but is considered secondary to the direct ingestion pathway.

3.3.4.3 Inhalation

Inhalation is a potentially complete, but secondary exposure pathway for terrestrial receptors. This exposure pathway may include the inhalation of constituents which have volatilized, or which are adsorbed to airborne particulates. Burrowing animals may be exposed to constituents through inhalation pathways while occupying burrows. Inhalation exposure pathways may be related to the inhalation of VOCs in soil vapor or soil dust particles within the burrow. Based on the SLERA and other Phase I Site Characterization data, VOCs were infrequently detected and not identified as COPCs in soils from terrestrial exposure areas where burrowing mammals may be present. Therefore, it is not likely that exposure to VOCs in subsurface soil vapor contributes significantly to the risk to potential burrowing animals at the Site. Burrowing animals may also be exposed to constituents sorbed to respirable dust particles that may be inhaled while occupying burrows. However, the inhalation of respirable dust is likely to have a minor contribution to overall risk. Based on exposure to humans, inhalation of respirable dust particles represents a relatively insignificant portion of the total exposure (i.e., less than 5 percent; USEPA, 2005b). Inhalation pathways likely result in negligible contributions to overall exposure relative to ingestion pathways; therefore, inhalation exposures will not be evaluated quantitatively in the BERA.

3.3.5 *Temporal Variability in Exposure Media*

Temporal variability in constituent concentrations in ecological exposure media was evaluated in the Phase II SAP based on the results of the Phase I Site Characterization Sampling (Roux Associates, 2018). Temporal variability in hydrology and constituent concentrations in surface water and groundwater were evaluated. A summary of key findings of the temporal evaluation as they relate to the ECSM are presented below; the complete temporal analysis is provided in the Phase II SAP (Roux Associates, 2018).

The results of the temporal evaluation of surface water hydrology based on an evaluation of discharge data from the Flathead River indicate that average monthly discharge patterns for 2016 and 2017 were generally consistent with the 10-year monthly discharge pattern from 2008 to 2017. Over the 10-year period, maximum discharges typically occur in May/June and minimum discharges between October and March. For the period during Phase I Site Characterization sampling in 2016 and 2017, maximum and minimum discharge events occurred within a representative time frame that is consistent with historical data. Within the Phase I sampling period, 2016 was a year with lower than average monthly discharge, except for October and November. 2017 was a year of higher discharge and greater extremes in both maximum and minimum monthly discharge.

The Phase II SAP also evaluated temporal variability in total cyanide and fluoride concentrations in surface water samples collected over four sampling rounds under variable hydrologic conditions. Surface water sampling results in the Backwater Seep Sampling Area and downstream Flathead River indicate temporal and spatial variability in surface water total cyanide and fluoride concentrations. **Figure 7** illustrates the temporal variability in surface water fluoride and total cyanide concentrations in the Backwater Seep Area and downstream stations in the Flathead River over the four sampling events; **Figure 7** also illustrates a

spatial gradient in surface water fluoride and total cyanide concentrations from sampling station CFSWP-005, located adjacent to the seep, to station CFSWP-001 in the Flathead River downstream of the Backwater Seep Sampling Area (left to right on **Figure 7**). The greatest surface water concentrations of total cyanide and fluoride were generally observed at station CFSWP-005 during Round 1 and Round 2 when discharge in the Flathead River was low (**Figure 7**). Surface water concentrations at CFSWP-005 were lowest during high-water sampling events (Round 3 and Round 4), except the total cyanide concentration in Round 4. During all sampling rounds, surface water concentrations of total cyanide and fluoride decreased with increasing distance downstream from CFSWP-005 (left to right on **Figure 7**). The relative decrease in surface water concentrations was greater within increasing distance downstream during low-water sampling events. This evaluation indicates that exposure to total cyanide and fluoride in surface water in the Backwater Seep Sampling Area is greatest during low-flow sampling events in the Flathead River (September and December). However, concentrations attenuate during all sampling events with increased distance downstream of the Backwater Seep Sampling Area due to mixing with the Flathead River.

The temporal evaluation of total cyanide and fluoride concentrations in surface water samples from other aquatic and transitional exposure areas of the Site indicated some seasonal variability in fluoride concentrations. However, variability in total cyanide concentrations did not indicate a clear seasonal pattern. Minimum fluoride concentrations in surface water were observed consistently during low-water conditions in Round 1 and maximum fluoride concentrations were consistently observed during high-flow conditions in Round 4 (Roux Associates, 2018). These findings are not consistent with the previous fluoride results presented in **Figure 7** for surface water results from the Backwater Seep Sampling Area. Except for the Backwater Seep Sampling Area, total cyanide concentrations in surface water did not indicate a clear seasonal influence; however, total cyanide concentrations were below the detection limit for the majority of samples analyzed during the four sampling events.

Further evaluation of the temporal variability in constituent concentrations in surface water and sediment datasets will be conducted based on the combined Phase I and Phase II Site Characterization datasets. Additional surface water sampling will be conducted as part of the Phase II SAP to capture additional low-water and high-water sampling events. Additional sediment characterization sampling conducted during the Phase II Site Characterization and expedited risk evaluation of the South Percolation Ponds (**Section 1.0**) will enable an evaluation of the temporal variability in sediment concentrations within aquatic and transitional exposure areas. The temporal evaluation will be included in the Uncertainty Analysis of the BERA (**Section 5.4**) and will include evaluations of temporal variability in surface water and sediment concentrations for each aquatic and transitional exposure area based on the combined Phase I and Phase II Site Characterization datasets.

3.3.6 Ecological Receptors of Concern

The ecological exposure areas identified in **Section 3.3.1** may support multiple ecological receptors of concern. Aquatic receptors of concern that may use habitats within aquatic and/or transitional exposure areas include plants, invertebrates, fish, herptiles, and semi-aquatic birds and mammals. Terrestrial receptors of concern that may use habitats within aquatic, transitional, and/or terrestrial exposure areas include plants, invertebrates, herptiles, and terrestrial birds and mammals.

Several surrogate species were identified as representative species to evaluate exposure to mammalian and avian receptors based on feeding guild. Representative terrestrial species for each receptor group based on feeding guild are provided below.

Receptor Group	Scientific Name	Common Name
Mammalian Fauna		
Herbivorous Mammal	<i>Microtus pennsylvanicus</i>	Meadow Vole
Insectivorous Mammal	<i>Blarina brevicauda</i>	Northern Short-tailed Shrew
Carnivorous Mammal	<i>Mustela frenata</i>	Long-tailed Weasel
Avian Fauna		
Herbivorous Bird	<i>Zenaida macroura</i>	Mourning Dove
Insectivorous Bird	<i>Scolopax minor</i>	Woodcock
Carnivorous Bird	<i>Buteo jamaicensis</i>	Red-tailed Hawk

Representative aquatic/semi-aquatic species for each receptor group based on feeding guild are provided below.

Receptor Group	Scientific Name	Common Name
Mammalian Fauna		
Piscivorous Mammal	<i>Mustela vison</i>	Mink
Avian Fauna		
Insectivorous Bird	<i>Cinclus mexicanus</i>	American Dipper
Piscivorous Bird	<i>Megaceryle alcyon</i>	Belted Kingfisher

Plant, invertebrate, and herptile communities will also be evaluated, where appropriate, based on the availability of published toxicity data for organisms that occupy similar niches.

The United States Fish and Wildlife Service Information for Planning and Consultation (USFWS IPaC; <https://ecos.fws.gov/ipac>) indicated that six federally threatened (or proposed threatened) species may occur at the Site. No federally endangered species were identified by the USFWS IPaC search. The six federally threatened (or proposed threatened) species identified by USFWS IPaC are presented in the following table.

Scientific Name	Common Name	Status
Mammals		
<i>Lynx canadensis</i>	Canada Lynx	Threatened
<i>Ursus arctos horribilis</i>	Grizzly Bear	Threatened
<i>Gulo gulo luscus</i>	North American Wolverine	Proposed Threatened
Birds		
<i>Coccyzus americanus</i>	Yellow-billed Cuckoo	Threatened
Fish		
<i>Salvelinus confluentus</i>	Bull Trout	Threatened

Scientific Name	Common Name	Status
Plants		
<i>Silene spaldingii</i>	Spalding's Catchfly	Threatened

The USFWS IPaC also indicated that critical habitats for the federally threatened Bull Trout and eight migratory USFWS Birds of Conservation Concern may occur at the Site. The migratory Birds of Conservation Concern are presented in the following table.

Scientific Name	Common Name	Breeding Season
<i>Carpodacus cassinii</i>	Cassin's Finch	5/15 - 7/15
<i>Aechmophorus clarkii</i>	Clark's Grebe	1/1 - 12/31
<i>Tringa flavipes</i>	Lesser Yellowlegs	Breeds Elsewhere
<i>Numenius Americanus</i>	Long-billed Curlew	4/1 - 7/31
<i>Limosa fedoa</i>	Marbled Godwit	5/1 - 7/31
<i>Contopus cooperi</i>	Olive-sided Flycatcher	5/20 - 8/31
<i>Selaphorus rufus</i>	Rufous Hummingbird	4/15 - 7/15
<i>Tringa semipalmata</i>	Willet	4/20 - 8/5

3.3.7 Ecotoxicity of Primary Constituents of Potential Concern

The results of the Phase I Site Characterization and SLERA indicated that cyanide, fluoride, and PAHs are the primary COPCs identified within the potential source areas and site features (Roux Associates, 2017a; Roux Associates, 2017b). Metals were also frequently detected in site media at maximum concentrations exceeding conservative ESVs in the SLERA. The following sections present a preliminary review of the ecotoxicity of these constituent groups in aquatic, transitional, and terrestrial exposure areas identified at the Site.

3.3.7.1 Cyanide

Cyanide is a general term that is used to refer to many compounds that contain a carbon-nitrogen functional group where the two atoms are bound together with a triple bond. Cyanide occurs in multiple forms in the environment. In water, cyanide can occur in strong and weak metal-cyanide complexes, as cyanate or thiocyanate, organocyanides, or as free cyanide. In solid phases, cyanides can occur in simple metal cyanide solids, complexes with alkali earth metals, or in complexes with other metals (Jaszczak et al., 2017). The toxicity of cyanide depends on its form. Free cyanide, including the liberated anion of cyanide (CN^-) as well as hydrogen cyanide (HCN), and soluble cyanide salts are most acutely toxic.

During the aluminum reduction process many chemical reactions can take place within the smelting potliner, which consists of the refractory lining, carbon cathode, and carbon sidewalls. Some of the chemical reactions that take place within pot lining materials are responsible for the production of cyanide compounds. Cyanide, along with other potentially hazardous compounds, such as fluorides, can accumulate within the potliner during its operational lifespan. Once the liner has reached its operational lifespan and is removed from the pot lines, it is considered spent potliner (SPL), which is regulated as hazardous waste by the USEPA (Silveira et al., 2002). The presence of sodium-cyanide (NaCN) in SPL is of greatest concern

because it is a soluble cyanide salt. Other less-soluble cyanide compounds, such as sodium ferrocyanide, are also present in large quantities within SPL (Courbariaux et al., 2004). Lisbona et al. (2012) determined the soluble cyanide fraction of SPL using a water washing approach. Approximately 20 percent of the total cyanide within the studied SPL was soluble.

The primary mode of toxicity of cyanide compounds is disruption of cellular respiration. More specifically, cyanide causes histotoxic hypoxia, or the inability for cells to take up oxygen. The mechanism that causes disruption to cellular respiration is free cyanide binding with the trivalent iron within cytochrome oxidase, an essential enzyme in the electron transport chain. Once bound, the synthesis of adenosine triphosphate (ATP) ceases and cellular function ceases due to the lack of energy (Jaszczak et al., 2017). Cyanide ions can also affect other enzymatic paths in flora and fauna (Ebbs, 2004), and react with hemoglobin (Lanno and Menzie, 2006). The ecotoxicity of cyanide is discussed for aquatic and terrestrial receptors below.

Cyanide exposure in aquatic environments occurs through direct contact with cyanide-containing water. This exposure occurs through ingestion or rapid gill uptake by aquatic organisms. Semi-aquatic organisms can also be exposed through drinking cyanide-containing water. Exposure to less soluble forms of cyanide in water can still be problematic to mammalian and avian receptors, because cyanide can be liberated in the stomach due to the acidic and anoxic conditions. Incidental ingestion of cyanides in sediment is not a significant exposure pathway because free cyanide and weak metal–cyanide complexes tend to not accumulate in sediments unless organic carbon is abundant (Higgins and Dzombak, 2006). Cyanide does not tend to persist in aquatic environments because rapid chemical disassociation or biogeochemical metabolism occurs within the water column. The reactive nature of cyanide in water and its acute toxicity to (and rapid metabolism within) organisms limits the potential for bioaccumulation (Eisler, 1991; Lanno and Menzie, 2006). Species mean acute toxicity values for 28 freshwater species ranged from 0.046 to 10 mg CN/L (Lanno and Menzie, 2006). Chronic data are much more sparsely available for cyanide, and chronic toxicity values ranged between 0.008 and 0.079 mg CN/L for five freshwater and two marine species (Lanno and Menzie, 2006).

In terrestrial environments, free cyanide is typically not present. Upon entering the soil matrix via groundwater or deposition, free cyanide is rapidly complexed with metals to form cyanide-metal complexes, metabolized through microbial processes, or volatilized (Lanno and Menzie, 2006). Because cyanide compounds do not typically bioaccumulate, direct contact exposure and incidental ingestion of soils containing cyanides are the primary exposure routes for cyanides in terrestrial organisms. The mode of toxicity of cyanide to terrestrial plants is similar to that of fauna. Enzymatic binding to cytochrome oxidase results in cessation of cellular electron transport (Yu, 2015). Some plant species can assimilate or metabolize cyanide, and phytoremediation techniques as a means to cleanup terrestrial cyanide have been extensively studied (Yu, 2015).

The literature regarding cyanide bioavailability and toxicity summarized in this section will be used to support the development of ecological benchmark concentrations for relevant exposure media in an interim deliverable establishing refined ESVs, as well as the Effects Analysis of the BERA Report. The derivation of ecological benchmark concentrations will consider the site-specific conditions in terrestrial, transitional, and aquatic exposure areas that may influence cyanide bioavailability and toxicity to representative ecological receptors.

3.3.7.2 Fluoride

Fluoride is naturally abundant in soils and contained in minerals apatite ($\text{Ca}_5(\text{PO}_4)_3\text{F}$), fluorite (CaF_2), cryolite (Na_3AlF_6) and micaceous clay materials. Potassium fluoride (KF) and sodium fluoride (NaF) are soluble salts that contain fluoride. The fluoride containing feedstocks used in smelting include fluorite,

aluminum fluoride (AlF_3), and cryolite. Synthetic cryolite is the predominate flux compound used in aluminum smelting. Fluorite has the lowest solubility in water (16 mg/L at 20 °C) and cryolite is also relatively insoluble in water (420 mg/L at 20 °C). Aluminum fluoride has an increased solubility in water of 6,700 mg/L at 20 °C. KF and NaF represent the most soluble sources of fluoride with solubility in water at 20 °C of 95,000 mg/L and 40,400 mg/L, respectively. NaF and KF are often used in toxicity testing of fluoride for both aqueous and solid matrices. The ecotoxicity of fluoride is discussed for aquatic and terrestrial receptors below.

Aquatic invertebrates and fish tend to take up fluoride directly from water, and, to a lesser extent, from consumption of organisms that contain fluorides. Fluorides can bioaccumulate within aquatic organisms, typically in exoskeletons for invertebrates and skeletal bones in fish. In aquatic flora, fluoride can accumulate in plant and root tissues.

The toxic action of fluoride is linked to the strong electronegative state of fluoride ions, which act as enzymatic poisons. Key enzymes, for which their activity can be compromised by the presence of fluoride ions include: phosphatase, hexokinases, enolase, succinic, dehydrogenase, pyruvic oxidase, and others (Camargo, 2003). The decreased enzymatic activity results in interruption of key metabolic processes, such as glycolysis and protein synthesis (Kessabi, 1984). The specific mechanism that causes the decoupling of metabolic processes due to enzymatic activity inhibition is not fully understood.

Increased fluoride concentration, exposure time, and water temperature increases the toxic effects of fluoride to aquatic invertebrates (Camargo, 2003). Inorganic fluorides in solution can be removed from the aquatic phase by precipitation in the presence of calcium carbonate, calcium phosphate, calcium fluoride and, magnesium fluoride (Stumm and Morgan, 1996). Therefore, harder or more saline water tends to be less toxic to aquatic invertebrates. A preliminary evaluation of available literature for freshwater acute and chronic effect endpoint data indicated that *Hyalella azteca*, an amphipod, exhibits the greatest sensitivity to fluoride among the freshwater invertebrate species used for toxicological testing. The 10 and 50 percent inhibition concentrations (IC_{10} and IC_{50}) were 1,800 and 4,100 $\mu\text{g F/L}$, respectively at a hardness of 90 mg/L CaCO_3 and chloride content of 2,000 $\mu\text{g Cl/L}$ (Pearcy et al., 2015).

Increased fluoride concentration, exposure time, and water temperature also increases the toxic effects of fluoride to fish (Camargo, 2003). However, increasing intraspecific fish size and increasing calcium and chloride concentrations in water tends to decrease the toxic effects of fluoride to fish. Based on recent work by Percy et al. (2015), it appears that chloride concentration in surface water has a greater influence on the reduced toxicity of fluoride to freshwater organisms than calcium carbonate. Chloride concentration in water does reduce the toxic effects of fluoride to certain species; however, chloride does not mitigate toxic effects for all species. A preliminary evaluation of available literature for freshwater acute and chronic effect endpoint data indicated that *Oncorhynchus mykiss*, the rainbow trout, exhibits the greatest sensitivity to fluoride among the freshwater fish species used for toxicological testing. The IC_{10} and IC_{50} were 6,000 and >64,100 $\mu\text{g F/L}$, respectively, at a hardness of 6 mg/L CaCO_3 and chloride content of 2,000 $\mu\text{g Cl/L}$ (Percy et al., 2015).

Depending upon concentration, exposure time, and species, fluoride can have inhibitory or enhancing effect on freshwater algal growth (Camargo, 2003). Like terrestrial plants, fluoride content in aquatic macrophyte tissue increases with increasing water concentration and exposure time. A preliminary evaluation of available literature for freshwater acute and chronic effect endpoint data for aquatic plants indicated that *Chlorella vulgaris*, a green algae, exhibits a sensitivity to fluoride. The non-inhibitory concentration and lethal concentration in 50 percent of the test organisms (LC_{50}) were 66,500 and 380,000 $\mu\text{g F/L}$, respectively at a pH of 6.8 (Rai et al., 1998).

In terrestrial environments, fluoride can have effects on plant roots and aboveground vegetation depending on uptake mechanisms, as well as the age and source of fluoride. Plants can take up fluorides from soil and transfer them to foliar tissues through xylematic flows (Fornasiero, 2001). When taken up by roots, some residual fluoride is accumulated into root tissue; however, much of the fluoride is transported to shoot or leaf biomass (Jha et al., 2009).

In addition to potential uptake from soil, gaseous fluorides can be absorbed through leaf stomata and be transferred to foliar tissues through xylematic flows (Zouari et al., 2014). When exposure is predominately atmospheric, accumulation of fluoride in plant roots is much less than when exposure is predominately through soil sources (Baunthiyal et al., 2014). However, the uptake of fluoride into foliar tissue has been shown to decrease, coincident with decreasing atmospheric fluoride concentrations. For example, Horntvedt (1995) found no apparent long-term effects in spruce and pine needles from fluoride accumulation into foliar tissues over a period of approximately 25 years with coincidental decreases in atmospheric fluoride emissions. This suggests that both the age and source of fluoride contamination may affect its uptake and toxicity within the terrestrial environment.

The most common visible symptom of fluoride toxicity in terrestrial plants is foliar damage (leaf necrosis). This occurs due to several morphological modifications to the upper and lower epidermis. Collapse of mesophyll results in cell distortion and sharpening (Fornasiero, 2001). Leaf necrosis can occur along the leaf margin (sides) or at the tip of the leaf (apical leaf necrosis).

High internal fluoride concentrations affect multiple physiological and metabolic plant processes (Yadu et al., 2016). Elevated fluoride can reduce growth and development, affect rates of photosynthesis, and disrupt multiple enzymatic processes. However, the effects of fluoride on growth and development of terrestrial plants vary considerably between species (Baunthiyal et al., 2014). Coniferous trees have been identified as sensitive plant species for exposure to fluoride. Zwiazek and Shay (1988) reported a lowest observed effect concentration (LOEC) for *Pinus banksiana* (jack pine) seedlings for growth of 3 mg F/kg dry weight of sand. Effects were observed after 29 hours. Arnesen (1997) reported a LOEC for *Lolium multiflorum* (ryegrass) growth of 400 mg F/kg dry weight.

The effect of fluoride on terrestrial invertebrates is not as well studied as the effects on plants and higher trophic levels. Increased fluoride concentration and exposure time has been shown to increase fluoride body burden to the terrestrial invertebrate *Eisenia fetida* (Lawson and Yu, 2003). The accumulation of fluoride by numerous other invertebrates from fluoride contaminated soils has also been studied (Buse, 1986).

The fluorination of soils by the addition of super phosphate fertilizers (e.g., monocalcium phosphate, $\text{Ca}(\text{H}_2\text{PO}_4)_2$) has resulted in many studies which focus on the effects of fluorides on grazing animals such as sheep and cows. Ingestion is the primary exposure route for fluoride in higher trophic level organisms. Fluoride compounds are absorbed in the stomach and small intestine, where acidic conditions can convert recalcitrant forms of fluoride into more bioavailable forms (Cronin et al., 2000). Threshold soil fluoride concentrations for cattle and sheep were between 326 and 1,085 mg F/kg soil dw and 372 and 1,461 mg F/kg soil dw, respectively. More recent evaluation of terrestrial exposure by Pascoe et al. (2014) found that the lowest no observed adverse effects level (NOAEL) and lowest observed adverse effects level (LOAEL) risk-based concentrations were 149 mg F/kg soil dw and 659 mg F/kg soil dw, respectively.

One key consideration to the ecotoxicity of fluoride in soils is the degree to which fluoride is adsorbed to soil particles. Fluoride adsorption is greatest in acidic non-calcareous soils containing aluminum hydroxides, where fluorides occur predominantly as aluminum fluorosilicate complexes (Pascoe et al. 2014). In slightly alkaline soils with sufficient calcium carbonate (CaCO_3), soluble fluoride would be most likely completely fixed as CaF_2 (Brewer, 1966) and less bioavailable. However, an increasing electrostatic

potential at even higher pH decreases the retention of fluoride on the soil and increases solubility. This is partially attributed to the displacement of adsorbed fluorine by the increased concentration of hydroxide ions (Larsen & Widdowson, 1971).

The literature regarding fluoride bioavailability and toxicity summarized in this section will be used to support the development of ecological benchmark concentrations for relevant exposure media in an interim deliverable establishing refined ESVs, as well as the Effects Analysis of the BERA Report. The derivation of ecological benchmark concentrations will consider the site-specific conditions in terrestrial, transitional, and aquatic exposure areas that may influence fluoride bioavailability and toxicity to representative ecological receptors.

3.3.7.3 Polycyclic Aromatic Hydrocarbons

PAHs are a group of organic compounds that contain at least two condensed aromatic ring structures. When a PAH has three or less condensed aromatic rings, it is considered a low molecular weight PAH (LMW PAH). When it has four or more aromatic rings, it is considered a high molecular weight PAH (HMW PAH; USEPA, 2007a). During the production of aluminum using the Hall-Héroult process, carbon anodes and cathodes are used to conduct electricity through the alumina to produce molten aluminum. The coal tar pitch and coke used to create carbon anodes and cathodes contain multiple PAH compounds. The ecotoxicity of PAHs in aquatic and terrestrial environments are discussed below.

In aquatic environments, it is generally accepted that PAH compounds exert toxicity to benthic invertebrates primarily by a narcosis mode of action (USEPA, 2003; DiToro et al., 2000; Swartz et al., 1995; Russom et al., 1997; McGrath et al., 2004). Narcosis is a nonspecific, reversible disruption of neural activity (i.e., anesthesia). Based on the similar mode of action of PAH compounds, the toxicity of multiple PAH compounds in a sediment mixture is approximately additive; therefore, exposure to the PAH mixture must be evaluated to assess potential toxicity in sediment (USEPA, 2003). The composition of individual compounds within PAH mixtures and the relative contribution of those compounds to the additive toxicity to the benthic community vary depending on the source of PAHs.

Additional modes of ecotoxicity include phototoxicity, whereby exposure to ultraviolet (UV) light increases the toxicity of PAHs. Phototoxicity has been demonstrated in aquatic environments (van Brummelen et al., 1998; Weinstein and Polk, 2001). However, comparisons by Swartz et al. (1995) suggest that responses of benthic communities in PAH-contaminated sites correlate well with the toxicity that is predicted based on narcosis, suggesting that phototoxicity was not a major confounding factor for those environments.

Similar to aquatic receptors, the primary mode of toxicity of PAHs to terrestrial invertebrates is through narcosis (Sverdrup et al., 2002). Soluble phases of PAH compounds found in interstitial pore waters present the greatest risk to invertebrates through ingestion or incidental ingestion. For LMW PAHs 10 percent effect concentrations (EC₁₀) for reproduction or growth for several invertebrate species ranged from 8 to 113 mg/kg dw, whereas the EC₁₀ or the maximum acceptable toxicant concentration (MATC) for soil invertebrates exposed to HMW PAHs ranged from 10 to 80 mg/kg dw (USEPA, 2007a). Higher molecular weight PAH compounds generally exhibit greater toxicity to organisms, particularly mammals due to the carcinogenic and mutagenic properties. Mammalian insectivores, the most sensitive receptor group, can have a variety of physiological responses to PAH exposure (USEPA, 2007a).

The literature regarding PAH bioavailability and toxicity summarized in this section will be used to support the development of ecological benchmark concentrations for relevant exposure media in an interim deliverable establishing refined ESVs, as well as the Effects Analysis of the BERA Report. The derivation of ecological benchmark concentrations will consider the site-specific conditions in terrestrial, transitional,

and aquatic exposure areas that may influence PAH bioavailability and toxicity to representative ecological receptors.

3.3.7.4 Metals

The availability of metals to be incorporated into biological tissues does not necessarily correspond with the total concentration of metals in soil, sediment, or surface water; bioavailability is directly related to the speciation of metals. For most divalent metals, the most bioavailable and toxic forms of metals are the metal ions or small metal-anion complexes, which are present at very low concentrations in the environment. Most metals in sediment are not available for uptake due to strong complexation by solid phases. For example, metals precipitated as metal-sulfide ligands may be resistant to solubilization under typical geochemical conditions observed in sediment or sediment pore water (Sigg and Behra, 2005).

Many metal compounds are essential to maintaining cellular homeostasis. However, when metal concentrations exceed what is needed to maintain normal organismal functions, toxic effects can occur (Valko et al, 2005). Metal-induced toxicity can occur by several mechanisms in organisms, including hepatotoxicity (liver toxicity), neurotoxicity (brain toxicity), and nephrotoxicity (kidney toxicity). Iron, copper, chromium, vanadium, and cobalt can undergo redox-cycling reactions that can lead to deleterious types of oxidative stress. Mercury, cadmium, and nickel can deplete glutathione, which is an essential antioxidant in organisms. Arsenic primarily acts on organisms by binding to thiols, which can disrupt important enzymatic functions (Valko et al, 2005). The ability of metals to bioaccumulate within organisms varies depending on the receptor group and type of metal. Some metals biomagnify (e.g., mercury), or increase in concentration within receptor tissues moving up to higher trophic level.

The literature regarding the bioavailability and toxicity of metals summarized in this section will be used to support the development of ecological benchmark concentrations for relevant exposure media in an interim deliverable establishing refined ESVs, as well as the Effects Analysis of the BERA Report. The derivation of ecological benchmark concentrations will consider the site-specific conditions in terrestrial, transitional, and aquatic exposure areas that may influence metal bioavailability and toxicity to representative ecological receptors.

3.4 Refinement of Constituents of Potential Ecological Concern

A fundamental step in the baseline problem formulation is the refinement of COPECs identified in the SLERA to identify those COPECs that are most likely to drive risk management decision-making for the Site. The intent of the refinement step is to focus and streamline the overall ERAGS process by considering additional components early in the BERA process. COPEC refinement in the BERA problem formulation is consistent with USEPA *The Role of Screening -Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessment* (USEPA, 2001a). Specific elements of COPEC refinement include consideration of the following:

- SLERA Uncertainty Analysis: COPECs retained in the SLERA due to uncertainties, including constituents with MDLs exceeding conservative ESVs or constituents lacking ESVs, will be re-evaluated to provide context regarding the potential impact of these uncertainties on the overall findings and conclusions of the BERA.
- Re-screening based on refined ESVs: Alternative ESVs that are protective of chronic exposure but represent a broader range of no observed effect concentration (NOEC) endpoints are considered to provide context for the potential ecological risk associated with COPECs identified in the SLERA and to focus the evaluation of COPECs in the BERA.

- Background concentrations: COPECs in exposure areas at concentrations that are not significantly different from background concentrations may represent regional conditions that are not related to site activities or are not likely to drive risk in the BERA.
- Frequency and magnitude of detection: COPECs that are infrequently detected (< 5 percent) or detected at concentrations slightly exceeding conservative ESVs (hazard quotients [HQs] near 1.0) are not likely to ultimately drive risk management decisions in the BERA process.
- Dietary considerations: COPECs that serve as essential nutrients (e.g., iron, magnesium, sodium, and potassium) typically pose little ecological risk when present in concentrations that allow them to function as nutrients.

A preliminary refinement of COPECs identified in the SLERA was conducted based on the Phase I Site Characterization data (Roux Associates, 2017b). The preliminary COPEC refinement is not intended to remove COPECs from further consideration in the Phase II Site Characterization or BERA. Rather, the COPEC refinement is intended to identify and provide context for those constituents that are likely to be focal COPECs in the BERA process.

Additional COPEC refinement will be conducted in the BERA based on the combined datasets from the Phase I and Phase II Site Characterization sampling for ecological exposure media. The combined Phase I and Phase II datasets will be refined based on the elements identified above, consistent with USEPA (2001a). Screening of constituents based on the combined Phase I and Phase II datasets for each exposure area and exposure medium will be based on a tiered approach:

- 1) Maximum concentrations of constituents in Phase I and Phase II Site Characterization datasets will be initially compared to minimum ESVs presented in the SLERA; and
- 2) Constituents identified as COPECs in the initial screening will be refined based on the re-screening of COPECs using comparisons of maximum concentrations to refined ESVs presented in the BERA WP or developed as part of an interim deliverable submitted to USEPA. An interim deliverable will be prepared for USEPA and MDEQ review to support the selection of revised ESVs from a range of NOECs identified in literature sources.

The following sections describe the results of the preliminary refinement of COPECs identified in the SLERA based on the Phase I Site Characterization data (Roux Associates, 2017b).

3.4.1 Evaluation of SLERA Uncertainty Analysis

Constituents were identified as COPECs in the SLERA for multiple exposure media due to uncertainties in the screening-level exposure analysis. Constituents identified as COPECs based on uncertainty are re-evaluated in the BERA problem formulation to assess whether the uncertainty associated with exposure to these constituents is likely to influence the overall findings and conclusions of the BERA. Constituents identified as COPECs in the SLERA based on the following tiers of uncertainty were re-evaluated in the BERA problem formulation:

- Constituents below the detection limit with one half of the MDL exceeding an ESV
- Detected constituents lacking ESVs

Constituents identified as COPECs based on the tiers of uncertainty listed above will be further evaluated in the Uncertainty Analysis of the BERA Report. To evaluate the potential importance of non-detected constituents with one-half of the MDL exceeding the ESV in the BERA, maximum MDLs were compared to the range of ESVs considered during COPEC selection in the SLERA. ESVs identified in the SLERA were based on chronic, no effect endpoints used as ecological screening criteria by various agencies. While the minimum ESV from these sources was used in the SLERA conservative screening process, the range

of ESVs based on chronic, no effect endpoints are considered to represent concentrations that are not likely to cause adverse ecological effects. Therefore, exposure to non-detected constituents, if present, with MDLs within the range of ESVs identified in the SLERA is not likely to result in adverse ecological effects. Based on this rationale, non-detected constituents with MDLs below the maximum ESV identified in the SLERA are not likely to influence the overall findings and conclusions in the BERA. Further exposure evaluations of detected constituents lacking ESVs will be included in the BERA. The following sections present the re-evaluation of SLERA COPECs identified based on uncertainty.

3.4.1.1 Soil COPEC Uncertainty Analysis

Non-detected constituents identified as soil COPECs in the SLERA based on one half of MDL concentrations exceeding ESVs represent minimal uncertainty and are not likely to influence the overall findings and conclusions of the BERA. One non-detected pesticide (endrin), one PCB Aroclor (PCB-1248), and multiple semi-volatile organic compounds (SVOCs) were identified as soil COPECs in the SLERA based on one half of MDL concentrations exceeding ESVs (**Table 1**). Detection limits for endrin and PCB-1248 were within the range of SLERA ESVs, indicating minimal potential for adverse effects due to exposure to these constituents, if present. Detection limits for many SVOCs were within the range of SLERA ESVs, also indicating minimal uncertainty regarding exposure to these constituents, if present in soil samples. All but two SVOCs with maximum MDLs exceeding maximum SLERA ESVs, had detection limits within the range of SLERA ESVs for over 80 percent of samples analyzed (i.e., less than 100 of 515 samples with detection limits below minimum ESVs; see **Table 1**). The absence of detections of these SVOCs in 80 percent of soil samples with detection limits below minimum ESVs indicates minimal potential for exposure to these constituents, if present, to result in adverse ecological effects. Detection limits for 2,4-dimethylphenol and 2,4-dinitrophenol were greater than minimum ESVs in all samples. However, these constituents were not detected in other Site media. This indicates that these constituents are not likely present in soil; therefore, the potential for these constituents to cause adverse ecological risks is minimal.

3.4.1.2 Sediment COPEC Uncertainty Analysis

Non-detected constituents identified as sediment COPECs in the SLERA based on one-half of MDL concentrations exceeding ESVs represent minimal uncertainty and are not likely to influence the overall findings and conclusions of the BERA. Non-detected pesticides and select SVOCs were identified as sediment COPECs in the SLERA based on one-half of MDL concentrations exceeding ESVs. As presented in **Table 2**, the maximum MDL for all but five non-detected pesticides and 16 SVOCs were within the range of ESVs considered in the SLERA screening process. Given that the MDLs for these constituents are within the range of chronic, no effect endpoints, exposure to these constituents, if present, is not likely to result in adverse ecological effects. MDLs for dieldrin, endrin, heptachlor epoxide, and p,p'-DDE exceeded SLERA ESVs in less than 5 of 23 sediment samples; MDLs were less than two times the maximum SLERA ESV, indicating a narrow concentration range representing uncertainty for these constituents. The MDL for toxaphene was greater than the range of SLERA ESVs; however, toxaphene was not detected in any other site matrices and is not expected to be related to site activities. SVOCs with maximum MDLs frequently exceeding the range of ESVs included:

- 2,4-dimethylphenol
- 2,4-dinitrophenol
- 2,4-dinitrotoluene
- 2-methylphenol
- Atrazine
- Phenol

The following were not detected in surficial soils samples at the Site; therefore, these constituents are not likely present in sediment:

- 2,4-Dimethylphenol
- 2,4-dinitrophenol
- 2,4-dinitrotoluene
- 2-methylphenol
- Atrazine

Phenol was detected (J-qualified results) in less than 2 percent of surficial soil samples at the site [12 of 515 soil samples from 0-0.5 and 0.5-2-ft below ground surface (bgs)]; therefore, it is also unlikely that phenol is present in sediment at the Site. As a result, uncertainty regarding the potential for adverse effects due to exposure to these constituents, if present, is not likely to result in adverse ecological effects.

3.4.1.3 Surface Water COPEC Uncertainty Analysis

Two metals, pesticides, PCBs, select VOCs, and SVOCs that were below detection limits in the Phase I Site Characterization were identified as surface water COPECs in the SLERA based on one-half of MDL concentrations exceeding ESVs. As presented in **Table 3**, the maximum MDL for most non-detected constituents in surface water was within the range of ESVs considered in the SLERA screening process. If present at concentrations below the MDL, these constituents are within the range of chronic, no effect endpoints and therefore are not likely to result in adverse effects. The maximum MDLs for p,p'-DDD, toxaphene, select PCB Aroclors, hexachlorobenzene, and cis- and trans-1,3-dichloropropene were greater than the maximum ESV considered in the SLERA screening process. However, these constituents are not considered to be site-related and were not detected in soil or sediment in any site. As a result, uncertainty regarding the potential for adverse effects due to exposure to these constituents, if present, is not likely to result in adverse ecological effects.

3.4.2 *Dietary Considerations*

As described in Supplemental Component 3 of *The Role of Screening-Level Risk Assessments and Refining Contaminants of Concern in Baseline Ecological Risk Assessments* (USEPA, 2001a), physiological electrolytes (e.g., iron, magnesium, sodium, and potassium) or macro and micro-nutrients (e.g., nitrogen, phosphorus, and copper) are considered in the broader context of their essential role in performing intracellular functions in aquatic and terrestrial flora and fauna. Within the surface water, sediment, and soil matrices evaluated as part of the SLERA investigation, several constituents require further discussion pertaining to dietary considerations. Anions, cationic metals, and nutrient constituent groups are discussed below for each matrix evaluated. The anion chloride is discussed, as well as the cationic metals sodium, potassium, calcium, and magnesium. Nutrients, measured in surface water, include nitrate/nitrite-nitrogen, ammonium-nitrogen, and total orthophosphate-phosphorus. Most nutrients, cationic metals, and anions lacked ESVs in the SLERA evaluation. However, these constituents may be included in subsequent surface water, sediment, and soil evaluations as they provide important ancillary information that can refine exposure criteria [e.g., biotic ligand model (BLM) in surface waters] or further characterize exposure to identified COPECs. For example, calcium will be retained as a COPEC because of its association with fluoride in fluorite (CaF₂). The role of these constituents as essential components of specialized intracellular functions is discussed below.

In surface water, several essential anion, cationic metals, and nutrient constituents were measured as part of SLERA investigations. Calcium, chloride, magnesium, potassium, and sodium were evaluated, as well as ammonium-nitrogen, nitrate/nitrite-nitrogen, and total orthophosphate nutrients. These anions, cationic metals, and nutrients are particularly important for algal growth (Ansari et al., 2014). No exceedances were

noted for the anion or cationic metal compounds with ESVs. Anion and cationic metals will be retained for future analysis for the purposes of evaluating metal constituent bioavailability (e.g., copper) using the BLM, if deemed necessary.

MDEQ developed phosphorus and nitrogen nutrient criteria for Wadeable Streams (MDEQ, 2013) that have been reviewed and accepted by the USEPA. Cedar Creek, the only applicable water body for the criteria, did not have any exceedances for nitrogen or phosphorus compounds. The Flathead River is considered a large river under the numeric criteria framework developed by MDEQ. Large rivers require process-based mechanistic water quality models to determine appropriate criteria (MDEQ, 2013). No orthophosphate-phosphorus or nitrogen compounds were detected in the main stem of the Flathead River at levels that exceeded the criteria. Concentrations of nitrate/nitrite-nitrogen were greater than the criteria for Wadeable Streams in samples collected along the channel margin of the Flathead River within the Backwater Seep Sampling Area. However, elevated concentrations observed in these samples are typical of mean groundwater nitrate concentrations in shallow groundwater within the Flathead Valley (McDonald and LaFave, 2004).

Cationic metals, including calcium, magnesium, potassium, and sodium, were evaluated in sediment and soil matrices. The range of observed constituent concentrations in surficial intervals for site surface soil (0 to 2-ft bgs) and sediment was consistent with the range of typical values for western soils described in Element Concentrations in Soils and other Surficial Materials of the Conterminous United States (USGS, 1984). Geometric mean $\pm$ 1 geometric standard deviation (GSD) concentrations are presented in the following table for Site and western U.S. soils.

Cationic Metal	CFAC Site	Western U.S. Soils (USGS, 1984)	
	Concentration Range (mg/kg)	Geomean $\pm$ GSD Concentration (mg/kg)	Concentration Range (mg/kg)
Calcium	1,370 to 313,000	18,000 $\pm$ 30,500	600 to 320,000
Magnesium	1,090 to 27,500	7,400 $\pm$ 22,100	300 to 100,000
Potassium	194 to 3,080	18,000 $\pm$ 7,100	1,900 to 63,000
Sodium	31.3 to 10,500	9,700 $\pm$ 19,500	500 to 100,000

Notes:

CFAC = Columbia Falls Aluminum Company, LLC

GSD = Geometric standard deviation

USGS = United States Geological Survey

The range of site surficial soils and sediments fell within the geometric mean $\pm$ GSD for western conterminous U.S. soils for all cationic metals except calcium. Calcium concentrations above the upper GSD of the geometric mean for western conterminous U.S. soils were noted in soils and sediments from the South Percolation Pond Exposure area.

The potential for adverse ecological effects associated with exposure to essential nutrients will be further evaluated in the BERA based on comparisons of concentrations measured within exposure areas to ESVs and background concentrations measured as part of the Phase II Site Characterization sampling (**Section 4.2.3**). Based on analyses of the combined Phase I and Phase II Site Characterization datasets, essential nutrients will be removed from further consideration in the COPEC refinement conducted as part of the BERA Problem Formulation if site concentrations are less than ESVs and/or representative background concentrations.

3.4.3 Refined COPEC Screening Process

Following the evaluation of COPECs identified as uncertainties in the SLERA screening process and dietary considerations for essential elements, a refined COPEC screening process was conducted to preliminarily identify focal COPECs that may influence the BERA. As indicated in **Section 3.4**, the refined COPEC screening process is not intended to remove COPECs from further consideration in the Phase II Site Characterization or BERA. Rather, the COPEC refinement is intended to identify and provide context for those constituents that are likely to be focal COPECs in the BERA process. Additional COPEC re-screening will be conducted in the BERA Problem Formulation based on the combined datasets from the Phase I and Phase II Site Characterization sampling for ecological exposure media using the tiered screening approach described in **Section 3.4**. As described in **Section 4.2.3**, proposed Phase II Site Characterization sampling will include the collection of background datasets that will be incorporated into the COPEC refinement process (Roux Associates, 2018).

The refined COPEC screening process considers alternative ESVs for COPECs identified in the conservative SLERA screening process. As discussed in **Section 3.2**, the conservative exposure scenario evaluated in the SLERA (maximum exposure concentrations and minimum ESVs) minimized the potential for COPECs to be dismissed from the screening process prematurely, but did not provide a basis for assessing the potential for adverse effects to occur. Alternative ESVs in the COPEC refinement process are selected to be protective of chronic exposure to ecological receptor groups, but represent a broader range of NOECs than the minimum ESVs used in the conservative screening process.

A summary of preliminary refined ESVs used in the preliminary COPEC refinement is presented in **Table A-1** (soil and sediment) and **Table A-2** (surface water and ground water) of Appendix A. As discussed in **Section 3.4**, an interim deliverable will be prepared for USEPA review to support the selection of revised ESVs from a range of NOECs identified in literature sources. The refined ESVs proposed in the interim deliverable will be used in the COPEC refinement step of the BERA Problem Formulation to re-screen data from each exposure area and exposure medium based on the combined Phase I and Phase II Site Characterization datasets.

For the preliminary COPEC refinement, data were grouped by exposure medium and maximum concentrations were compared to alternative ESVs. For surface water, COPEC refinement included comparison of surface water data from aquatic and transitional exposure areas to refined ESVs based on USEPA National Recommended Water Quality Criteria (NRWQC) or MDEQ chronic surface water quality for the protection of aquatic life. Groundwater data from downgradient, perimeter wells adjacent to the Flathead River were also screened against the refined surface water ESVs to evaluate the groundwater-to-surface water pathway. For sediment, COPEC refinement included comparison of sediment data from aquatic and transitional exposure areas, as well as surficial soil data (0-0.5 ft) from transitional exposure areas, to refined ESVs. For soil, COPEC refinement included comparison of soil data (0-2 ft) from terrestrial and transitional exposure areas, as well as sediment data from transitional exposure areas to refined ESVs. Sediment and soil from transitional exposure areas were included in the COPEC refinement process for sediment and soil due to the transitional nature of the seasonally-wetted habitats. The following sections present results of the refined COPEC screening process based on the Phase I Site Characterization data, including the rationale for the derivation of refined ESVs.

3.4.3.1 Refined Soil Screening

Refined soil ESVs were derived based on peer-reviewed, multi-trophic level soil screening criteria and consideration of regional soil concentrations for metal COPECs, as measured in the Montana State Background Investigation (MSBI; Hydrometrics, 2013). MSBI regional data are presented in the refined

soil screening in the BERA Work Plan to provide context for regional soil metals concentrations relative to minimum ESVs for soil. Further characterization of background conditions is proposed as part of the Phase II Site Characterization (**Section 4.2.3**); these site-specific background data will supplant the MSBI regional soil data in the COPEC refinement process conducted as part of the BERA Problem Formulation.

The derivation of refined soil screening criteria was based on the USEPA approach for deriving Ecological Soil Screening Levels (Eco-SSLs). Eco-SSLs were derived as risk-based soil screening levels through a peer review process for the protection of multiple terrestrial receptor categories (USEPA, 2005b):

- Terrestrial plants
- Soil invertebrates
- Birds
- Mammals

Eco-SSLs are intended for use in the screening process to identify constituents that are not of potential ecological concern and do not need to be considered in the BERA (USEPA, 2005b). Eco-SSLs are considered to be protective of terrestrial ecosystems, including rare, endangered, and threatened species that may be present (USEPA, 2005b).

To supplement established Eco-SSL criteria, endpoints from the multiple terrestrial receptor categories included in the Eco-SSL approach were compiled from the Los Alamos National Laboratory (LANL) ECORISK Database (Release 4.1). Consistent with the Eco-SSL approach, geometric mean concentrations of NOEC endpoints were used as screening criteria for each terrestrial receptor category in the ECORISK Database. The minimum screening criterion for each COPEC in terrestrial receptor categories in the Eco-SSLs and LANL ECORISK Database was used as the refined soil screening criterion.

For metal COPECs, mean concentrations representative of unimpacted soils analyzed as part of the MSBI were used to provide regional context to refined soil criteria. Mean MSBI concentrations are representative of a measure of the central tendency of the MSBI dataset; therefore, these values are considered a conservative estimate of regional soil conditions. For metal COPECs, the refined ESV was selected as the greater value between the refined soil screening criterion (based on the minimum Eco-SSL and ECORISK Database values) and the mean MSBI regional concentration.

Avian and mammalian exposures to dioxin/furan compounds measured in soil samples collected in the Main Plant Area was evaluated in a preliminary screening based on the toxicity equivalency quotient (TEQ) approach (USEPA, 2008a). Terrestrial plant and invertebrate exposure to dioxin/furan compounds was not considered in the screening evaluation since it has been demonstrated that a wide variety of invertebrates and plants are insensitive to dioxin/furan exposure relative to birds and mammals (USEPA, 2008a). However, the LANL ECORISK ESL of 5 mg 2,3,7,8-TCDD/kg will be included in the evaluation of soil-dwelling invertebrate exposure to dioxin/furan compounds in the BERA.

Avian and mammalian exposures to the mixture of 17 dioxin/furan compounds analyzed in surficial soil samples from the Main Plant Area were evaluated relative to the toxicity of 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) using toxicity equivalency factors (TEFs) developed for birds and mammals by the World Health Organization (Van den Berg et al., 2006; Van den Berg et al., 1998; USEPA, 2008a). For dioxin/furan screening, measured concentrations of the 17 dioxin/furan compounds in surface soil samples from the Main Plant Area were multiplied by compound-specific TEFs to calculate toxicity equivalence concentrations (TECs) for each compound. The summed TECs for each sample were compared to soil concentrations protective of avian and mammalian exposure to 2,3,7,8-TCDD (Efroymson, et al., 1997 and LANL, 2003, respectively). Dioxin/furan concentrations that were below the detection limit were estimated as 0.5 times the quantitation limit in the TEC calculation for constituents that were detected in at least one

other sample in the soil dataset; constituents that were below detection in all soil samples were assigned a concentration of 0 in the TEC calculation (USEPA, 2008). TEC calculations for dioxin/furan samples collected in the Main Plant Area are provided in Appendix A (**Table A-4**). Further refinement of avian and mammalian exposure to dioxin/furan compounds will be conducted in the BERA using dietary exposure modeling based on the combined dioxin/furan dataset collected as part of the Phase I and Phase II Site Characterization (Section 5.2.3.1).

In the absence of sufficient data to refine soil ESVs based on the Eco-SSL approach or regional MSBI data, the conservative minimum ESV used in the SLERA was retained. Further literature review will be conducted to refine ESVs for these COPECs in the problem formulation presented in the BERA Report.

Results of the refined soil screening evaluation are presented by ecological exposure area in Appendix A and summarized in **Table 4**. The following constituents were detected in soils from terrestrial and/or transitional exposure areas and exceeded the refined soil ESVs, including:

- Metals – Exceedances of refined ESVs were noted in multiple exposure areas, and were most prevalent in the Central Landfills Area, Main Plant Area, and North Percolation Pond Area. No exceedances were noted in the Flathead River Riparian Area.
- Cyanide – Exceedances were noted in all ecological exposure areas evaluated, except the Flathead River Riparian Area.
- Fluoride – Exceedances were noted in the Central Landfills Area, Eastern Undeveloped Area, Main Plant Area, North Percolation Pond Area, North-Central Undeveloped Area, and Western Undeveloped Area.
- Dioxin/furan compounds (Main Plant Area) – TEC concentrations exceeded soil concentrations protective of avian or mammalian exposure to 2,3,7,8-TCDD at 11 of 13 sampling stations within the rectifier yards in the Main Plant Area.
- PCBs – Exceedances were noted for Aroclor 1254 in the Central Landfills Area.
- PAHs – Exceedances were primarily limited to the North Percolation Pond Area, Main Plant Area, and Central Landfills Area.
- Other SVOCs – Exceedances were noted in multiple exposure areas for benzyl butyl phthalate, bis(2-ethylhexyl) phthalate, dibenzofuran, di-n-butyl phthalate, hexachlorobenzene, pentachlorophenol, and phenol.

Detected constituents lacking ESVs for soil are also summarized in **Table 4** (gray symbols) and will be integrated into the BERA.

3.4.3.2 Refined Sediment Screening

Refined ESVs for sediment were based primarily on consensus-based criteria and equilibrium partitioning-based criteria for PAHs. Consistent with the approach used for refined soil ESVs, refined sediment ESVs for metal COPECs and select organic COPECs were estimated as the geometric mean of NOEC endpoints following the consensus-based approach (MacDonald et al., 2000).

Refined ESVs for PAHs in sediment were based on USEPA *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures* (USEPA, 2003). ESBs derived in USEPA (2003) were used to estimate the potential additive narcotic effects of PAH mixtures in sediment based on theoretical partitioning of PAH compounds between organic carbon and pore water. Exposure to the PAH mixture was evaluated based on the sum of equilibrium partitioning sediment benchmark toxic units ($\sum$ ESBTUs) calculated from individual PAH compounds:

$$\sum ESBTU_{FCV,Total} = \sum_{i=1}^{17} \frac{C_{oc,PAHi}}{C_{oc,PAHi,FCVi}} \times UF$$

where:

$\sum ESBTU_{FCV,Total}$	= Sum of ESBTUs for the PAH mixture based on 34 PAH compounds (unitless)
$C_{oc,PAHi}$	= Organic carbon normalized concentration of PAH <i>i</i> (µg/g _{oc})
$C_{oc,PAHi,FCVi}$	= Organic carbon normalized critical concentration of PAH <i>i</i> based on the final chronic value (FCV; µg/g _{oc})
UF	= Uncertainty factor to estimate the toxicity of total PAHs (based on 34 PAHs – 18 parent and 16 alkylated compounds)

Sediment samples collected in the Phase I Site Characterization were analyzed for 17 of the 34 PAH compounds included in the USEPA ESB model. Therefore, an uncertainty factor of 2.57 was applied to account for the potential toxicity of unmeasured PAHs in the $\sum ESBTU$ calculation (USEPA, 2003). $\sum ESBTU$ values less than or equal to 1.0 are considered acceptable for the protection of benthic invertebrate receptors; values exceeding 1.0 indicate a potential for narcotic effects in benthic receptors (USEPA, 2003).

In the absence of sufficient data to refine sediment ESVs based on consensus-based or equilibrium partitioning approaches, the conservative minimum ESV used in the SLERA was retained. Further literature review and/or equilibrium partitioning modeling will be conducted to refine ESVs for sediment COPECs in the problem formulation presented in the BERA Report.

Results of the refined sediment screening evaluation are presented by ecological exposure area in Appendix A and summarized in **Table 5**. The following constituents were detected in sediments from aquatic and/or transitional exposure areas and exceeded the refined sediment ESVs, including:

- Metals – Exceedances were noted in several exposure areas but were primarily observed in the North Percolation Pond Area. No exceedances were noted in Cedar Creek or the Flathead River, and few exceedances were noted in the Cedar Creek Reservoir Overflow Ditch, Northern Surface Water Feature, and South Percolation Pond Area.
- Cyanide – Exceedances were noted in all aquatic and transitional exposure areas evaluated.
- PAHs – $\sum ESBTU_{FCV,Total}$ values greater than 1.0 were limited to the North Percolation Pond Area.
- Other SVOCs – Exceedances were noted for dibenzofuran.

Detected constituents lacking ESVs for sediment are also summarized in **Table 5** (gray symbols) and will be integrated into the BERA.

3.4.3.3 Refined Surface Water Screening

Refined ESVs for surface water were based on USEPA NRWQC or MDEQ chronic surface water quality for the protection of aquatic life. Chronic aquatic life surface water criteria are derived for the protection of 95 percent of aquatic species. Therefore, these criteria are considered adequately protective to identify COPEC concentrations in surface water that have the potential to result in adverse ecological effects and warrant additional evaluation in the BERA.

Refined ESVs were applied to sample results corresponding to the aqueous toxicity data used to establish the chronic aquatic life surface water criteria. For many metals, chronic surface water quality criteria are based on exposure to the dissolved phase. For these COPECs, refined ESVs were applied to filtered surface

water samples, which operationally represents the dissolved COPEC phase in the sample. Filtered samples were only collected in the fourth round of sampling specified in the Phase I SAP. Therefore, data from all four phases were evaluated to account for potential temporal and seasonal fluctuations in concentrations in unfiltered samples.

In the absence of sufficient data to refine surface water ESVs based on USEPA NRWQC or MDEQ surface water quality criteria, the conservative minimum ESVs used the SLERA were retained. Further literature review of aqueous toxicity data will be conducted to refine ESVs for surface water COPECs in the problem formulation presented in the BERA Report.

Results of the refined surface water screening evaluation are presented by ecological exposure area in Appendix A and summarized in **Table 6**. Metals with unfiltered fractions exceeding criteria based on dissolved phases are presented in **Table 6** but will not be subject to further evaluation in the BERA. The following constituents were detected in surface water from aquatic and/or transitional exposure areas and exceeded the refined surface water ESVs, including:

- Metals (dissolved) – Exceedances were noted for select metals, including barium (all aquatic and transitional exposure areas), cadmium (North Percolation Pond Area), and copper (Flathead River).
- Metals (total) – Exceedances were limited to aluminum (all exposure areas except Cedar Creek and the South Percolation Pond Area) and iron (Cedar Creek Reservoir Overflow Ditch, Flathead River, and Northern Surface Water Feature).
- Cyanide – Exceedances for dissolved cyanide were limited to the Flathead River and South Percolation Pond Area, while exceedances for dissolved cyanide (free) were limited to the Flathead River.
- Fluoride – Exceedances were noted in all aquatic and transitional exposure areas evaluated.
- PAHs – Exceedances were limited to benzo(a)anthracene, benzo(a)pyrene, fluoranthene, phenanthrene, and pyrene in the North Percolation Pond Area. Several other PAHs were detected but no ESVs were available for comparison; therefore, these compounds will be integrated into the uncertainty assessment.

Results of the groundwater-to-surface water pathway screening evaluation are summarized in Appendix A. The following constituents were detected in groundwater from downgradient, perimeter wells adjacent to the Flathead River, and exceeded the refined surface water ESVs, including:

- Metals (dissolved) – Exceedances were limited to barium in wells from the Western Undeveloped Area, Main Plant Area, and Flathead River Riparian Area.
- Metals (total) – Exceedances were limited to aluminum in one well (CFMW-059) from the Western Undeveloped Area and two wells (CFMW-45 and CFMW-54) from the Main Plant Area.
- Cyanide – Exceedances for dissolved cyanide were noted at six wells (CFMW-45, CFMW-47, CFMW-49, CFMW-50, CFMW-53, and CFMW-54) in the Main Plant Area and one well (CFMW-64) in the Flathead River Riparian Area. Exceedances for dissolved cyanide (free) were limited to two wells (CFMW-054 and CFMW-045) in the Main Plant Area.
- Fluoride – Exceedances for dissolved fluoride were noted at six wells (CFMW-45, CFMW-47, CFMW-49, CFMW-50, CFMW-53, and CFMW-54) in the Main Plant Area and two wells (CFMW-61 and CFMW-64) in the Flathead River Riparian Area.
- VOCs – One exceedance was noted for carbon disulfide and toluene in one well (CFMW-047) from the Main Plant Area.

3.4.4 *Summary of Refined COPECs*

Results of the refined screening evaluations are summarized by exposure area for surface water, sediment, and soil in **Tables 4 to 6**. COPECs identified as part of the refined screening evaluation include:

Surface Water (**Table 4**)

- Metals – Aluminum, barium, cadmium, and copper
- Other inorganics – Cyanide and fluoride
- PAHs – Benzo(a)anthracene, benzo(a)pyrene, fluoranthene, phenanthrene, and pyrene

Sediment (**Table 5**)

- Metals
- Other inorganics – Cyanide
- PAHs (North Percolation Pond only)
- Other SVOCs – Dibenzofuran

Soil

- Metals (**Table 6**)
- Other inorganics – Cyanide and fluoride
- Dioxin/furan compounds (Main Plant Area only)
- PCBs (Central Landfills Area only)
- PAHs
- Other SVOCs – Benzyl butyl phthalate, bis(2-ethylhexyl) phthalate, dibenzofuran, di-n-butyl phthalate, hexachlorobenzene, pentachlorophenol, and phenol

Detected constituents lacking ESVs for surface water, sediment, and/or soil were also identified as COPECs (gray symbols) for further evaluation in the BERA (**Tables 4 to 6**).

3.5 Assessment Endpoints, Risk Questions, and Measurement Endpoints

Assessment endpoints are identified to explicitly express the environmental value that is to be protected (USEPA, 1997a). Measurement endpoints are qualitative or quantitative observations that will be measured for each receptor category in each exposure area to evaluate the assessment endpoint. Risk questions were formulated to identify specific measurable ecological characteristics that could be used to evaluate the selected assessment endpoints. These measurement endpoints represent numerical observations that will be measured in ecological exposure areas and compared to similar observations measured at reference sites or reported in the literature (e.g., effects thresholds). The selected measurement endpoints will be used in a weight-of-evidence assessment of risk to each representative receptor based on the identified assessment endpoints.

Based on the problem formulation and ECSMs presented in the preceding sections, preliminary assessment endpoints, risk questions, and measurement endpoints were formulated for aquatic, transitional, and terrestrial exposure areas identified in **Section 3.3.1 (Figure 3)**. A summary of the preliminary risk questions and measurement endpoints selected for each preliminary assessment endpoint is provided in **Table 7** for aquatic exposure areas, **Table 8** for transitional exposure areas, and **Table 9** for terrestrial exposure areas.

Preliminary assessment endpoints include potential exposure to special status species (Threatened or proposed Threatened) that were identified by the USFWS IPaC query (**Section 3.3.5**). Consistent with ERAGS, potential exposure to Threatened species will be evaluated based on the individual level of organization, as opposed to population level (**Tables 7 and 9**). Measurement endpoints for Threatened species will be based on comparisons of estimated daily doses to NOAEL toxicity reference values (TRVs). Further evaluation of the assessment endpoints for special status species will be conducted as part of the BERA Problem Formulation. Additional considerations for these assessment endpoints will include an assessment of the potential for special status species to occur in site exposure areas based on documented occurrences and the potential for suitable habitat to support special status species. The following section

presents a conceptual study design to collect data to support the evaluation of measurement endpoints in the BERA.

4.0 BERA CONCEPTUAL STUDY DESIGN

This section presents a conceptual study design based on the preliminary BERA problem formulation presented in the previous section. The conceptual study design is intended to identify key data objectives for the Phase II Site Characterization to support the evaluation of assessment endpoints and risk questions based on defined measurement endpoints identified in the preliminary BERA problem formulation for aquatic, transitional, and terrestrial exposure areas at the Site (see **Section 3.5**). A detailed study design will be presented in the Phase II Site Characterization SAP to implement the conceptual study design to support the risk analysis plan for the BERA (see **Section 5.0**).

The following sections discuss an analysis of data gaps identified in the SLERA and present a conceptual plan for collecting additional data during the Phase II Site Characterization to support the BERA process.

4.1 SLERA Data Gap Analysis

In the context of the preliminary BERA problem formulation, an analysis was conducted on the Phase I Site Characterization data and SLERA findings to identify data gaps in existing information to support the BERA problem formulation. The data gap analysis also incorporates USEPA and MDEQ comments on the SLERA to identify data needs in the ecological risk assessment process for the Site. USEPA and MDEQ comments regarding re-screening of all four rounds of surface water data collected as part of the Phase I Site Characterization and the evaluation of groundwater data from the upper hydrogeologic unit in wells near the Flathead River were addressed as part of the refined COPEC screening process (see **Section 3.4.3**). However, additional USEPA and MDEQ comments will be addressed as part of the BERA process.

Based on the analysis, primary data gaps to be addressed in the Phase II Site Characterization SAP include the following:

- Characterization of exposure: The number and distribution of sampling stations within aquatic and transitional exposure areas in the Phase I Site Characterization were considered adequate for the purposes of the SLERA; however, the spatial representativeness of soil samples to characterize exposure was considered insufficient in some terrestrial exposure areas. Due to the limited spatial distribution of soil data, insufficient data were available to screen and eliminate exposure areas from further consideration. Further exposure characterization is necessary to evaluate and support ecological risk decision-making for terrestrial exposure areas in the BERA.
- COPEC bioavailability: Analytical parameters included in the Phase I Site Characterization were based on total recoverable concentrations in soil and sediment. Analytical parameters for surface water were based on total recoverable (unfiltered) results for three of four sampling rounds. The bioavailability of COPECs in soil, surface water, pore water will be further evaluated in the Phase II Site Characterization SAP by evaluating COPEC concentrations in pore water.

In addition to the key data gaps that will be addressed as part of the Phase II Site Characterization SAP, additional background data may be collected in future sampling efforts to further characterize COPEC concentrations representative of regional conditions. The adequacy of Phase I Site Characterization data collected to represent background conditions was identified as an uncertainty in the SLERA. Soil, sediment, and surface water data from samples collected outside of the suspected influence of site pathways were used in the SLERA to preliminarily identify COPECs that may be attributable to background conditions. However, further development of statistically-robust background data will be necessary to eliminate COPECs from further evaluation in the risk management step (Step 8) of the ERAGS process. The need for additional background data and the scope of potential background data collection will be revisited following the completion of the BERA. The need for additional background data will be based upon

whether and to what extent COPCs that are naturally occurring substances are determined to be contributing risk and potentially driving risk management decisions at the Site.

Additional data collected as part of the Phase II Site Characterization SAP will be integrated with Phase I Site Characterization data to support additional analyses in the BERA that were not presented in the SLERA, including:

- Dietary exposure modeling: Risk estimates in the SLERA did not explicitly evaluate exposure via direct and indirect ingestion pathways. ESVs evaluated for soil included sources with endpoints protective of avian and mammalian receptors; however, ESVs for sediment and surface water did not consider potential exposure via ingestion pathways. As indicated in the revised SLERA, quantification of direct and indirect ingestion pathways will be included in the BERA risk analysis plan (see **Section 5.2.3**). The analysis of ingestion pathways includes direct ingestion of surface water by wildlife.
- Surface water BLM: Ancillary parameters to support the evaluation of the BLM for copper (temperature, pH, dissolved organic carbon [DOC], calcium, magnesium, sodium, potassium, sulfate, chloride, and alkalinity) were collected in the final round of four surface water sampling events conducted as part of the Phase I Site Characterization. Exposure characterization for copper in surface water in the BERA will include analyses of the necessary ancillary parameters to support the evaluation of the BLM.

Consistent with the objectives of Step 1 and 2 of ERAGS, the SLERA presented a conservative screening of total recoverable data that were used to characterize the nature and extent of constituent concentrations at the Site. However, additional data that evaluate the site-specific factors influencing COPEC bioavailability and toxicity is warranted to support site-specific risk-based decision-making in the BERA. Specific factors that will be evaluated in the BERA to understand COPEC bioavailability in exposure media at the Site include, but are not limited to:

- Soil pH: Influences the bioavailability and toxicity of aluminum and other metals in terrestrial soils.
- Organic carbon content: Influences the partitioning and bioavailability of metals and organic COPECs in soil and sediment.
- Soluble fluoride: Measures of the bioavailable and potentially toxic form of fluoride in soil and sediment.
- Free cyanide: Represents the bioavailable and potentially toxic form of cyanide, primarily present in aqueous media (e.g., surface water, pore water).
- Dissolved metals in surface water: Dissolved metal fraction represented by filtered surface water sampling (0.45- μ m pore size filter) results are indicative of the bioavailable and toxic fraction of metals. Surface water quality benchmarks for many metals are derived based on exposure to dissolved metals.
- Sediment pore water: The bioavailability and toxicity of sediment COPECs is correlated with the fraction of COPECs dissolved in sediment pore water rather than the bulk sediment COPEC concentrations (USEPA, 2007b; USEPA, 2003; USEPA, 2008b).
- Acid volatile sulfides (AVS): In reduced sediments, AVS bind with free metal ions to form insoluble metal sulfide complexes that have low bioavailability (USEPA, 2005a).

4.2 Conceptual BERA Investigation Approach

This section presents a conceptual investigation approach to address data gaps identified in the previous section for the SLERA. These conceptual approaches will be incorporated into the Phase II Site Characterization SAP to support the BERA investigation.

4.2.1 Analytical Characterization Data

Additional data will be collected during the Phase II Site Characterization to supplement existing Phase I Site Characterization data to further define the nature and extent of COPECs (Roux Associates, 2017a). The design of the sampling plan for the collection of additional characterization data to support the BERA investigation will include the following considerations: spatial adequacy, calculation of exposure point concentrations (EPCs), and characterization of relevant ecological exposure intervals within exposure media.

4.2.1.1 Spatial Adequacy

The spatial adequacy of analytical data to characterize ecological exposure is limited, primarily for terrestrial exposure areas (**Figure 3**). Additional soil samples will be collected during the Phase II Site Characterization to further characterize potential exposure in these terrestrial exposure areas. Except for the Main Plant Area, Central Landfill Area, and Industrial Landfill Area, terrestrial exposure areas are located within undeveloped portions of the Site. Given that these areas were not developed as part of site operations, potential COPEC migration pathways to these areas are limited primarily to overland surface runoff and potentially localized historical atmospheric deposition. Additional spatial characterization of these undeveloped terrestrial exposure areas in the Phase II Site Characterization will focus on characterizing exposure along the most likely migration pathways from potential source areas of the Site. Phase I Site Characterization efforts focused soil sampling within the Main Plant and Central Landfills Area; therefore, spatially adequate characterization data exists for these areas. Additional characterization in the landfill areas, including the potential characterization of cap material, will be evaluated as part of future landfill investigations in the Phase II Site Characterization SAP and will incorporate data objectives of the BERA investigation.

Phase I Site Characterization sediment and surface water data was considered adequate to characterize aquatic and transitional habitats in the SLERA. Additional sediment and surface water characterization sampling has since been completed for the South Percolation Ponds Area and Backwater Seep Area of the Flathead River to supplement Phase I Site Characterization results; specifically, to develop adequate datasets to calculate statistically valid EPCs as part of the expedited risk assessment of the South Percolation Ponds Area. Additional sampling may be considered in the Phase II Site Characterization SAP to target specific stations to supplement Phase I Site Characterization data within other aquatic and transitional features. Additional sediment or surface water sampling in other aquatic or transitional areas will be conducted as necessary to develop adequate datasets to calculate statistically valid EPCs.

4.2.1.2 Ecological Exposure Intervals

Vertical characterization of COPECs in relevant ecological exposure intervals was conducted as part of the Phase I Site Characterization and will be continued in future sampling efforts to support the BERA investigation. Consistent with the Phase I Site Characterization, relevant sediment exposure intervals will be defined operationally as 0-0.5 ft below the sediment-surface water interface (USEPA, 2015a). Characterization of soil intervals will include analyses of the 0-0.5 ft bgs and 0.5-2 ft bgs sampling intervals, consistent with the Phase I Site Characterization.

Based on the ecological conceptual site model, soil data from the 0-2 ft bgs sampling interval are sufficient to characterize the primary exposure pathways for terrestrial receptors. In evaluating biologically relevant sampling depth intervals for the terrestrial biotic zone, USEPA (2015a) recommends sampling to a depth of 25-30 cm (approximately 1 foot). This depth interval is recommended to capture exposure within the A-horizon of soil, which is associated with the average biologically active zone (BAZ) of soils. The BAZ

represents the soil interval where most ecological receptors live or forage; therefore, this zone is most relevant to characterize direct contact and bioaccumulation exposure pathways into dietary items (e.g., plants, soil invertebrates) that may be consumed by terrestrial receptors.

Exposure pathways to burrowing animals, including red fox (*Vulpes vulpes*), may be complete at soil depths greater than the 0-2 ft bgs sampling interval; however, potential exposure pathways to burrowing mammals associated with subsurface soil (> 2 ft bgs) are not likely to result in greater exposure relative to direct and incidental ingestion pathways associated with the 0-2 ft bgs sampling interval.

Burrowing animals may be exposed to constituents primarily through dermal contact, inhalation, and incidental soil ingestion pathways while occupying burrows. Dermal contact exposure pathways to burrowing animals are typically not significant exposure pathways due to the presence of fur on mammals, feathers on birds, and scales on reptiles that mitigate direct dermal exposure (USEPA, 2005b). As discussed in **Section 3.3.4**, inhalation exposure pathways may be related to the inhalation of VOCs in soil vapor or soil dust particles within the burrow. However, VOCs were infrequently detected and not identified as COPECs in soils from terrestrial exposure areas at the Site where burrowing mammals may be present. Therefore, it is not likely that exposure to VOCs in subsurface soil vapor contributes significantly to the risk to potential burrowing animals at the Site. Burrowing animals may also be exposed to constituents sorbed to respirable dust particles that may be inhaled while occupying burrows. However, the inhalation of respirable dust is likely to have a minor contribution to overall risk. USEPA (2005b) demonstrated that the inhalation of respirable dust particles represents a relatively insignificant portion (i.e., less than 0.01 percent) of the total daily dose of metals and organic constituents to meadow vole (*Microtus pennsylvanicus*). Collectively, the dermal contact and inhalation pathways in subsurface soils likely result in relatively low contributions to overall exposure relative to ingestion pathways associated with pathways from soils in the 0-2 ft bgs sampling interval.

The incidental ingestion of soil particles through foraging activities or the inhalation of non-respirable dust particles are accounted for in soil ingestion rates used to evaluate overall ingestion pathways to terrestrial wildlife (USEPA, 2005b). A significant component of the soil ingestion rate is likely associated with foraging activities at the surface, which are accounted for in the 0-2 ft bgs sampling interval. Potential incidental soil ingestion pathways to subsurface soils below the 0-2 ft bgs sampling interval are likely limited to incidental ingestion during the consumption of prey, preening, and inhalation of non-respirable dust particles while in the burrow. However, these pathways from subsurface soils are not considered to contribute significantly to the overall exposure to burrowing animals relative to direct ingestion of dietary items associated with surface soil bioaccumulation pathways and incidental soil ingestion pathways associated with the 0-2 ft bgs sampling intervals (USEPA, 2005b). Based on the evaluation of these potential exposure pathways to burrowing mammals at the Site, the most significant exposure pathways to burrowing mammals are likely associated with direct and incidental ingestion pathways to COPECs in soil within the 0-2 ft bgs sampling interval.

Based on the ECSM for terrestrial exposure areas at the Site, burrowing mammals are not expected to experience greater exposure to COPECs via potentially complete pathways to subsurface soil (> 2-ft bgs) relative to exposure via direct and incidental ingestion of COPECs in surface soils (0-2-ft bgs). An evaluation of soil data from the Phase I Site Characterization indicates that COPEC concentrations are generally greater in surface and shallow intervals and decrease with increasing soil depth, consistent with surficial migration pathways from source areas (e.g., surface transport, localized atmospheric deposition,

etc.). **Table 10**¹ presents summary statistics of Phase I soil data by depth interval: surface (0-0.5-ft bgs), shallow (0.5-2.0-ft bgs), and intermediate (variable intervals, but intervals greater than 2-ft bgs). Maximum, mean, and median concentrations from each depth interval are presented for each soil constituent. The maximum value of each summary statistic for each constituent is shaded in red; the minimum value of each summary statistic for each constituent is shaded green.

The evaluation of vertical COPEC concentration gradients based on the summary statistics presented in **Table 10** indicates that the greatest maximum, mean, and median concentrations of COPECs are observed in the surface or shallow sampling interval, with few exceptions. Based on the observed vertical concentration gradients in soil, potential exposure to subsurface soils (> 2 ft bgs) is not likely to result in greater exposure to burrowing mammals relative to direct and incidental ingestion pathways associated with the 0-2-ft bgs sampling interval. Therefore, the evaluation of direct and incidental ingestion pathways within the 0-2-ft bgs interval is adequate and protective for the evaluation of potential exposure to burrowing mammals in the BERA.

The Phase II SAP includes additional sampling at intermediate depth intervals (6 – 8-ft bgs) at a subset (approximately 30 percent) of soil boring stations that are proposed to advance greater 2 ft bgs (Roux Associates, 2018). The additional intermediate samples will be biased to proposed soil boring locations where there is a greater potential for the presences of COPECs (Roux Associates, 2018). The results of these additional intermediate soil sample analyses will be evaluated with Phase I Site Characterization data to further characterize vertical concentration gradients. The findings of this evaluation will be discussed in the BERA Uncertainty Analysis to assess the potential uncertainty associated with the assumption that burrowing mammal exposure to subsurface soils (> 2 ft bgs) is not likely to result in greater exposure relative to exposure pathways associated with the 0-2-ft bgs sampling interval.

4.2.1.3 Exposure Point Concentrations

An additional consideration in evaluating the adequacy of data to support the BERA investigation is the calculation of EPC calculations as part of the exposure analysis. As described further in the risk analysis plan (see **Section 5.0**), EPCs will include calculations of upper confidence limit of the mean (UCL_{mean}) concentrations based on 95 percent confidence or greater. UCL_{mean} concentrations will be calculated using USEPA ProUCL software (version 5.1 or later) and the statistical approach will be consistent with USEPA ProUCL Version 5.1 Technical Guidance (ProUCL Technical Guidance; USEPA, 2015b). In general, ProUCL Technical Guidance requires a minimum of 8 to 10 observations for the calculation of statistically valid UCL_{mean} concentrations. Therefore, exposure areas evaluated in the BERA will have a minimum of 8 to 10 observations for each matrix evaluated in the exposure analysis. Bioavailability and Toxicity Assessment

As identified in the SLERA data gap analysis (see **Section 4.1**), analytical parameters included in the Phase I Site Characterization were based on total recoverable concentrations in soil/sediment and total recoverable (unfiltered) results for three of four surface water sampling rounds. Total recoverable concentrations from bulk sediment and soil samples represent concentrations that may be bound to organic carbon within the

¹ The summary statistics provided in **Table 10** exclude the sample results from intermediate sampling intervals at three unique soil boring stations where opportunistic sampling of visually impacted material was conducted: [CFMW-028a (4.5-6-ft bgs and 10-12-ft bgs), CSFB-131 (18-20-ft-bgs), and CFSB-130 (10-12-ft bgs, 18-20-ft bgs, and (22-23-ft bgs). These intermediate soil intervals were not representative of intermediated depth intervals observed in other soil borings. Further, soil borings from CFSB-130 and CFSB-131 were advanced through the concrete floor of the Main Plant Building where cathode soaking occurred. Given that these opportunistic samples from intermediate intervals were collected at unique soil boring stations that were not representative of intermediate soil conditions in other ecological exposure areas, these results were removed from the vertical concentration gradient evaluation.

sediment/soil matrix and not biologically available to ecological receptors. Total recoverable concentrations in unfiltered surface water samples typically contain particulate- and colloidal-bound fraction of COPECs that may not be bioavailable to aquatic receptors. Therefore, total recoverable results can overestimate COPEC bioaccumulation and toxicity in exposure media. Further evaluation of exposure in the BERA requires analyses of parameters that measure the bioavailable fraction of COPECs and the site-specific conditions that influence COPEC bioavailability.

The bioavailability and toxicity of COPECs identified in site exposure media will be evaluated using the conceptual framework presented in the following sections for aquatic and terrestrial exposure areas. The conceptual framework is designed based on a tiered approach that includes possible lines of evidence that may be used as measurement endpoints to support risk estimation in the BERA (**Table 7**). The progression of analyses in the tiered approach will be dependent on the findings of each tier. All potential tiers of analysis are included in the BERA Work Plan to present the complete conceptual framework; however, implementation of every tier may not be warranted and the decision to proceed to the next tier will be evaluated upon completion of the analysis tier. The following sections present the conceptual approach for evaluating the bioavailability and toxicity of COPECs within aquatic, transitional, and terrestrial exposure areas.

4.2.1.4 Aquatic Exposure Areas

Surface water analyses in aquatic exposure areas will include analyses of filtered (dissolved) samples for metals, cyanide, free cyanide, and fluoride. Consistent with the analyses of pore water in sediment, the freely dissolved fraction is a better indicator of potential bioavailability and toxicity of COPECs in surface water. Surface water analyses will also include the analysis of free cyanide, which is more representative of the bioavailable and toxic form of cyanide.

The bioavailability and toxicity of COPECs in sediment within aquatic exposure areas will be evaluated in the BERA based on a tiered approach that is consistent with framework presented in USEPA guidance for evaluating ecological risk to benthic receptors from PAHs in sediment (USEPA, 2009). The tiered approach is applicable to the evaluation of PAHs and other organic and inorganic COPECs in sediment. The tiered approach includes the following components:

- Tier 1 – Assessment of COPEC bioavailability based on whole sediment analysis
- Tier 2 – Assessment of COPEC bioavailability based on pore water analysis
- Tier 3 – Assessment of COPEC bioavailability using the Sediment Quality Triad (SQT) approach and/or tissue analyses

Tier 1 analyses of COPEC bioavailability, including predictive models based on equilibrium partitioning (EqP) relationships, have been completed for select constituent groups based on Phase I Site Characterization Data in the SLERA and COPEC Refinement (**Section 3.4**). Tier 1 analyses will be conducted on any additional data collected as part of the Phase II Site Characterization SAP as part of a weight-of-evidence evaluation of exposure. Predictive EqP models estimate the bioavailable fraction of COPECs in pore water based on the partitioning of COPECs between sediment organic carbon, pore water, and biota. EqP ESBs represent concentrations of organic constituents in bulk sediment that, at equilibrium, would result in partitioning to sediment pore water at concentrations equivalent to a water quality benchmark (WQB) that may be based on NOEC or LOEC endpoints for survival, growth, or reproduction. Further refinement of these predictive approaches will be conducted as part of Tier 1 analyses in the BERA, consistent with the following USEPA guidance:

- PAHs: *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures* (USEPA, 2003)

- Divalent metals: *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Metals Mixtures (Cadmium, Copper, Lead, Nickel, Silver, and Zinc)* (USEPA, 2005a)
- Nonionic Organic Compounds: *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Compendium of Tier 2 Values for Nonionic Organics* (USEPA, 2008b)

For organic COPECs lacking ESB values from the above sources, site-specific ESBs will be derived using the sample-specific fraction of organic carbon (f_{oc}), constituent-specific organic carbon-water partitioning coefficient (K_{oc}), and WQB based on the following EqP relationship:

$$ESB = (f_{oc} \times K_{oc} \times WQB)$$

where:

ESB	= EqP Sediment Benchmark ($\mu\text{g/kg}$ dry weight sediment)
f_{oc}	= Sample-specific fraction of organic carbon in sediment
K_{oc}	= Organic carbon-water partitioning coefficient (L/kg)
WQB	= Water quality benchmark ($\mu\text{g/L}$)

The use of conservative partitioning coefficients and WQB values in predictive EqP models will minimize the potential for false negatives (i.e., erroneously eliminating a constituent from further consideration) in the Tier 1 analyses.

Tier 2 analyses will be conducted as part of the Phase II Site Characterization in aquatic exposure areas where Tier 1 analyses indicate the potential for adverse ecological effects based on predictive models. Tier 2 analyses will consist of the direct measurement of the freely dissolved COPEC fraction in sediment pore water and direct measurements of bioavailable fractions in bulk sediment. The freely dissolved fraction better predicts COPEC bioavailability and toxicity in sediment when compared to bulk sediment analyses. Direct measurements of COPEC concentrations in pore water provide an empirical measurement to supplement the conservative theoretical estimate of COPEC concentrations in pore water derived from predictive EqP models.

In addition to pore water analyses, analyses of bioavailable fractions in sediment will also be considered in Tier 2 analyses. Measurements of AVS and simultaneously extracted metals (SEM) will be evaluated in inundated or saturated sediments where divalent metals may be elevated above sediment ESVs based on total recoverable analyses (USEPA, 2005a). Soluble fluoride will also be analyzed in sediment to evaluate the potential bioavailability and toxicity of fluoride to benthic organisms.

The need for and scope of potential Tier 3 analyses will be evaluated pending the results of Tier 2 evaluations. If Tier 3 analyses are warranted, a BERA Work Plan Addendum will be submitted to establish data objectives, specify the study design and testing methods, and establish decision criteria for the weight-of-evidence evaluation. If needed, Tier 3 analyses will consist of site-specific studies to directly measure the bioavailability and potential toxicity of COPECs in sediment. Pending the outcome of Tier 2 analyses, the SQT will be evaluated as a site-specific approach to assess potential risk to benthic invertebrate communities in aquatic exposure areas where sediment and pore water analyses indicate COPEC bioavailability and toxicity in Tier 2 analyses. The SQT approach is a weight-of-evidence evaluation of bioavailability and toxicity based on the following lines of evidence (Chapman et al., 1987):

- Benthic community analyses: *In situ* evaluations of potential differences in benthic macroinvertebrate community structure

- Sediment toxicity testing: *Ex situ* evaluations of sediment toxicity to freshwater invertebrate test organisms in long-term sediment toxicity tests
- Chemical analyses: Comparisons of measured COPEC concentrations in sediment and pore water to literature-derived benchmarks for sediment and aqueous exposures, respectively

In addition to the SQT evaluation of potential benthic invertebrate impacts, the analysis of biological tissues will be evaluated if Tier 2 analyses indicate that COPECs are bioavailable in sediment and pore water. Tissue analyses provide an indication of potential exposure based on comparisons to critical body residues (CBRs) and may also be considered in evaluating COPEC concentrations in prey items as a component of wildlife ingestion pathways.

4.2.1.5 Terrestrial Exposure Areas

The bioavailability of metals, cyanide, fluoride, and PAHs in soils is complex and influenced strongly by pH, cation exchange capacity (CEC), organic matter content, localized hydrology, and grain size. Soil pH is considered the primary soil variable, because it controls many soil biogeochemical processes and has a significant influence on constituent bioavailability (USEPA, 2007b). Depending on COPEC speciation, and whether it is complexed/sorbed to organic matter or clay, some portion of soil COPECs may not be bioavailable because it does not readily dissolve in water or solubilize during passage through organism intestines.

The bioavailability and toxicity of COPECs in soils within terrestrial exposure areas will be evaluated in the BERA based on a tiered approach as follows:

- Tier 1 – Assessment of potential COPEC toxicity based on bulk soil analysis
- Tier 2 – Measurement of COPEC bioavailability and toxicity based on fractional analytical methods
- Tier 3 – Measurement of COPEC bioavailability and toxicity based on *in situ* toxicity studies and/or tissue analyses

Tier 1 analyses evaluating potential soil COPEC toxicity have been completed based on the available Phase I Site Characterization Data in the SLERA and COPEC Refinement (**Section 3.4**). Tier 1 analyses will be conducted on any additional data collected as part of the Phase II Site Characterization SAP as part of a weight-of-evidence evaluation of exposure. Tier 1 analyses include comparisons of total COPEC concentrations to ESVs and the identification of important soil physicochemical parameters that help inform soil COPEC bioavailability, particularly, soil pH and soil organic carbon content.

Based on the results from Tier 1 assessments, direct measurements of the bioavailable fraction of soil COPECs and characterization of important soil physicochemical parameters will be conducted as part of Tier 2 analyses. Tier 2 analyses will include the characterization of site-specific geochemical conditions that may influence the bioavailability of soil COPECs (e.g., soil pH, organic carbon) in exposure areas where Tier 1 analyses indicate exceedances of ESVs based on bulk soil analysis. Tier 2 analyses may also include analytical techniques such as weak acid extractable metals or sequential extraction to evaluate the bioavailable fraction of COPECs under representative geochemical conditions encountered in surficial soils (0-2 ft bgs). The scope of Tier 2 analyses will be presented in the Phase II Site Characterization SAP.

The scope of potential Tier 3 analyses in terrestrial exposure areas will be evaluated pending the results of Tier 2 evaluations. If Tier 3 analyses are warranted, a BERA Work Plan Addendum will be submitted to establish data objectives, specify the study design and testing methods, and establish decision criteria for the weight-of-evidence evaluation. Depending on the magnitude of bioavailable COPEC fractions identified in soil as part of Tier 2 analyses, toxicity testing and/or tissue analyses may be warranted in Tier 3 to directly measure site-specific bioavailability and toxicity. If warranted, *in situ* evaluations in Tier 3

may include soil toxicity testing to assess the direct toxicity of compounds or mixtures of compounds in site soils. Although bioaccumulation of site-related COPECs is considered to be limited, site-specific tissue analyses may be conducted to assess COPEC bioaccumulation and body burden. Tissue analyses may be used to support the evaluation of residue-relationships based on COPEC-specific CBRs for receptor groups. Tissue analyses may also be used to evaluate site-specific bioaccumulation relationships for exposure media to support the evaluation of wildlife ingestion pathways (see **Section 5.2.3**).

4.2.1.6 Transitional Exposure Areas

The evaluation of the bioavailability and toxicity of COPECs in transitional exposure areas will consider the approaches presented in the preceding sections for aquatic and terrestrial exposure areas. The approach for transitional exposure areas will be developed based on localized exposure conditions indicating the likelihood of occurrence of aquatic or terrestrial receptors. The scope of Tier 2 analyses for transitional exposure areas will be specified in the Phase II Site Characterization SAP. Pending the evaluation of Tier 2 analyses, the need for Tier 3 analyses will be assessed. If warranted, Tier 3 analyses will be proposed in an addendum to the BERA Work Plan.

4.2.2 *Background Characterization*

The adequacy of Phase I Site Characterization data collected to represent background conditions was identified as an uncertainty in the SLERA. As discussed in **Section 4.1**, additional background data will be collected as part of the Phase II Site Characterization to further characterize COPEC concentrations representative of regional conditions (Roux Associates, 2018). Further development of statistically-robust background data will be necessary to eliminate COPECs from further evaluation in the risk management step (Step 8) of the ERAGS process.

A separate Background Investigation SAP (Background SAP) will be developed to establish the data objectives, study design, and methodologies that will be used to establish a representative background dataset. Candidate soil background locations will be distal to industrial operations at CFAC and have no known waste materials present. Background soil samples will be collected from similar soil types as soils identified on the Site. Surface water, and sediment sampling locations will target areas hydraulically upgradient of the Site. Background locations for aquatic environments will be located upstream of the Site in locations with similar habitats and substrate characteristics to aquatic exposure areas at the Site.

Sample size for soil, sediment, and surface water background samples will be sufficient to develop statistically-robust measurements of UCL_{mean} , as well as background threshold values (BTVs) using ProUCL. Background datasets will have a minimum of 8 – 10 observations for each matrix to support statistical calculations.

4.3 *Data Quality Objectives*

The Phase II Site Characterization SAP will present the detailed study design and supporting data quality objective (DQO) process to evaluate site-specific ecological risk based on identified assessment endpoints, risk questions, and measurement endpoints defined in the baseline problem formulation. The development of the study design in the Phase II Site Characterization SAP will be guided by the USEPA DQO process, which is a seven-step planning approach to develop sampling designs for data collection activities that support decision making (USEPA, 2000). Per USEPA (1997a), the goals of the DQO process in the context of ERAGS are to:

- Clarify the study objective and the most appropriate types of data to collect
- Determine the most appropriate field conditions under which to collect the data

- Specify acceptable criteria that will be used as the basis for establishing the quantity and quality of data needed to support risk management decisions

5.0 BERA RISK ANALYSIS PLAN

Risk estimates will be developed in the BERA using data and observational information generated as part of the Phase I Site Characterization and the Phase II Site Characterization SAP. Risk estimates will be based on quantitative comparisons of EPCs to effects endpoints established based on the refined ecological effects analysis discussed in the following section.

5.1 Effects Analysis

As part of the risk analysis phase, the preliminary ecotoxicity review presented in the BERA problem formulation (see **Section 3.3.7**) will be refined based on more detailed literature reviews of the potential ecotoxicological effects of primary COPECs and/or the analysis and interpretation of site-specific data to evaluate potential exposure-response relationships observed in exposure areas at the Site. The following sections describe general procedures for conducting the effect analysis phase of the BERA.

5.1.1 Direct Contact Exposure Pathways

The effects analysis for direct contact pathways will be conducted based on literature/guidance reviews to refine direct contact ESVs to better represent site-specific conditions. Site-specific studies may also be conducted as part of the BERA to measure potential effects of receptors exposed to site-specific media in a laboratory or *in situ* conditions within exposure areas (see Section 4.2; **Table 7**). The results of these site-specific studies, if conducted, will be used to support a site-specific effects analysis for relevant exposure pathways. Based on the availability of data, two general tiers of endpoints will be derived to evaluate the potential for adverse effects related to direct contact exposure pathways:

- NOEC: Representative of the central tendency (e.g., geometric mean) of NOEC endpoints identified for relevant test organisms in literature/database studies.
- LOEC: Representative of the low end of the distribution of LOEC endpoints (e.g., 15th percentile or bounded study endpoints) identified for relevant test organisms in literature/database studies.

The calculation of endpoints for specific COPECs and receptor groups will be dependent on the availability and relevance of ecotoxicity data. When available, existing estimates of NOECs/NOAELs derived in the literature or guidance based on the geometric mean of no effect endpoints will be used in the BERA. If insufficient data are available or it is not warranted to derive a geometric mean-based NOEC/NOAEL, established NOECs/NOAELs from literature or guidance will be proposed. The basis for the derivation of endpoints for direct contact pathways will be presented in the effects analysis section of the BERA Report. The following sections describe the general approach for conducting effects analyses for direct contact exposure pathways from relevant exposure media.

5.1.1.1 Soil

Potential effects associated with direct contact pathways from soils will be evaluated based on literature/database reviews of NOEC and LOEC endpoints from toxicological studies. Effects endpoints will be established for the receptor categories identified for direct contact pathways to soil in the terrestrial and transitional ECSMs and measurement endpoints for soil (**Table 9**):

- Terrestrial plant community
- Soil invertebrate community

Potential sources of toxicological data that will be used to support the development of direct contact NOEC and LOEC endpoints for soil COPECs include, but are not limited to:

- USEPA Eco-SSLs

- Oak Ridge National Laboratory (ORNL) Risk Assessment Information System (RAIS)
- LANL ECORISK Database
- USEPA ECOTOX Database
- Targeted literature reviews for specific COPECs and receptor categories

Where applicable, effects endpoints that consider site-specific conditions that influence COPEC bioavailability and toxicity in soil will be prioritized in the effects analyses. Considerations of site-specific conditions affecting COPEC bioavailability in soil that were identified in the BERA problem formulation (see **Section 3.3**) and conceptual investigation approach (see **Section 4.2**) include, but are not limited to:

- Soil pH: Influences the bioavailability and toxicity of aluminum in terrestrial soils.
- Organic carbon: Influences the partitioning and bioavailability of metals and organic COPECs in soil.
- Soluble fluoride: Represents the bioavailable and potentially toxic form of fluoride in soil.

The basis for the derivation of endpoints for direct contact pathways to soil will be presented in the effects analysis section of the BERA Report.

5.1.1.2 Surface Water

Potential effects associated with direct contact pathways from surface water will be evaluated based on literature/database reviews of survival, growth, and reproduction endpoints from aqueous toxicity studies. In the absence of other data, chronic surface water quality criteria for the protection of aquatic life promulgated by the USEPA NRWQC or MDEQ Numeric Water Quality Standards will be considered default NOECs for the protection of aquatic receptors that may be exposed to surface water in aquatic and transitional exposure areas at the Site.

As available, receptor-specific surface water NOEC and LOEC endpoints will be derived from a review of aqueous toxicity studies/databases for relevant test organisms to support the evaluation of measurement endpoints (**Table 7**). Potential sources of aqueous toxicity studies to support the derivation of receptor-specific surface water benchmarks include, but are not limited to:

- USEPA ECOTOX Database
- LANL ECORISK Database
- ORNL RAIS
- Targeted literature reviews for specific COPECs and receptor categories

Where applicable, effects endpoints that consider site-specific conditions that influence COPEC bioavailability and toxicity in surface water will be preferentially selected. Chronic surface water quality criteria for many metals are based on exposure to the dissolved phase and are a function of surface water hardness (as mg/L CaCO₃). For these hardness-dependent metals, effects endpoints will be based on sample-specific hardness measurements to spatially and temporally align hardness and filtered (dissolved) metals results. For copper, NOEC concentrations will be based on the BLM, consistent with the USEPA NRWQC. In addition, draft USEPA aquatic life ambient water quality criteria for aluminum that considers the influence of hardness and pH on aluminum toxicity will be evaluated in the BERA (USEPA, 2017). Other site-specific conditions that may affect COPEC bioavailability in surface water that will be considered in the development of effects endpoints include, but are not limited to:

- Surface water pH: Influences the bioavailability and toxicity of cyanide, aluminum, and other metals.
- Free cyanide: Represents the bioavailable and potentially toxic form of cyanide.

The basis for the derivation of endpoints for direct contact pathways to surface water will be presented in the effects analysis section of the BERA Report. It is anticipated that the availability of aqueous toxicity data from these sources may vary considerably based on COPEC and receptor category. For example, aqueous toxicity data for direct contact exposure pathways to aquatic plants, amphibians, and reptiles is generally lacking for a number of COPECs. Surface water exposure pathways for COPECs and receptor categories lacking available aqueous toxicity endpoints will be addressed as an uncertainty in the BERA Report.

5.1.1.3 Sediment

When available, potential effects associated with direct contact pathways from sediment to benthic invertebrates will be evaluated based on predictive models derived using EqP relationships. The approach for deriving ESBs will be based on USEPA ESB guidance for multiple constituent groups relevant to sediment exposure in aquatic and transitional exposure areas at the Site:

- PAHs: *USEPA Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: PAH Mixtures* (USEPA, 2003)
- Divalent metals: *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Metals Mixtures (Cadmium, Copper, Lead, Nickel, Silver, and Zinc)* (USEPA, 2005a)
- Nonionic Organic Compounds: *Procedures for the Derivation of Equilibrium Partitioning Sediment Benchmarks (ESBs) for the Protection of Benthic Organisms: Compendium of Tier 2 Values for Nonionic Organics* (USEPA, 2008b)

For organic COPECs lacking ESB values from the above sources, site-specific ESBs will be derived using the sample-specific fraction of organic carbon (f_{oc}), constituent-specific organic carbon-water partitioning coefficient (K_{oc}), and WQB based on the EqP presented in **Section 0**.

In the absence of appropriate EqP relationships to derive site-specific ESBs for COPECs, literature/database reviews will be conducted to identify NOEC and LOEC endpoints from toxicological studies. Potential sources of toxicological data that will be used to support the development of direct contact NOEC and LOEC endpoints for sediment COPECs include, but are not limited to:

- National Oceanic and Atmospheric Agency (NOAA) Sediment Toxicity (SEDTOX) Database
- ORNL RAIS
- LANL ECORISK Database
- Targeted literature reviews for specific COPECs

The basis for the derivation of endpoints for direct contact pathways to sediment will be presented in the effects analysis section of the BERA Report.

5.1.1.4 Pore Water

Potential effects associated with direct contact pathways to pore water will be evaluated based on literature/database reviews of survival, growth, and reproduction endpoints from aqueous toxicity studies. When available, pore water NOEC and LOEC benchmarks will be derived for each receptor category that may be exposed to pore water in the ECSM (aquatic plants, benthic invertebrates, amphibians) using aqueous toxicity endpoints for test organisms representing each receptor category. Sources of aqueous toxicity data will include sources identified for surface water (see **Section 5.1.1.2**), but will also include aqueous toxicity benchmarks presented in the ESB guidance for sediment (see **Section 5.1.1.3**). WQBs are considered to be protective of benthic invertebrates in the derivation of ESBs; therefore, the WQBs are considered appropriate for direct comparisons to pore water to evaluate potential effects to benthic

invertebrates. WQBs derived for the protection of general aquatic life are considered protective of all receptor categories that may be exposed to pore water.

Consistent with the derivation of surface water effect endpoints, the derivation of pore water effects endpoints will consider site-specific conditions that influence COPEC bioavailability and toxicity. Site-specific conditions in pore water that will be considered in the development of effects endpoints include, but are not limited to:

- Pore water pH: Influences the bioavailability and toxicity of cyanide, aluminum, and other metals.
- Pore water hardness: Criteria for the dissolved phase of select metals is a function of pore water hardness (as CaCO_3).
- Free cyanide: Represents the bioavailable and potentially toxic form of cyanide.

In the absence of available aqueous toxicity endpoints for specific receptor categories, chronic surface water quality criteria for the protection of aquatic life promulgated by the USEPA NRWQC MDEQ Numeric Water Quality Standards will be considered default NOECs for the protection of receptors that may be exposed to pore water.

5.1.2 Ingestion Exposure Pathways

For ingestion pathways, the effects analysis will include a detailed review of TRVs derived from toxicological studies to evaluate the potential for adverse ecological effects associated with the dietary doses estimated using the approaches described in **Section 5.2.3**. Two tiers of chronic TRVs representing NOAELs and LOAELs for growth, reproduction, and survival endpoints will be identified to evaluate the potential for adverse effects via ingestion pathways:

- Low TRV (TRV_{Low}): Represents the geometric mean NOAEL TRV identified in literature studies.
- High TRV (TRV_{High}): Represents a TRV based on chronic exposure, that estimates a potential threshold between NOAEL and LOAEL in literature studies.

The two tiers of TRVs will be used to evaluate potential wildlife exposure based on estimated daily doses (EDDs) calculated using screening-level and refined exposure assumptions. TRVs will be obtained primarily from peer-reviewed compilations of toxicity data for ecological risk assessment from sources including, but not limited to:

- USEPA Eco-SSLs
- ORNL *Toxicological Benchmarks for Wildlife*: 1996 Revision (Sample et al., 1996)
- LANL ECORISK Database
- Targeted literature reviews for specific COPECs and receptor categories

In addition, at the request of USEPA, LOAELs provided in TechLaw (2008) and the approach for deriving TRVs presented in that document will be also considered in the selection of TRVs. The basis for deriving TRVs from literature/database searches will be presented in the effects analysis section of the BERA Report.

5.2 Exposure Analysis

Risk estimates will be developed in the BERA using data and observational information generated as part of the Phase I Site Characterization and Phase II Site Characterization SAP. Risk estimates will be based on quantitative comparisons of EPCs to effects thresholds established based on the refined ecological effects analysis discussed in the preceding section. In the BERA, EPCs will also be calculated to represent likely exposure scenarios, in addition to the maximum exposure scenarios evaluated in the conservative SLERA. EPCs for risk estimation via direct contact and ingestion pathways will be calculated based on

UCL_{mean} COPEC concentrations to represent a conservative estimate of average exposure conditions over an exposure area.

5.2.1 *Calculation of Exposure Point Concentrations*

Exposure point concentrations to evaluate exposure in the BERA will be estimated for each exposure area using data collected as part of the Phase I and Phase II Site Characterizations. EPCs will be calculated to represent a range of exposure scenarios:

- Maximum EPC: Represent a reasonable maximum exposure scenario based on the maximum measured concentration in each exposure area.
- Refined EPC: Represent likely exposure scenarios based on random exposure throughout each exposure area.

Refined EPCs for risk estimation via direct contact and ingestion pathways will be calculated based on UCL_{mean} COPEC concentrations to represent average exposure conditions over an exposure area. UCL_{mean} concentrations will be calculated using USEPA ProUCL software (version 5.1 or later) and the statistical approach will be consistent with USEPA ProUCL Version 5.1 Technical Guidance (USEPA, 2015b). In general, the UCL_{mean} calculation recommended in ProUCL will be used as the refined EPC in the risk estimate. The rationale for any deviations from the ProUCL-recommended UCL_{mean} calculation will be documented in the BERA Report.

In addition to UCL_{mean} EPCs, exposure will also be evaluated on a point-by-point basis for sedentary receptors, such as plants, soil invertebrates, and benthic invertebrates, and wildlife receptors with small home ranges (e.g., meadow vole, short-tailed shrew). Point-by-point comparisons will be conducted for COPECs with maximum EPCs exceeding direct contact NOECs or EDDs based on maximum EPCs that exceed TRV_{Low} doses. The evaluation of potential exposure on a point-by-point basis will support a spatial evaluation where sedentary or small home range receptors may be exposed to concentrations in soil that may result in adverse effects. Further discussion of the approach for evaluation exposure to small home range wildlife receptors is presented in **Section 5.2.3**.

Consistent with the Phase I Site Characterization SAP, EPCs will be calculated using incremental soil sampling (ISS) results to represent average exposure over the entire Operational Soil Area, as well as localized exposure within each individual sampling grid within the Operational Soil Area (Roux Associates, 2015). EPCs for the entire Operational Soil area will represent potential exposure to ecological receptors with large home ranges and will be estimated based on UCL_{mean} concentrations of ISS samples from all sampling grids within an exposure area. Consistent with the Interstate Technology and Regulatory Council (ITRC) (2012), UCL_{mean} concentrations will be calculated based on the Chebyshev UCL or Student's t UCL methods. UCL_{mean} concentrations for ISS samples will be calculated using the 95% UCL Calculator provided in ITRC (2012). EPCs within individual one-acre sampling grids will represent localized exposure to ecological receptors with small home ranges (i.e., one acre). The ISS sample within each sampling grid will be used as the EPC to evaluate point-by-point exposure to ecological receptors with small foraging ranges (e.g., meadow vole, short-tailed shrew).

5.2.2 *Direct Contact Exposure Pathways*

Direct contact pathways identified in the ECSM will be evaluated based on comparisons of EPCs to receptor-specific effects endpoints. As stated in the preceding section, direct contact exposure evaluations will include a range of exposure conditions based on maximum EPC and refined EPC scenarios. Maximum and refined EPCs will be compared to NOEC and LOEC endpoints to evaluate the potential for adverse effects based on a range of effects endpoints.

5.2.3 Ingestion Pathways

The evaluation of potential exposure via direct and incidental ingestion pathways will be conducted based on a tiered approach in accordance with the USEPA guidance for conducting probabilistic ecological risk assessment (USEPA, 2001b), the tiered approach will include the following ingestion models to quantitatively assess potential risks to representative wildlife receptors:

- Deterministic exposure modeling: Based on conventional single point estimates of EPCs and typical exposure parameters.
- Probabilistic exposure modeling: If estimated doses based on deterministic modeling exceed doses associated with LOAELs, probabilistic models will be developed to estimate exposure based on the distributions of EPCs and exposure parameters to account for variability and/or uncertainty in model parameters.

5.2.3.1 Model Structure

Dietary exposure estimates consider the typical dietary preference and composition for each receptor, in terms of representative dietary items at the site. Exposure estimates for ingestion pathways will be based on comparisons of receptor-specific EDDs calculated from simple dose rate models to TRVs. As previously stated, the modeling approach will be tiered, with an initial deterministic model supplemented by a probabilistic model, as warranted. The general form of the dose rate model used to calculate EDDs in both modeling scenarios is as follows:

$$EDD = \frac{1}{BW} \sum_{i=1}^N \left(FIR_{dw} \times \sum_{j=1}^M (f_j \times C_j) + SIR \times C_{sub} + WIR \times C_{sw} \right) \times AUF_i$$

where:

i	=	Number of exposure areas
j	=	Receptor-specific dietary items
BW	=	Receptor-specific body weight
FIR_{dw}	=	Receptor-specific daily food ingestion rate (dry weight)
f_j	=	Proportion of dietary item j to total dietary composition
C_j	=	COPEC concentration in dietary item j
SIR	=	Receptor-specific incidental sediment ingestion rate
C_{sub}	=	COPEC concentration in substrate (sediment or soil)
WIR	=	Receptor-specific daily drinking-water ingestion rate
C_{sw}	=	COPEC concentration in unfiltered surface water
AUF_i	=	Area use factor

The underlying algorithm is consistent for deterministic and probabilistic exposure models. However, deterministic estimates use single, discrete values for model parameters (i.e., representative of a typical or a worst case), whereas probabilistic estimates use a distribution of values for model parameters to account for the inherent variability and/or uncertainty in the estimation of those parameters. Procedures for calculating probabilistic exposure estimates are consistent with USEPA (2001b) guidance on probabilistic ecological risk assessments and USEPA (1997b) guidance on Monte Carlo analyses.

A modified version of the model will be used to evaluate the potential additive exposure to dioxin/furan compounds in surface soil sampled within the Main Plant Area and adjacent areas. The modified dietary exposure model will calculate an EDD for the 17 individual dioxin/furan compounds in each sample based on measured concentrations and soil-to-biota bioaccumulation factors (BAFs). The EDD for each

compound will be multiplied by the compound-specific TEF for birds or mammals to estimate the TEC for each compound (Van den Berg et al., 2006; Van den Berg et al., 1998; USEPA, 2008a). TECs of the 17 dioxin/furan compounds in each sample will be summed to calculate an overall TEC for the sample. The TEC for each sample will be evaluated relative to avian or mammalian dietary TRVs for 2,3,7,8-TCDD.

5.2.3.2 Exposure Point Concentrations

Preliminary EPCs for soil, sediment, or surface water inputs into dose rate models will be based on the maximum measured concentration in each exposure medium to represent the most conservative exposure scenario. Refined EPCs will include a conservative estimate of the central tendency of exposure (e.g., UCL_{mean} concentration) to reflect the average dose that a receptor may experience while foraging randomly within an exposure area.

Potential wildlife exposure via dietary ingestion pathways associated with surficial soils will be based on depth-weighted average concentrations of sampling intervals within 0-2 ft bgs (0-0.5 ft and 0.5-2.0 ft) to provide a representative EPC for each soil boring station. Depth-weighted average concentrations for the 0-2 ft bgs sampling interval will be calculated as follows:

$$C_{sub,0-2ft} = C_{sub,0-0.5ft} \times \frac{0.5ft}{2ft} + C_{sub,0.5-2ft} \times \frac{1.5ft}{2ft}$$

where:

$C_{sub,x-y ft}$ = Concentration in sampling interval starting from x to y ft bgs.

In addition to maximum and refined EPCs, the evaluation of dietary exposure to small home range receptors will be based on point-by-point comparisons of measured concentrations in biologically relevant sampling intervals to estimated soil or sediment benchmark concentrations that are back-calculated from TRVs. Consistent with the approach used to calculate USEPA Eco-SSL values (USEPA, 2005), the general exposure model presented in **Section 5.2.3.1** will be used to back-calculate soil or sediment benchmark concentrations from TRVs. Back-calculated soil or sediment benchmarks for each representative small home range receptor will be calculated by setting the EDD equivalent to the TRV and solving for the concentration in soil or sediment (C_{soil} or C_{sed}). Soil or sediment benchmarks will be calculated based on TRV_{Low} and TRV_{High} values (**Section 5.1.2**). TRV_{Low} and TRV_{High} -based soil or sediment benchmarks will be compared on a point-by-point basis to soil or sediment data from relevant exposure intervals specified in **Section 4.2.1.2**. Comparisons of TRV_{Low} and TRV_{High} -based benchmarks to soil or sediment data from relevant exposure intervals will be presented visually within each exposure area to illustrate potential risks to small home range receptors.

Relevant surface water sources that will be used as drinking water sources in the dietary exposure models for small-ranging (S) and long-ranging (L) terrestrial wildlife receptors are summarized below by terrestrial exposure area:

Exposure Area	Surface Water Source					
	Cedar Creek	Cedar Creek Resv. Overflow	North Percolation Ponds	South Percolation Ponds	Flathead River	Northern Surface Water Feature
Eastern Undeveloped Area	L	S,L	L	L	L	L
North-Central Undeveloped Area	L	S,L	S,L	L	L	S,L
Western Undeveloped Area	S,L	L	L	L	L	L
Central Landfill Area	L	S,L	S,L	L	L	L
Industrial Landfill Area	L	S,L	L	L	L	S,L
Main Plant Area	L	L	S,L	L	L	L
Flathead River Riparian Area	L	L	L	S,L	S,L	L

Notes:

S, Small-ranging receptors

L, Long-ranging receptors

For long-ranging receptors, potential drinking water sources will include an estimate of average exposure point concentrations (e.g., UCL_{mean}) from multiple surface water features that may be encountered while foraging. For receptors with small home ranges, surface water features within or adjacent to terrestrial exposure areas will be considered the primary drinking water source. It will be assumed that semi-aquatic wildlife receptors obtain drinking water from the aquatic or transitional exposure areas from which dietary and incidental ingestion exposure pathways are evaluated.

5.2.3.3 Model Parameters

Dietary exposure models include parameters relating to receptor-specific exposure factors, EPCs, and area use factors (AUFs). Exposure factors refer to receptor-specific variables (e.g., BW, FIR_{fw} , SIR, WIR, etc.), which are typically derived from literature sources. Exposure variables refer to site-specific measurements, namely COPEC concentrations estimated in exposure media. The approach for estimating exposure factors and variables for wildlife ingestion pathways is summarized below. An interim BERA Work Plan deliverable will be submitted that summarizes the receptor-specific exposure parameters for each surrogate receptor prior to the initiation of dietary exposure modeling for the BERA. The BERA Report will also include an appendix that provides model calculations and specific details regarding exposure assumptions and parameters included in the estimation of the EDD for each exposure scenario.

The USEPA *Wildlife Exposure Factors Handbook* [“the Handbook” (USEPA, 1993)] will be the primary data source of exposure factors for the wildlife receptor species used to represent the receptor categories identified in the ECSM (see **Section 3.3.6**). Additional receptor-specific literature sources will also supplement exposure data compiled in the Handbook (e.g., USACHPPM, 2004). Deterministic exposure modeling uses exposure factors that are representative of typical or average (e.g., mean parameter) exposure conditions. Probabilistic exposure modeling evaluates a range of potential exposure factors to capture the individual- and population-level variation in exposure factors that are likely to occur within the entire exposure area. **Table 11** presents a summary of the approach, including key literature sources, for identifying exposure parameters for deterministic and probabilistic dose rate models.

Based on the conceptual study design, dietary pathways will be evaluated based on the estimates of the bioaccumulation of COPECs into dietary items from soil, sediment, and surface water pathways. Concentrations of COPECs in dietary items will be estimated using conservative assumptions of BAFs, biota-sediment accumulation factors (BSAFs) from sediment, or bioconcentration factors (BCFs) from surface water. The following table details the key literature/database sources for estimating bioaccumulation in dietary items.

Exposure Medium	Dietary Item	Bioaccumulation Relationship
Soil	Plants	Eco-SSL Guidance (USEPA, 2005b) ORNL Guidance (Bechtel Jacobs, 1998) Baes et al. (1984) LANL ECORISK Database
	Invertebrates	Eco-SSL (USEPA, 2005b) ORNL Guidance (Sample et al., 1998a) LANL ECORISK Database
	Small mammals	Eco-SSL (USEPA, 2005b) LANL ECORISK Database ORNL Guidance (Sample et al., 1998b)
Sediment	Benthic invertebrates	LANL ECORISK Database United States Army Corp of Engineers ERED Database
	Fish	LANL ECORISK Database Song and Breslin (1993)
Surface Water	Fish	LANL ECORISK Database

Notes:

Eco-SSL = ecological soil screening level

LANL = Los Alamos National Laboratory

ORNL = Oak Ridge National Laboratory

USEPA = United States Environmental Protection Agency

In addition to the compilation of bioaccumulation data from these key literature/database sources, targeted literature searches will be conducted as needed for specific exposure medium-dietary item relationships. An interim BERA Work Plan deliverable will be submitted that summarizes the bioaccumulation models that will be used to support dietary modeling in the BERA. The BERA Report will also include an appendix that provides the basis for bioaccumulation relationships used in dietary exposure modeling.

5.2.3.4 Toxicity Reference Values

TRVs will be derived to evaluate the potential for adverse ecological effects associated with the dietary doses estimated using the approaches described in the preceding sections. Two tiers of chronic TRVs representing NOAELs and LOAELs for growth, reproduction, and survival endpoints will be identified to evaluate the potential for adverse effects via ingestion pathways:

- Low TRV (TRV_{Low}): Represents the geometric mean NOAEL TRV identified in literature studies
- High TRV (TRV_{High}): Represents a TRV based on chronic exposure, that estimates a potential threshold between NOAEL and LOAEL in literature studies

The two tiers of TRVs will be used to evaluate potential wildlife exposure based on EDDs calculated using screening-level and refined exposure assumptions. TRVs will be obtained primarily from peer-reviewed compilations of toxicity data for ecological risk assessment (e.g., USEPA, 2005b; Sample et al., 1996). At the request of USEPA, LOAELs provided in TechLaw (2008) and the approach used to derive TRVs will be also considered in the selection of TRVs. For constituents lacking toxicity data from these compilations, literature sources will be reviewed to identify appropriate low and high TRVs. An interim BERA Work Plan deliverable will be submitted that summarizes the basis for TRVs from literature/database searches prior to the initiation of dietary exposure modeling for the BERA. The BERA Report will also include an appendix that documents the basis for deriving TRVs.

5.3 Risk Calculation

Potential risk associated with exposure estimates presented in the BERA will be expressed as an HQ, calculated as the ratio of the EPC to ESV for direct contact pathway and the EDD to the TRV for ingestion pathways:

$$HQ = \frac{EPC}{ESV} \text{ or } \frac{EDD}{TRV}$$

Potential ecological risk may be characterized based on HQs for each pathway, as follows:

- $HQ_{SNOEC/NOAEL}$ less than or equal to 1.0 indicates limited potential for adverse effects because constituent concentrations result in an exposure that has not been demonstrated to cause adverse ecological effects.
- $HQ_{SNOEC/NOAEL}$ greater than 1.0 indicates that an EPC or EDD for the constituent exceeds an ecological benchmark representing a NOEC or NOAEL. The exposure may or may not constitute an actual risk; however, the potential for adverse effects cannot be dismissed and further evaluation is warranted.

HQs calculated based on LOEC ESVs or TRV_{High} will be used to assess the likelihood of adverse effects based on exposure to concentrations or doses known to be associated with an adverse effect on survival, growth, or reproduction. These evaluations will be used to identify potential risk drivers within receptor groups and exposure areas.

5.4 Uncertainty Analysis

A critical component of the BERA is the analysis of uncertainty that is inherent in the ERA process. A thorough uncertainty analysis is necessary to understand how potential uncertainty may affect the risk estimates and associated risk characterization that may be used to support risk management decision-making. Potential elements of uncertainty that will be addressed in the analysis include, but may not be limited to:

- Adequacy, representativeness, and quality of sampling data
- Temporal (seasonal) variability in exposure
- Uncertainties associated with exposure pathways not quantified in the BERA
- Potential exposure to constituents not detected in BERA datasets
- Potential exposure to constituents lacking ecotoxicity data
- Confidence in ecological effects thresholds used in the risk estimation
- Potential synergistic or antagonistic toxicological effects associated with exposure to multiple COPECs

- Appropriateness of assumptions included in dose rate models, including exposure parameters, EPCs, and AUFs
- Variations in the responses of individuals and populations of ecological receptors
- Relative difference of *in situ* bioavailability compared to bioavailability in toxicological studies
- Uncertainty associated with the HQ approach to estimating risk
- Potential population- and community-level impacts of non-COPEC stressors
- Confidence in the available lines of evidence to support ecological risk conclusions

The analysis will assess the impact of these uncertainties on overall BERA conclusions and recommendations.

5.5 Risk Characterization

Risk characterization in the BERA will focus on establishing causal relationships, if present, between ecological effects and site-specific exposure to COPECs. Risk characterization procedures in the BERA will follow a similar framework to exposure estimation and risk calculations in the SLERA. However, the BERA will focus on more site-specific measurement endpoints and may require a greater level of sophistication of analyses (e.g., probabilistic modeling) to support the evaluation of assessment endpoints.

A description of ecological risks will be documented in the BERA for each assessment endpoint based on the findings and interpretations of risk estimates from corresponding measurement endpoints. The risk description provides a weight-of-evidence evaluation of the likelihood and ecological significance of the estimated risks and may be used to support risk management decision-making (USEPA, 1997a). Key elements included in the BERA risk description include, but may not be limited to:

- Identifying thresholds for ecological effects for observed exposure-response relationships
- Estimating the likelihood of adverse ecological effects
- Evaluating the spatial extent of unacceptable risk within exposure areas
- Assessing the potential for identified risks to persist in the future, considering the potential for natural recovery once the sources of COPECs or migration pathways to the exposure area are mitigated

The output of the risk characterization process will provide the basis for the conclusions and recommendations that will be presented in the BERA. These recommendations may be used in risk management decision-making to determine the need, extent, and nature of potential remedial actions to address unacceptable ecological risks.

5.6 BERA Summary and Conclusions

The findings of the BERA will be summarized to clearly identify the assessment procedures used, the potential risks identified, the uncertainties associated with the conclusions. The BERA findings will be evaluated for each ecological exposure area to support area-specific recommendations to guide risk management decision-making for the Site.

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TABLES

Table 1
Sitewide Summary of Non-Detected Constituents in Soil with MDLs Exceeding SLERA Soil ESVs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Detection Frequency	Minimum Detection Limit	Median Detection Limit	Maximum Detection Limit	Minimum SLERA Ecological Screening Value	Maximum SLERA Ecological Screening Value	Count of Detection Limits Exceeding Minimum SLERA Ecological Screening Value	Maximum Detection Limit Within Range of SLERA Ecological Screening Values
PESTICIDES (mg/kg)								
Endrin	0 / 120	0.0015	0.0016	0.0022	0.0014	0.182	6	Yes
POLYCHLORINATED BIPHENYLS (mg/kg)								
PCB-1248 (Aroclor 1248)	0 / 515	0.0085	0.0097	0.023	0.0072	0.071	514	Yes
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)								
1,2,4,5-Tetrachlorobenzene	0 / 515	2.300	4.450	9.00	2.02	2.02	4	No
1,4-Dioxane (P-Dioxane)	0 / 515	1.900	4.900	32.00	1.83	2.05	17	No
2,4,5-Trichlorophenol	0 / 515	4.800	7.100	12.00	4	14.1	3	Yes
2,4-Dimethylphenol	0 / 515	0.069	0.080	27.00	0.01	0.01	515	No
2,4-Dinitrophenol	0 / 515	0.240	0.280	91.00	0.0609	20	515	No
2,4-Dinitrotoluene	0 / 515	1.900	2.800	4.80	1.28	18	3	Yes
2,6-Dinitrotoluene	0 / 515	0.034	0.099	6.40	0.0328	52	76	Yes
2-Chloronaphthalene	0 / 515	0.014	0.041	2.70	0.0122	0.0122	77	No
2-Chlorophenol	0 / 515	0.430	0.500	3.10	0.243	0.54	11	No
2-Methylphenol (O-Cresol)	0 / 515	0.740	0.850	5.30	0.67	590	11	Yes
2-Nitrophenol	0 / 515	2.400	3.250	4.10	1.6	1.6	2	No
3,3'-Dichlorobenzidine	0 / 515	0.690	2.000	13.00	0.646	0.646	19	No
3-Nitroaniline	0 / 515	3.600	3.600	3.60	3.16	3.16	1	No
4,6-Dinitro-2-Methylphenol	0 / 515	0.150	0.490	32.00	0.144	0.144	78	No
4-Nitrophenol	0 / 515	8.100	9.400	58.00	7	7	11	No
Hexachlorobutadiene	0 / 515	0.046	0.097	3.40	0.0398	0.0398	54	No
Hexachlorocyclopentadiene	0 / 515	1.100	1.200	7.50	0.755	10	11	Yes
Hexachloroethane	0 / 515	0.620	0.710	4.40	0.596	0.596	11	No
Nitrobenzene	0 / 515	1.500	2.200	3.80	1.31	40	3	Yes
N-Nitrosodi-N-Propylamine	0 / 515	0.570	0.660	4.10	0.544	0.544	11	No
N-Nitrosodiphenylamine	0 / 515	0.560	1.600	11.00	0.545	20	19	Yes

Notes:

All soil samples included in this assessment.
Quantitation limit used as the detection limit.

Table 2
Sitewide Summary of Non-Detected Constituents in Sediment with MDLs Exceeding SLERA Sediment ESVs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Detection Frequency	Minimum Detection Limit	Median Detection Limit	Maximum Detection Limit	Minimum SLERA Ecological Screening Value	Maximum SLERA Ecological Screening Value	Count of Detection Limits Exceeding Minimum SLERA Ecological Screening Value	Maximum Detection Limit Within Range of SLERA Ecological Screening Values
PESTICIDES (mg/kg)								
Aldrin	0 / 23	0.0024	0.0025	0.0027	0.002	7.35	3	Yes
Alpha Endosulfan	0 / 23	0.0011	0.0014	0.0031	0.00000642	0.00326	23	Yes
Beta Endosulfan	0 / 23	0.0012	0.0016	0.0035	0.00000642	0.014	23	Yes
Dieldrin	0 / 23	0.0021	0.0027	0.0029	0.0019	0.0019	4	No
Endosulfan Sulfate	0 / 23	0.0009	0.0012	0.0026	0.00000642	0.0346	23	Yes
Endrin	0 / 23	0.0026	0.0027	0.0028	0.00222	0.00222	3	No
Heptachlor	0 / 23	0.0010	0.0013	0.0029	0.0006	0.068	23	Yes
Heptachlor Epoxide	0 / 23	0.0028	0.0040	0.0044	0.00247	0.00247	5	No
P,P'-DDE	0 / 23	0.0032	0.0032	0.0032	0.00316	0.00316	1	No
Toxaphene	0 / 23	0.0220	0.0300	0.0650	0.000077	0.000514	23	No
SEMIVOLATILE ORGANIC COMPOUNDS (mg/kg)								
2,3,4,6-Tetrachlorophenol	0 / 23	0.1300	0.1850	0.9600	0.129	0.284	4	No
2,4,5-Trichlorophenol	0 / 23	1.0000	1.0000	1.0000	0.288	0.288	1	No
2,4,6-Trichlorophenol	0 / 23	0.2900	0.2900	0.2900	0.208	0.213	1	No
2,4-Dichlorophenol	0 / 23	0.2400	0.2400	0.2400	0.0817	0.117	1	No
2,4-Dimethylphenol	0 / 23	0.0830	0.1300	2.2000	0.029	0.304	23	No
2,4-Dinitrophenol	0 / 23	0.2900	0.4500	7.7000	0.00621	0.00621	23	No
2,4-Dinitrotoluene	0 / 23	0.0150	0.0240	0.4000	0.0144	0.0416	23	No
2,6-Dinitrotoluene	0 / 23	0.0530	0.0595	0.5400	0.0398	0.0398	10	No
2-Chlorophenol	0 / 23	0.0280	0.0380	0.2600	0.02716	0.0319	6	No
2-Methylphenol (O-Cresol)	0 / 23	0.0170	0.0260	0.4400	0.011856	0.011856	23	No
3,3'-Dichlorobenzidine	0 / 23	0.1300	0.1800	1.1000	0.127	0.127	5	No
4-Bromophenyl Phenyl Ether	0 / 23	0.3200	0.3200	0.3200	0.255	1.55	1	Yes
4-Chloro-3-Methylphenol	0 / 23	0.4400	0.4400	0.4400	0.388	0.388	1	No
Atrazine	0 / 23	0.0170	0.0270	0.4500	0.00662	0.00662	23	No
Hexachlorobenzene	0 / 23	0.0210	0.0420	0.4100	0.02	0.02	13	No
Hexachlorobutadiene	0 / 23	0.0280	0.0315	0.2900	0.0265	0.6981	10	Yes
Hexachloroethane	0 / 23	0.3700	0.3700	0.3700	0.2136	1.027	1	Yes
N-Nitrosodiphenylamine	0 / 23	0.9200	0.9200	0.9200	0.516	0.516	1	No
Nitrobenzene	0 / 23	0.3200	0.3200	0.3200	0.145	0.145	1	No
Pentachlorophenol	0 / 23	1.2000	1.2000	1.2000	0.504	23	1	Yes
Phenol	0 / 23	0.0120	0.0200	0.3300	0.001152	0.42	23	Yes

Notes:

All sediment samples included in this assessment.
Quantitation limit used as the detection limit.

Table 3
Sitewide Summary of Non-Detected Constituents in Surface Water with MDLs Exceeding SLERA Surface Water ESVs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Fraction	Detection Frequency	Minimum Detection Limit	Median Detection Limit	Maximum Detection Limit	Minimum SLERA Ecological Screening Value	Maximum SLERA Ecological Screening Value	Count of Detection Limits Exceeding Minimum SLERA Ecological Screening Value	Maximum Detection Limit Within Range of SLERA Ecological Screening Values
METALS (µg/L)									
Mercury	D	0 / 22	0.17	0.17	0.17	0.026	1.3	22	Yes
Mercury	T	0 / 84	0.14	0.17	0.17	--	--	--	--
Silver	D	0 / 22	1.3	1.3	1.3	0.067	3.2	22	Yes
Silver	T	0 / 84	1.3	1.3	1.5	--	--	--	--
PESTICIDES (µg/L)									
Endrin	T	0 / 1	0.004	0.004	0.004	0.0023	0.036	1	Yes
Alpha Endosulfan	T	0 / 4	0.005	0.005	0.005	0.003	0.056	3	Yes
Endrin	T	0 / 4	0.004	0.004	0.004	0.0023	0.036	1	Yes
Gamma Bhc (Lindane)	T	0 / 4	0.012	0.012	0.012	0.01	3.3	1	Yes
Heptachlor	T	0 / 4	0.003	0.004	0.004	0.0019	1.26	4	Yes
Heptachlor Epoxide	T	0 / 4	0.004	0.004	0.005	0.0019	1.26	4	Yes
P,P'-DDD	T	0 / 4	0.005	0.005	0.006	0.001	1.69	4	Yes
P,P'-DDE	T	0 / 4	0.002	0.004	0.004	0.001	0.001	4	No
P,P'-DDT	T	0 / 4	0.004	0.004	0.004	0.0005	0.3	4	Yes
Toxaphene	T	0 / 4	0.06	0.06	0.11	0.0002	0.008	4	No
trans-Chlordane	T	0 / 4	0.005	0.005	0.005	0.0043	1.09	3	Yes
POLYCHLORINATED BIPHENYLS (µg/L)									
PCB-1016 (Aroclor 1016)	T	0 / 4	0.098	0.098	0.1	0.000074	0.014	4	No
PCB-1221 (Aroclor 1221)	T	0 / 4	0.098	0.098	0.1	0.000074	60	4	Yes
PCB-1232 (Aroclor 1232)	T	0 / 4	0.098	0.098	0.1	0.000074	124	4	Yes
PCB-1242 (Aroclor 1242)	T	0 / 4	0.098	0.098	0.1	0.000074	4.9	4	Yes
PCB-1248 (Aroclor 1248)	T	0 / 4	0.098	0.098	0.1	0.000074	0.081	4	No
PCB-1254 (Aroclor 1254)	T	0 / 4	0.084	0.084	0.099	0.000074	0.1	4	Yes
PCB-1260 (Aroclor 1260)	T	0 / 4	0.084	0.084	0.099	0.000074	94	4	Yes
PCB-1268 (Aroclor 1268)	T	0 / 4	0.084	0.084	0.099	0.014	0.014	4	No
Polychlorinated Biphenyl (PCBs)	T	0 / 4	0.098	0.098	0.1	0.000074	0.14	4	Yes
SEMIVOLATILE ORGANIC COMPOUNDS (µg/L)									
Anthracene	T	0 / 4	0.57	0.58	0.62	0.012	0.73	4	Yes
Hexachlorobenzene	T	0 / 4	0.47	0.48	0.51	0.0003	0.0003	4	No
Pentachlorophenol	T	0 / 4	2.2	2.25	2.4	0.5	15	4	Yes
VOLATILE ORGANIC COMPOUNDS (µg/L)									
Cis-1,3-Dichloropropene	T	0 / 4	0.16	0.16	0.16	0.055	0.055	4	No
Trans-1,3-Dichloropropene	T	0 / 4	0.19	0.19	0.19	0.055	0.055	4	No

Notes:

All surface water samples included in this assessment.
Quantitation limit used as the detection limit.

Table 4
Summary of Refined Soil COPECs by Ecological Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Terrestrial Exposure Areas						Transitional Exposure Areas				
	Central Landfills	Eastern Undeveloped	Flathead River Riparian	Main Plant	North-Central Undeveloped	Western Undeveloped	Northern Surface Water Feature	Cedar Creek Reservoir Overflow Ditch	North Percolation Pond	South Percolation Pond	Sitewide
METALS											
Aluminum	●	●	●	●	●	●	●	●	●	●	●
Antimony	●			●					●		●
Arsenic	●			●					●		●
Barium	●	●		●	●	●	●	●	●	●	●
Beryllium	●								●		●
Cadmium	●			●		●			●		●
Calcium	●	●	●	●	●	●	●	●	●	●	●
Chromium, Total	●			●					●		●
Cobalt				●					●		●
Copper	●			●		●	●		●	●	●
Iron	●	●	●	●	●	●	●	●	●	●	●
Lead	●			●		●		●	●	●	●
Manganese	●	●		●	●	●		●	●		●
Mercury	●	●		●	●	●			●	●	●
Nickel	●			●		●		●	●		●
Selenium	●			●		●	●	●	●	●	●
Thallium	●								●		●
Vanadium	●			●		●			●		●
Zinc	●	●		●	●	●		●	●	●	●
OTHER INORGANICS											
Cyanide	●	●		●	●	●	●	●	●	●	●
Fluoride	●	●		●	●	●			●		●
DIOXIN/FURAN											
2,3,7,8-Tetrachlorodibenzo-P-Dioxin				●							●
1,2,3,7,8-Pentachlorodibenzo-P-Dioxin				●							●
1,2,3,4,7,8-Hexachlorodibenzo-P-Dioxin				●							●
1,2,3,6,7,8-Hexachlorodibenzo-P-Dioxin				●							●
1,2,3,7,8,9-Hexachlorodibenzo-P-Dioxin				●							●
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)				●							●
Octachlorodibenzo-P-Dioxin				●							●
2,3,7,8-Tetrachlorodibenzofuran				●							●
1,2,3,7,8-Pentachlorodibenzofuran				●							●
2,3,4,7,8-Pentachlorodibenzofuran				●							●
1,2,3,4,7,8-Hexachlorodibenzofuran				●							●
1,2,3,6,7,8-Hexachlorodibenzofuran				●							●
1,2,3,7,8,9-Hexachlorodibenzofuran				●							●
2,3,4,6,7,8-Hexachlorodibenzofuran				●							●
1,2,3,4,6,7,8-Heptachlorodibenzofuran				●							●
1,2,3,4,7,8,9-Heptachlorodibenzofuran				●							●
Octachlorodibenzofuran				●							●
TEC _{2,3,7,8-TCDD}				●							●
POLYCHLORINATED BIPHENYLS											
PCB-1254 (Aroclor 1254)	●										

Table 4
Summary of Refined Soil COPECs by Ecological Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Terrestrial Exposure Areas						Transitional Exposure Areas			
	Central Landfills	Eastern Undeveloped	Flathead River Riparian	Main Plant	North-Central Undeveloped	Western Undeveloped	Northern Surface Water Feature Cedar Creek Reservoir Overflow Ditch	North Percolation Pond	South Percolation Pond	Sitewide
POLYCYCLIC AROMATIC HYDROCARBON COMPOUNDS										
Benzo(A)Anthracene	●			●		●	●	●		●
Benzo(A)Pyrene	●			●		●		●		●
Benzo(B)Fluoranthene	●			●				●		●
Benzo(G,H,I)Perylene	●			●				●		●
Benzo(K)Fluoranthene				●				●		●
Chrysene	●			●		●		●		●
Dibenz(A,H)Anthracene	●			●				●		●
Indeno(1,2,3-C,D)Pyrene	●			●				●		●
Pyrene	●			●				●		●
Total High Molecular Weight PAHs	●	●	●	●	●	●	●	●	●	●
2-Methylnaphthalene	●							●		●
Acenaphthene	●			●				●		●
Anthracene	●			●				●		●
Fluoranthene	●			●				●		●
Fluorene	●			●				●		●
Naphthalene	●			●				●		●
Phenanthrene	●			●				●		●
Total Low Molecular Weight PAHs	●			●				●		●
OTHER SEMIVOLATILE ORGANIC COMPOUNDS										
3- And 4- Methylphenol (Total)	●	●		●						●
Benzaldehyde	●	●	●	●		●	●		●	●
Benzyl Butyl Phthalate	●			●				●		●
Bis(2-Ethylhexyl) Phthalate	●			●	●	●	●	●		●
Caprolactam	●		●							●
Dibenzofuran	●							●		●
Di-N-Butyl Phthalate	●	●	●	●		●	●		●	●
Hexachlorobenzene				●						●
Pentachlorophenol				●						●
Phenol	●									●
VOLATILE ORGANIC COMPOUNDS										
Bromomethane	●			●						●
Cyclohexane	●		●	●		●		●	●	●
Isopropylbenzene (Cumene)	●			●				●		●
M,P-Xylene	●		●	●		●		●	●	●
Methyl Acetate	●		●	●	●			●	●	●
Methylcyclohexane	●		●	●		●		●	●	●
O-Xylene (1,2-Dimethylbenzene)	●		●	●				●	●	●

Notes:

All soil samples from the 0-2' depth interval and sediment samples from the 0-0.5' depth interval within transitional aquatic exposure areas included in COPEC assessment.

- At least one sample exceeded BERA soil ecological screening criteria
- At least one sample was detected and had no associated BERA soil ecological screening criteria

Table 5
Summary of Refined Sediment COPECs by Ecological Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Aquatic Exposure Areas		Transitional Exposure Areas			
	Cedar Creek	Flathead River	Cedar Creek Reservoir Overflow Ditch	North Percolation Pond	Northern Surface Water Feature	South Percolation Pond
METALS						
Aluminum				●	●	
Antimony				●		
Arsenic				●		
Barium	●	●	●	●	●	●
Beryllium	●	●	●	●	●	●
Cadmium				●		
Calcium	●	●	●	●	●	●
Chromium, Total				●		
Copper				●	●	●
Lead				●		
Manganese			●	●		
Nickel			●	●		
Selenium				●		
Silver				●		
Thallium				●		
Vanadium	●	●	●	●	●	●
Zinc			●	●		●
OTHER INORGANICS						
Cyanide	●	●	●	●	●	●
POLYCYCLIC AROMATIC HYDROCARBON COMPOUNDS						
$\sum ESBTU_{FCV, Total}$				●		
OTHER SEMIVOLATILE ORGANIC COMPOUNDS						
3- And 4- Methylphenol (Total)		●				
Acetophenone			●	●		
Benzaldehyde	●		●			●
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)						●
Carbazole			●	●		●
Dibenzofuran				●		

Notes:

All sediment samples from the 0-0.5' depth interval and soil samples from the 0-0.5' depth interval within transitional aquatic exposure areas included in COPEC assessment.

- At least one sample exceeded BERA sediment ecological screening criteria
- At least one sample was detected and had no associated BERA ecological screening criteria

Table 6
Summary of Refined Surface Water COPECs by Ecological Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Fraction	Aquatic Exposure Areas		Transitional Exposure Areas			
		Cedar Creek	Flathead River	Cedar Creek Reservoir Overflow Ditch	North Percolation Pond Area	Northern Surface Water Feature	South Percolation Pond Area
OTHER INORGANICS							
Cyanide	D		●				●
Cyanide	T	●	●		●		●
Cyanide (Free)	D		●				
Cyanide (Free)	T		●				●
Fluoride	D	●	●	●	●	●	●
Fluoride	T	●	●	●	●	●	●
METALS							
Aluminum	D				●		
Aluminum	T		●	●	●	●	
Barium	D	●	●	●	●	●	●
Barium	T	○	○	○	○	○	○
Beryllium	T				○		
Cadmium	D				●		
Cadmium	T				○		
Copper	D		●				
Copper	T				○		○
Iron	T		●	●		●	
Lead	T		○	○	○	○	
Manganese	T		○	○		○	
Nickel	T				○		
Zinc	D				●		
Zinc	T				○		
POLYCYCLIC AROMATIC HYDROCARBON COMPOUNDS							
Benzo(A)Anthracene	T				●		
Benzo(A)Pyrene	T				●		
Benzo(B)Fluoranthene	T				●		
Benzo(G,H,I)Perylene	T				●		
Chrysene	T				●		
Fluoranthene	T				●		
Indeno(1,2,3-C,D)Pyrene	T				●		
Phenanthrene	T				●		
Pyrene	T				●		

Notes:

All surface water samples included in COPEC assessment.

● At least one sample exceeded BERA surface water ecological screening criteria.

● At least one sample was detected and had no associated BERA ecological screening criteria.

○ Total fraction exceeds dissolved phase criteria.

T, Total recoverable analysis from an unfiltered sample.

D, Dissolved analysis from a filtered sample.

Table 7
Summary of Ecological Receptors, Assessment Endpoints, Measurement Endpoints, and Risk Questions - Aquatic Exposure Areas
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Ecological Receptor Category	Assessment Endpoints	Risk Questions	Focal Species/Level of Organization	Measurement Endpoints
Aquatic Exposure Areas				
Benthic invertebrate community	Survival, growth, and reproduction of benthic macroinvertebrate populations to support the maintenance of viable and functional benthic macroinvertebrate communities.	Are concentrations of site-related COPECs in sediment, pore water, or surface water greater than effects thresholds for the survival, growth, or reproduction of benthic invertebrates?	Population	<u>Tier 1:</u> 1) Comparisons of COPEC concentrations in bulk sediment to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative benthic invertebrate test organisms. 2) Comparisons of COPEC concentrations in surface water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative benthic invertebrate test organisms. <u>Tier 2:</u> 3) Comparisons of COPEC concentrations in pore water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative benthic invertebrate test organisms.
		Is the survival or growth of freshwater test organisms exposed to whole sediments from aquatic exposure areas significantly lower than comparable endpoints for test organisms exposed to whole sediments from reference areas? Is the benthic community structure in aquatic exposure areas different from the benthic community structure in reference areas with similar habitat? If differences in structure are observed, are those differences explained by site-related COPEC concentrations in abiotic exposure media and/or other habitat parameters?	Population Community	<u>Tier 3:</u> 4) SQT Line of Evidence: Sediment Toxicity Testing Statistical comparisons of survival, growth, and biomass endpoints from chronic, long-term sediment toxicity testing of bulk sediments from aquatic exposure areas to comparable endpoints from reference areas. 5) SQT Line of Evidence: Benthic Invertebrate Community Analysis a) SQT Line of Evidence: Statistical comparisons of multiple metrics (e.g., richness, composition, tolerance measures) that measure the structure and function of benthic invertebrate communities between study and reference stations; statistical evaluation of the results of the multi-metric community analyses with site-related COPEC concentrations in exposure media and other habitat parameters. b) Multivariate statistical comparisons (e.g., ordination) of benthic invertebrate taxa-abundance data to evaluate the structure and function of benthic communities between exposure area and reference area stations; statistical evaluation of the results of the multivariate analyses of community data with THg or MeHg concentrations in exposure media and other habitat parameters.
Pelagic (water-column) invertebrates	Survival, growth, and reproduction of pelagic invertebrate populations to support the maintenance of viable and functional pelagic invertebrate communities.	Are concentrations of site-related COPECs in surface water greater than effects thresholds for the survival, growth, or reproduction of pelagic invertebrates?	Population	1) Comparisons of COPEC concentrations in surface water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative pelagic invertebrate test organisms.
Aquatic plant community	Survival, growth, and reproduction of aquatic plant populations to support the maintenance of viable and functional aquatic plant communities.	Are concentrations of site-related COPECs in surface water greater than effects thresholds for the survival, growth, or reproduction of aquatic plants?	Population	1) Comparisons of COPEC concentrations in surface water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative aquatic plant test organisms. 2) Comparisons of COPEC concentrations in pore water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative aquatic plant test organisms.

Table 7
Summary of Ecological Receptors, Assessment Endpoints, Measurement Endpoints, and Risk Questions - Aquatic Exposure Areas
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Ecological Receptor Category	Assessment Endpoints	Risk Questions	Focal Species/Level of Organization	Measurement Endpoints
Fish	Survival, growth, and reproduction of fish populations to support the maintenance of viable and functional fish communities.	Are concentrations of site-related COPECs in surface water greater than effects thresholds for the survival, growth, or reproduction of fish?	Population	1) Comparisons of COPEC concentrations in surface water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative fish test organisms.
Special Status Fish (Flathead River Only)	Survival, growth, and reproduction of Bull Trout (<i>Salvelinus confluentus</i>) individuals, if present, to support the maintenance of viable and functional populations.	Are concentrations of site-related COPECs in surface water greater than effects thresholds for the survival, growth, or reproduction of Bull Trout?	Individual - Threatened	1) Comparisons of COPEC concentrations in surface water to NOECs derived from survival, growth, and reproductive endpoints for salmonids.
Amphibians	Survival, growth, and reproduction of amphibian populations to support the maintenance of viable and functional amphibian communities.	Are concentrations of site-related COPECs in surface water greater than effects thresholds for the survival, growth, or reproduction of amphibians?	Population	1) Comparisons of COPEC concentrations in surface water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative amphibian test organisms. 2) Comparisons of COPEC concentrations in pore water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative amphibian test organisms.
Reptiles	Survival, growth, and reproduction of reptile populations to support the maintenance of viable and functional reptilian communities.	Are concentrations of site-related COPECs in surface water and sediment greater than effects thresholds for the survival, growth, or reproduction of reptiles?	Population	1) Comparisons of COPEC concentrations in surface water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative reptilian test organisms. 2) Comparisons of COPEC concentrations in sediment to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative reptilian test organisms.
Birds	Survival, growth, and reproduction of semi-aquatic avian populations to support the maintenance of viable and functional avian communities.	Does the daily dose of site-related COPEC experienced by piscivorous birds through the direct ingestion of dietary items, incidental ingestion of sediment, and direct ingestion of surface water from aquatic exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of avian test organisms?	Belted Kingfisher (<i>Megaceryle alcyon</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs fish tissues, sediment, and surface water.
		Does the daily dose of site-related COPEC experienced by omnivorous birds through the direct ingestion of dietary items, incidental ingestion of sediment, and direct ingestion of surface water from aquatic exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of avian test organisms?	American Dipper (<i>Cinclus mexicanus</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs fish tissues, sediment, and surface water.
Mammals	Survival, growth, and reproduction of piscivorous mammalian populations to support the maintenance of viable and functional mammalian communities.	Does the daily dose of site-related COPEC experienced by piscivorous mammals through the direct ingestion of dietary items, incidental ingestion of sediment, and direct ingestion of surface water from aquatic exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of mammalian test organisms?	Mink (<i>Mustela vison</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs fish tissues, sediment, and surface water.

Table 8
Summary of Ecological Receptors, Assessment Endpoints, Measurement Endpoints, and Risk Questions - Transitional Exposure Areas
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Ecological Receptor Category	Assessment Endpoints	Risk Questions	Focal Species/Level of Organization	Measurement Endpoints
Transitional Exposure Areas				
Benthic invertebrate community	Survival, growth, and reproduction of benthic macroinvertebrate populations to support the maintenance of viable and functional benthic macroinvertebrate communities.	Are concentrations of site-related COPECs in sediment, pore water, or surface water greater than effects thresholds for the survival, growth, or reproduction of benthic invertebrates?	Population	<u>Tier 1:</u> 1) Comparisons of COPEC concentrations in bulk sediment to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative benthic invertebrate test organisms. 2) Comparisons of COPEC concentrations in surface water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative benthic invertebrate test organisms. <u>Tier 2:</u> 3) Comparisons of COPEC concentrations in pore water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative benthic invertebrate test organisms.
		Is the survival or growth of freshwater test organisms exposed to whole sediments from transitional exposure areas significantly lower than comparable endpoints for test organisms exposed to whole sediments from reference areas? Is the benthic community structure in transitional exposure areas different from the benthic community structure in reference areas with similar habitat? If differences in structure are observed, are those differences explained by site-related COPEC concentrations in abiotic exposure media and/or other habitat parameters?	Population Community	<u>Tier 3:</u> 4) SQT Line of Evidence: Sediment Toxicity Testing Statistical comparisons of survival, growth, and biomass endpoints from chronic, long-term sediment toxicity testing of bulk sediments from aquatic exposure areas to comparable endpoints from reference areas. 5) SQT Line of Evidence: Benthic Invertebrate Community Analysis a) SQT Line of Evidence: Statistical comparisons of multiple metrics (e.g., richness, composition, tolerance measures) that measure the structure and function of benthic invertebrate communities between study and reference stations; statistical evaluation of the results of the multi-metric community analyses with site-related COPEC concentrations in exposure media and other habitat parameters. b) Multivariate statistical comparisons (e.g., ordination) of benthic invertebrate taxa-abundance data to evaluate the structure and function of benthic communities between exposure area and reference area stations; statistical evaluation of the results of the multivariate analyses of community data with THg or MeHg concentrations in exposure media and other habitat parameters.
Soil invertebrate community	Survival, growth, and reproduction of amphibian populations to support the maintenance of viable and functional amphibian communities.	Are concentrations of site-related COPECs in surface water and sediment greater than effects thresholds for the survival, growth, or reproduction of amphibians?	Population	1) Comparisons of COPEC concentrations in surface water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative amphibian test organisms. 2) Comparisons of COPEC concentrations in sediment to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative amphibian test organisms.
Aquatic plant community	Survival, growth, and reproduction of aquatic plant populations to support the maintenance of viable and functional aquatic plant communities.	Are concentrations of site-related COPECs in surface water greater than effects thresholds for the survival, growth, or reproduction of aquatic plants?	Population	1) Comparisons of COPEC concentrations in surface water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative aquatic plant test organisms.

Table 8
Summary of Ecological Receptors, Assessment Endpoints, Measurement Endpoints, and Risk Questions - Transitional Exposure Areas
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Ecological Receptor Category	Assessment Endpoints	Risk Questions	Focal Species/Level of Organization	Measurement Endpoints
Terrestrial plant community	Survival, growth, and reproduction of terrestrial plant populations to support the maintenance of viable and functional terrestrial plant communities.	Are concentrations of site-related COPECs in soil greater than effects thresholds for the survival, growth, or reproduction of terrestrial plants?	Population	1) Comparisons of COPEC concentrations in surficial soil (0-2-feet bgs) to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative terrestrial plants.
Amphibians	Survival, growth, and reproduction of amphibian populations to support the maintenance of viable and functional amphibian communities.	Are concentrations of site-related COPECs in surface water and sediment greater than effects thresholds for the survival, growth, or reproduction of amphibians?	Population	1) Comparisons of COPEC concentrations in surface water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative amphibian test organisms. 2) Comparisons of COPEC concentrations in sediment to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative amphibian test organisms.
Reptiles	Survival, growth, and reproduction of reptile populations to support the maintenance of viable and functional reptilian communities.	Are concentrations of site-related COPECs in surface water and sediment greater than effects thresholds for the survival, growth, or reproduction of reptiles?	Population	1) Comparisons of COPEC concentrations in surface water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative reptilian test organisms. 2) Comparisons of COPEC concentrations in sediment to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative reptilian test organisms.
Birds				
Terrestrial carnivores	Survival, growth, and reproduction of avian carnivore populations to support the maintenance of viable and functional avian communities.	Does the daily dose of site-related COPEC experienced by carnivorous birds through the direct ingestion of dietary items, incidental ingestion of sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of avian test organisms?	Red-tailed hawk (<i>Buteo jamaicensis</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.
Terrestrial invertivores	Survival, growth, and reproduction of avian invertivore populations to support the maintenance of viable and functional avian communities.	Does the daily dose of site-related COPEC experienced by invertivorous birds through the direct ingestion of dietary items, incidental ingestion of soil/sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of avian test organisms?	American woodcock (<i>Scolopax minor</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.
Terrestrial herbivores	Survival, growth, and reproduction of avian herbivore populations to support the maintenance of viable and functional avian communities.	Does the daily dose of site-related COPEC experienced by herbivorous birds through the direct ingestion of dietary items, incidental ingestion of soil/sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of avian test organisms?	Mourning dove (<i>Zenaidura macroura</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.
Semi-Aquatic invertivore	Survival, growth, and reproduction of semi-aquatic avian invertivore populations to support the maintenance of viable and functional avian communities.	Does the daily dose of site-related COPEC experienced by semi-aquatic invertivorous birds through the direct ingestion of dietary items, incidental ingestion of soil/sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of avian test organisms?	American dipper (<i>Cinclus mexicanus</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, sediment, and surface water.

Table 8
Summary of Ecological Receptors, Assessment Endpoints, Measurement Endpoints, and Risk Questions - Transitional Exposure Areas
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Ecological Receptor Category	Assessment Endpoints	Risk Questions	Focal Species/Level of Organization	Measurement Endpoints
Mammals				
Terrestrial carnivores	Survival, growth, and reproduction of mammalian carnivore populations to support the maintenance of viable and functional mammalian communities.	Does the daily dose of site-related COPEC experienced by carnivorous mammals through the direct ingestion of dietary items, incidental ingestion of sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of mammalian test organisms?	Long-tailed weasel (<i>Mustela frenata</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.
Terrestrial invertivores	Survival, growth, and reproduction of mammalian invertivore populations to support the maintenance of viable and functional mammalian communities.	Does the daily dose of site-related COPEC experienced by invertivorous mammals through the direct ingestion of dietary items, incidental ingestion of soil/sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of mammalian test organisms?	Northern short-tailed shrew (<i>Blarina brevicauda</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.
Terrestrial herbivores	Survival, growth, and reproduction of mammalian herbivore populations to support the maintenance of viable and functional mammalian communities.	Does the daily dose of site-related COPEC experienced by herbivorous mammals through the direct ingestion of dietary items, incidental ingestion of soil/sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of mammalian test organisms?	Meadow Vole (<i>Microtus pennsylvanicus</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.
Carnivores (Special Status Species)	Survival, growth, and reproduction of Canada Lynx (<i>Lynx canadensis</i>) individuals, if present, to support the maintenance of viable and functional populations.	Does the daily dose of site-related COPEC potentially experienced by Canada Lynx through the direct ingestion of dietary items, incidental ingestion of sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of mammalian test organisms?	Individual - Threatened Canada Lynx (<i>Lynx canadensis</i>)	Comparison of NOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.
Carnivores (Special Status Species)	Survival, growth, and reproduction of Grizzly Bear (<i>Ursus arctos horribilis</i>) individuals, if present, to support the maintenance of viable and functional populations.	Does the daily dose of site-related COPEC potentially experienced by Grizzly Bear through the direct ingestion of dietary items, incidental ingestion of sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of mammalian test organisms?	Individual - Threatened Grizzly Bear (<i>Ursus arctos horribilis</i>)	Comparison of NOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.
Carnivores (Special Status Species)	Survival, growth, and reproduction of North American Wolverine (<i>Gulo gulo luscus</i>) individuals, if present, to support the maintenance of viable and functional populations.	Does the daily dose of site-related COPEC potentially experienced by North American Wolverine through the direct ingestion of dietary items, incidental ingestion of sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of mammalian test organisms?	Individual - Proposed Threatened North American Wolverine (<i>Gulo gulo luscus</i>)	Comparison of NOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.

Table 9
Summary of Ecological Receptors, Assessment Endpoints, Measurement Endpoints, and Risk Questions - Terrestrial Exposure Areas
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Ecological Receptor Category	Assessment Endpoints	Risk Questions	Focal Species/Level of Organization	Measurement Endpoints
Terrestrial Exposure Areas				
Soil Invertebrate Community	Survival, growth, and reproduction of amphibian populations to support the maintenance of viable and functional amphibian communities.	Are concentrations of site-related COPECs in surface water and sediment greater than effects thresholds for the survival, growth, or reproduction of amphibians?	Community	1) Comparisons of COPEC concentrations in surface water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative amphibian test organisms. 2) Comparisons of COPEC concentrations in sediment to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative amphibian test organisms.
Terrestrial Plant Community	Survival, growth, and reproduction of terrestrial plant populations to support the maintenance of viable and functional terrestrial plant communities.	Are concentrations of site-related COPECs in soil greater than effects thresholds for the survival, growth, or reproduction of terrestrial plants?	Community	1) Comparisons of COPEC concentrations in surficial soil (0-2-feet bgs) to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative terrestrial plants.
Special Status Species Terrestrial Plant	Survival, growth, and reproduction of Spalding's Catchfly (<i>Silene spaldingii</i>) individuals, if present, to support the maintenance of viable and functional populations.	Are concentrations of site-related COPECs in soil greater than effects thresholds for the survival, growth, or reproduction of terrestrial plants?	Individual - Threatened	1) Comparisons of COPEC concentrations in surficial soil (0-2-feet bgs) to NOECs derived from survival, growth, and reproductive endpoints for representative terrestrial plants.
Reptiles	Survival, growth, and reproduction of reptile populations to support the maintenance of viable and functional reptilian communities.	Are concentrations of site-related COPECs in surface water and sediment greater than effects thresholds for the survival, growth, or reproduction of reptiles?	Community	1) Comparisons of COPEC concentrations in surface water to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative reptilian test organisms. 2) Comparisons of COPEC concentrations in sediment to NOECs and LOECs derived from survival, growth, and reproductive endpoints for representative reptilian test organisms.
Birds				
Carnivores	Survival, growth, and reproduction of avian carnivore populations to support the maintenance of viable and functional avian communities.	Does the daily dose of site-related COPEC experienced by carnivorous birds through the direct ingestion of dietary items, incidental ingestion of sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of avian test organisms?	Red-tailed hawk (<i>Buteo jamaicensis</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.
Invertivores	Survival, growth, and reproduction of avian invertivore populations to support the maintenance of viable and functional avian communities.	Does the daily dose of site-related COPEC experienced by invertivorous birds through the direct ingestion of dietary items, incidental ingestion of soil/sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of avian test organisms?	American woodcock (<i>Scolopax minor</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.
Herbivores	Survival, growth, and reproduction of avian herbivore populations to support the maintenance of viable and functional avian communities.	Does the daily dose of site-related COPEC experienced by herbivorous birds through the direct ingestion of dietary items, incidental ingestion of soil/sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of avian test organisms?	Mourning dove (<i>Zenaida macroura</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.
Invertivores (Special Status Species)	Survival, growth, and reproduction of Yellow-billed Cuckoo (<i>Coccyzus americanus</i>) individuals, if present, to support the maintenance of viable and functional populations.	Does the daily dose of site-related COPEC experienced by Yellow-billed Cuckoo (<i>Coccyzus americanus</i>) through the direct ingestion of dietary items, incidental ingestion of soil/sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of avian test organisms?	Individual - Threatened Yellow-billed Cuckoo (<i>Coccyzus americanus</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.

Table 9
Summary of Ecological Receptors, Assessment Endpoints, Measurement Endpoints, and Risk Questions - Terrestrial Exposure Areas
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Ecological Receptor Category	Assessment Endpoints	Risk Questions	Focal Species/Level of Organization	Measurement Endpoints
Mammals				
Carnivores	Survival, growth, and reproduction of mammalian carnivore populations to support the maintenance of viable and functional mammalian communities.	Does the daily dose of site-related COPEC experienced by carnivorous mammals through the direct ingestion of dietary items, incidental ingestion of sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of mammalian test organisms?	Long-tailed weasel (<i>Mustela frenata</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.
Invertivores	Survival, growth, and reproduction of mammalian invertivore populations to support the maintenance of viable and functional mammalian communities.	Does the daily dose of site-related COPEC experienced by invertivorous mammals through the direct ingestion of dietary items, incidental ingestion of soil/sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of mammalian test organisms?	Northern short-tailed shrew (<i>Blarina brevicauda</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.
Herbivores	Survival, growth, and reproduction of mammalian herbivore populations to support the maintenance of viable and functional mammalian communities.	Does the daily dose of site-related COPEC experienced by herbivorous mammals through the direct ingestion of dietary items, incidental ingestion of soil/sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of mammalian test organisms?	Meadow vole (<i>Microtus pennsylvanicus</i>)	Comparison of NOAEL and LOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.
Carnivores (Special Status Species)	Survival, growth, and reproduction of Canada Lynx (<i>Lynx canadensis</i>) individuals, if present, to support the maintenance of viable and functional populations.	Does the daily dose of site-related COPEC potentially experienced by Canada Lynx through the direct ingestion of dietary items, incidental ingestion of sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of mammalian test organisms?	Individual - Threatened Canada Lynx (<i>Lynx canadensis</i>)	Comparison of NOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.
Carnivores (Special Status Species)	Survival, growth, and reproduction of Grizzly Bear (<i>Ursus arctos horribilis</i>) individuals, if present, to support the maintenance of viable and functional populations.	Does the daily dose of site-related COPEC potentially experienced by Grizzly Bear through the direct ingestion of dietary items, incidental ingestion of sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of mammalian test organisms?	Individual - Threatened Grizzly Bear (<i>Ursus arctos horribilis</i>)	Comparison of NOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.
Carnivores (Special Status Species)	Survival, growth, and reproduction of North American Wolverine (<i>Gulo gulo luscus</i>) individuals, if present, to support the maintenance of viable and functional populations.	Does the daily dose of site-related COPEC potentially experienced by North American Wolverine through the direct ingestion of dietary items, incidental ingestion of sediment, and direct ingestion of surface water from transitional exposure areas exceed toxicity reference values (TRVs) for the survival, growth, or reproduction of mammalian test organisms?	Individual - Proposed Threatened North American Wolverine (<i>Gulo gulo luscus</i>)	Comparison of NOAEL TRVs to dietary doses modeled using estimated concentrations of site-specific COPECs in dietary items, soil, and surface water.

Table 10
Summary Statistics of Constituent Concentrations in Soil by Sampling Interval
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Group	Constituent	Number of Results			Maximum Concentration By Interval (mg/kg)			Mean Concentration by Interval (mg/kg)			Median Concentration by Interval (mg/kg)			Location of Max
		Surface	Shallow	Intermediate	Surface	Shallow	Intermediate	Surface	Shallow	Intermediate	Surface	Shallow	Intermediate	
DIOXINFURAN	1,2,3,4,6,7,8-HpCDD	13	13	13	0.0001	0.0003	7.98E-05	3.29E-05	2.77E-05	9.46E-06	2.13E-05	2.46E-06	3.10E-06	CFSB-080
DIOXINFURAN	1,2,3,4,6,7,8-HpCDF	13	13	13	2.69E-05	6.64E-05	1.80E-05	8.65E-06	6.05E-06	2.13E-06	6.16E-06	2.60E-07	8.50E-07	CFSB-080
DIOXINFURAN	1,2,3,4,7,8,9-HpCDF	13	13	13	1.77E-06	4.10E-08	2.90E-07	4.90E-07	ND	ND	ND	ND	ND	CFSB-086
DIOXINFURAN	1,2,3,4,7,8-HxCDD	13	13	13	3.42E-06	2.34E-06	4.70E-07	6.26E-07	2.59E-07	1.00E-07	3.30E-07	ND	ND	CFSB-080
DIOXINFURAN	1,2,3,4,7,8-HxCDF	13	13	13	3.07E-06	9.63E-06	2.35E-06	9.88E-07	9.10E-07	3.05E-07	5.80E-07	1.40E-07	7.50E-08	CFSB-080
DIOXINFURAN	1,2,3,6,7,8-HxCDD	13	13	13	5.07E-06	1.08E-05	2.53E-06	1.67E-06	1.06E-06	3.91E-07	1.25E-06	1.50E-07	1.60E-07	CFSB-080
DIOXINFURAN	1,2,3,6,7,8-HxCDF	13	13	13	1.05E-06	2.86E-06	8.40E-07	4.62E-07	2.85E-07	1.29E-07	4.20E-07	ND	3.80E-08	CFSB-080
DIOXINFURAN	1,2,3,7,8,9-HxCDD	13	13	13	4.60E-06	5.14E-06	9.90E-07	1.27E-06	5.83E-07	2.02E-07	9.00E-07	9.10E-08	9.90E-08	CFSB-080
DIOXINFURAN	1,2,3,7,8,9-HxCDF	13	13	13	<4.7E-07	7.70E-08	1.60E-07	ND	8.18E-08	ND	ND	ND	ND	CFSB-075
DIOXINFURAN	1,2,3,7,8-PeCDD	13	13	13	1.21E-06	2.20E-07	1.70E-07	2.45E-07	8.61E-08	6.87E-08	ND	ND	ND	CFSB-075, CFSB-086
DIOXINFURAN	1,2,3,7,8-PeCDF	13	13	13	1.59E-06	2.10E-06	5.40E-07	3.86E-07	2.25E-07	9.31E-08	ND	ND	ND	CFSB-080
DIOXINFURAN	2,3,4,6,7,8-HxCDF	13	13	13	1.70E-06	4.58E-06	3.60E-07	4.19E-07	4.10E-07	7.21E-08	ND	4.00E-08	ND	CFSB-080
DIOXINFURAN	2,3,4,7,8-PeCDF	13	13	13	1.71E-06	1.88E-06	4.80E-07	3.82E-07	2.07E-07	8.20E-08	ND	ND	ND	CFSB-080
DIOXINFURAN	2,3,7,8-TCDD	13	13	13	5.80E-07	1.10E-07	<1.6E-07	1.63E-07	ND	ND	ND	ND	ND	-
DIOXINFURAN	2,3,7,8-TCDF	13	13	13	5.26E-06	2.02E-06	8.10E-07	1.34E-06	4.46E-07	2.32E-07	1.16E-06	2.20E-07	1.10E-07	CFSB-074
DIOXINFURAN	OCDD	13	13	13	0.0017	0.0044	0.0012	0.0003	0.0004	0.0001	0.0001	1.74E-05	2.45E-05	CFSB-080
DIOXINFURAN	OCDF	13	13	13	9.72E-05	7.96E-05	2.34E-05	2.27E-05	8.70E-06	3.69E-06	1.19E-05	9.30E-07	1.84E-06	CFSB-080
DIOXINFURAN	Total HpCDD	13	13	13	0.0002	0.0006	0.0001	5.96E-05	4.98E-05	1.70E-05	3.57E-05	4.54E-06	6.27E-06	CFSB-080
DIOXINFURAN	Total HpCDF	13	13	13	8.73E-05	0.0002	6.60E-05	2.69E-05	2.16E-05	7.58E-06	1.56E-05	1.62E-06	2.27E-06	CFSB-080
DIOXINFURAN	Total HxCDD	13	13	13	3.98E-05	3.77E-05	8.49E-06	9.08E-06	4.12E-06	1.62E-06	5.78E-06	8.20E-07	7.90E-07	CFSB-080
DIOXINFURAN	Total HxCDF	13	13	13	5.18E-05	0.0002	4.58E-05	1.13E-05	1.49E-05	4.52E-06	5.19E-06	7.90E-07	7.70E-07	CFSB-080
DIOXINFURAN	Total PeCDD	13	13	13	4.67E-06	4.80E-07	4.60E-07	6.31E-07	1.35E-07	1.15E-07	ND	ND	6.50E-08	CFSB-086
DIOXINFURAN	Total PeCDF	13	13	13	1.25E-05	2.27E-05	6.56E-06	3.10E-06	2.23E-06	7.75E-07	1.96E-06	2.70E-07	8.50E-08	CFSB-080
DIOXINFURAN	Total TCDD	13	13	13	5.61E-06	6.50E-07	4.00E-07	8.86E-07	1.57E-07	1.42E-07	3.00E-07	ND	8.00E-08	CFSB-086
DIOXINFURAN	Total TCDF	13	13	13	2.41E-05	3.89E-06	2.23E-06	5.34E-06	1.16E-06	6.83E-07	3.60E-06	7.40E-07	3.60E-07	CFSB-075
GENCHEM	Fluoride	136	132	129	571.0	367.0	164.0	56.1357	46.4692	15.4342	29.65	24.85	7.87	CFSB-045
GENCHEM	Total Organic Carbon (1)	28	16	15	183,000	57,200	23,200	38,795	11,708	14,044	26,550	6,965	16,600	CFMW-053a
METALS	Aluminum	136	132	129	106,000	121,000	16,000	15,723	13,368	7,522	13,650	10,600	7,250	CFSB-035
METALS	Antimony	136	132	129	2.6	0.68	0.48	ND	ND	ND	ND	ND	ND	CFSB-029
METALS	Arsenic	136	132	129	22.7	22.5	13.1	5.0521	4.7145	3.9692	4.75	4.35	3.6	CFMW-040
METALS	Barium	136	132	129	972.0	555.0	261.0	169.9331	123.3205	71.376	113.5	94.7	64.4	CFSB-069
METALS	Beryllium	136	132	129	17.2	10.6	0.77	0.7043	0.6076	0.3343	0.5	0.435	0.33	CFMW-059a
METALS	Cadmium	136	132	129	8.3	5.9	0.29	ND	ND	ND	ND	ND	ND	CFSB-095
METALS	Calcium	136	132	129	313,000	201,000	130,000	27,863	22,264	33,407	17,400	16,300	32,100	CFSB-095
METALS	Chromium	136	132	129	84.8	34.7	21.3	12.4993	10.8288	9.4	10.3	9.8	9.2	CFSB-126
METALS	Cobalt	136	132	129	27.4	11.7	8.0	5.3787	5.2174	4.624	5.2	5.1	4.6	CFSB-006
METALS	Copper	136	132	129	7.260	118.0	36.7	72.8353	16.4538	12.014	14.5	13.65	11.3	CFSB-065
METALS	Cyanide, Total	136	132	129	137.0	125.0	0.46	1.4175	1.3884	0.0373	0.0925	0.0525	0.018	CFSB-025
METALS	Iron	136	132	129	37,100	25,000	17,900	13,414	13,422	11,755	13,500	13,550	11,900	CFSB-006
METALS	Lead	164	132	129	238.0	130.0	22.0	19.414	12.8894	6.6946	12.8	9.6	6.0	CFMW-040
METALS	Magnesium	136	132	129	27,500	21,800	23,000	9,353	9,645	10,971	9,250	9,210	10,900	CFSB-071
METALS	Manganese	136	132	129	1,270	920.0	855.0	395.1088	370.6394	328.7496	367.5	379.0	329.0	CFSB-013
METALS	Mercury	136	132	129	0.14	0.27	0.064	0.0236	0.0225	0.0152	0.021	0.018	0.014	CFSB-094
METALS	Nickel	136	132	129	1,250	358.0	17.7	34.5897	20.6712	9.6047	14.15	11.5	9.4	CFSB-006
METALS	Potassium	136	132	129	1,900	1,570	1,710	887.3529	803.9091	681.938	864.0	788.5	656.0	CFSB-035
METALS	Selenium	136	132	129	3.3	1.9	0.7	0.3324	ND	ND	ND	ND	ND	CFSB-132
METALS	Silver	136	132	129	0.96	0.99	<0.98	ND	ND	ND	ND	ND	ND	-
METALS	Sodium	136	132	129	2,140	978.0	293.0	126.1647	100.9318	41.3558	62.65	46.0	ND	CFSB-045
METALS	Thallium	136	132	129	4.6	3.0	0.21	ND	ND	ND	ND	ND	ND	CFSB-025, CFSB-027
METALS	Vanadium	136	132	129	348.0	109.0	14.7	17.1919	13.1765	7.8124	12.05	10.55	7.4	CFMW-016a
METALS	Zinc	136	132	129	265.0	281.0	61.5	64.0875	53.3871	31.986	48.55	41.35	31.3	CFMW-026
OC_PEST	4,4'-DDD	69	NA	1	<0.0023	NA	<0.00093	ND	NA	ND	ND	NA	ND	-
OC_PEST	4,4'-DDE	69	NA	1	<0.0025	NA	<0.001	ND	NA	ND	ND	NA	ND	-
OC_PEST	4,4'-DDT	69	NA	1	<0.0018	NA	<0.00073	ND	NA	ND	ND	NA	ND	-
OC_PEST	Aldrin	69	NA	1	<0.0021	NA	<0.00086	ND	NA	ND	ND	NA	ND	-
OC_PEST	alpha-BHC	69	NA	1	<0.0016	NA	<0.00065	ND	NA	ND	ND	NA	ND	-
OC_PEST	alpha-Chlordane	69	NA	1	<0.0028	NA	<0.0012	ND	NA	ND	ND	NA	ND	-
OC_PEST	beta-BHC	69	NA	1	<0.0017	NA	<0.00069	ND	NA	ND	ND	NA	ND	-
OC_PEST	delta-BHC	69	NA	1	<0.0019	NA	<0.00077	ND	NA	ND	ND	NA	ND	-
OC_PEST	Dieldrin	68	NA	1	<0.0022	NA	<0.00092	ND	NA	ND	ND	NA	ND	-
OC_PEST	Endosulfan I	69	NA	1	<0.0024	NA	<0.00098	ND	NA	ND	ND	NA	ND	-
OC_PEST	Endosulfan II	69	NA	1	<0.0027	NA	<0.0011	ND	NA	ND	ND	NA	ND	-

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Columbia Falls, Montana

Group	Constituent	Number of Results			Maximum Concentration By Interval (mg/kg)			Mean Concentration by Interval (mg/kg)			Median Concentration by Interval (mg/kg)			Location of Max
		Surface	Shallow	Intermediate	Surface	Shallow	Intermediate	Surface	Shallow	Intermediate	Surface	Shallow	Intermediate	
OC_PEST	Endosulfan sulfate	69	NA	1	<0.002	NA	<0.00083	ND	NA	ND	ND	NA	ND	-
OC_PEST	Endrin	69	NA	1	<0.0022	NA	<0.0009	ND	NA	ND	ND	NA	ND	-
OC_PEST	Endrin aldehyde	69	NA	1	<0.0021	NA	<0.00088	ND	NA	ND	ND	NA	ND	-
OC_PEST	Endrin ketone	69	NA	1	<0.0024	NA	<0.00098	ND	NA	ND	ND	NA	ND	-
OC_PEST	gamma-BHC (Lindane)	69	NA	1	<0.0015	NA	<0.00064	ND	NA	ND	ND	NA	ND	-
OC_PEST	gamma-Chlordane	69	NA	1	<0.0037	NA	<0.0015	ND	NA	ND	ND	NA	ND	-
OC_PEST	Heptachlor	69	NA	1	<0.0022	NA	<0.00091	ND	NA	ND	ND	NA	ND	-
OC_PEST	Heptachlor epoxide	69	NA	1	<0.0034	NA	<0.0014	ND	NA	ND	ND	NA	ND	-
OC_PEST	Methoxychlor	69	NA	1	<0.0036	NA	<0.0015	ND	NA	ND	ND	NA	ND	-
OC_PEST	Toxaphene	69	NA	1	<0.05	NA	<0.021	ND	NA	ND	ND	NA	ND	-
PCB	Aroclor 1016	136	132	129	<0.023	<0.021	<0.012	ND	ND	ND	ND	ND	ND	-
PCB	Aroclor 1221	136	132	129	<0.023	<0.021	<0.012	ND	ND	ND	ND	ND	ND	-
PCB	Aroclor 1232	136	132	129	<0.023	<0.021	<0.012	ND	ND	ND	ND	ND	ND	-
PCB	Aroclor 1242	136	132	129	<0.023	<0.021	<0.012	ND	ND	ND	ND	ND	ND	-
PCB	Aroclor 1248	136	132	129	<0.023	<0.021	<0.012	ND	ND	ND	ND	ND	ND	-
PCB	Aroclor 1254	136	132	129	<0.024	<0.022	<0.013	ND	ND	ND	ND	ND	ND	-
PCB	Aroclor 1260	136	132	129	<0.024	<0.022	<0.013	ND	ND	ND	ND	ND	ND	-
PCB	Aroclor 1268	136	132	129	<0.024	<0.022	<0.013	ND	ND	ND	ND	ND	ND	-
PCB	Aroclor-1262	136	132	129	<0.024	<0.022	<0.013	ND	ND	ND	ND	ND	ND	-
PCB	Polychlorinated biphenyls, Total	136	132	129	<0.024	<0.022	<0.013	ND	ND	ND	ND	ND	ND	-
SVOC	1,1'-Biphenyl	136	132	129	0.072	0.11	0.054	ND	ND	ND	ND	ND	ND	CFSB-044
SVOC	1,2,4,5-Tetrachlorobenzene	136	132	129	<3.6	<5.3	<0.13	ND	ND	ND	ND	ND	ND	-
SVOC	1,4-Dioxane	136	132	129	<13	<19	<0.48	ND	ND	ND	ND	ND	ND	-
SVOC	2,2'-oxybis[1-chloropropane]	136	132	129	<2	<2.9	<0.074	ND	ND	ND	ND	ND	ND	-
SVOC	2,3,4,6-Tetrachlorophenol	136	132	129	<4.5	<6.7	<0.17	ND	ND	ND	ND	ND	ND	-
SVOC	2,4,5-Trichlorophenol	136	132	129	<4.8	<7.1	<0.18	ND	ND	ND	ND	ND	ND	-
SVOC	2,4,6-Trichlorophenol	136	132	129	<1.4	<2	<0.051	ND	ND	ND	ND	ND	ND	-
SVOC	2,4-Dichlorophenol	136	132	129	<1.1	<1.7	<0.043	ND	ND	ND	ND	ND	ND	-
SVOC	2,4-Dimethylphenol	136	132	129	<1.1	<1.6	<0.4	ND	ND	ND	ND	ND	ND	-
SVOC	2,4-Dinitrophenol	136	132	129	<37	<54	<1.4	ND	ND	ND	ND	ND	ND	-
SVOC	2,4-Dinitrotoluene	136	132	129	<1.9	<2.8	<0.071	ND	ND	ND	ND	ND	ND	-
SVOC	2,6-Dinitrotoluene	136	132	129	<2.6	<3.8	<0.096	ND	ND	ND	ND	ND	ND	-
SVOC	2-Chloronaphthalene	136	132	129	<1.1	<1.6	<0.041	ND	ND	ND	ND	ND	ND	-
SVOC	2-Chlorophenol	136	132	129	<1.2	<1.8	<0.046	ND	ND	ND	ND	ND	ND	-
SVOC	2-Methylnaphthalene	136	132	129	3.6	4.2	0.41	0.1336	0.0992	ND	ND	ND	ND	CFSB-040
SVOC	2-Methylphenol	136	132	129	<2.1	<3.1	<0.079	ND	ND	ND	ND	ND	ND	-
SVOC	2-Nitroaniline	136	132	129	<1.6	<2.3	<0.059	ND	ND	ND	ND	ND	ND	-
SVOC	2-Nitrophenol	136	132	129	<1.6	<2.4	<0.061	ND	ND	ND	ND	ND	ND	-
SVOC	3 & 4 Methylphenol	136	132	129	0.048	1.0	0.029	ND	ND	ND	ND	ND	ND	CFSB-033
SVOC	3,3'-Dichlorobenzidine	136	132	129	<5.4	<7.9	<0.2	ND	ND	ND	ND	ND	ND	-
SVOC	3-Nitroaniline	136	132	129	<1.4	<2.1	<0.053	ND	ND	ND	ND	ND	ND	-
SVOC	4,6-Dinitro-2-methylphenol	136	132	129	<13	<19	<0.48	ND	ND	ND	ND	ND	ND	-
SVOC	4-Bromophenyl phenyl ether	136	132	129	<1.5	<2.2	<0.057	ND	ND	ND	ND	ND	ND	-
SVOC	4-Chloro-3-methylphenol	136	132	129	<2.1	<3	<0.077	ND	ND	ND	ND	ND	ND	-
SVOC	4-Chloroaniline	136	132	129	<1.2	0.019	<0.046	ND	ND	ND	ND	ND	ND	-
SVOC	4-Chlorophenyl phenyl ether	136	132	129	<1.4	<2.1	<0.054	ND	ND	ND	ND	ND	ND	-
SVOC	4-Nitroaniline	136	132	129	<1.8	<2.7	<0.068	ND	ND	ND	ND	ND	ND	-
SVOC	4-Nitrophenol	136	132	129	<23	<34	<0.87	ND	ND	ND	ND	ND	ND	-
SVOC	Acenaphthene	136	132	129	40.0	28.0	3.1	0.8318	0.5769	0.0522	0.023	ND	ND	CFSB-040
SVOC	Acenaphthylene	136	132	129	1.2	1.0	<0.046	ND	ND	ND	ND	ND	ND	-
SVOC	Acetophenone	136	132	129	0.046	0.017	0.0077	ND	ND	ND	ND	ND	ND	CFSB-051
SVOC	Anthracene	136	132	129	47.0	110.0	4.6	1.626	1.7483	ND	0.0435	ND	ND	CFSB-040
SVOC	Atrazine	136	132	129	<2.2	<3.2	<0.08	ND	ND	ND	ND	ND	ND	-
SVOC	Benzaldehyde	136	132	129	0.093	<5.4	<0.14	ND	ND	ND	ND	ND	ND	-
SVOC	Benzo[a]anthracene	136	132	129	280.0	260.0	19.0	7.6546	5.4915	0.4371	0.26	0.0635	ND	CFSB-040
SVOC	Benzo[a]pyrene	136	132	129	320.0	170.0	23.0	7.9655	5.158	0.5156	0.365	0.065	ND	CFSB-040
SVOC	Benzo[b]fluoranthene	136	132	129	460.0	330.0	25.0	11.7495	8.495	0.6585	0.62	0.14	ND	CFSB-040
SVOC	Benzo[g,h,i]perylene	136	132	129	250.0	140.0	26.0	6.1692	4.3082	0.5537	0.465	0.0895	ND	CFSB-040
SVOC	Benzo[k]fluoranthene	136	132	129	150.0	110.0	12.0	4.2493	2.9295	0.267	0.185	0.045	ND	CFSB-040
SVOC	Bis(2-chloroethoxy)methane	136	132	129	<1.5	<2.2	0.015	ND	ND	ND	ND	ND	ND	CFSB-114
SVOC	Bis(2-chloroethyl)ether	136	132	129	0.017	<1.7	<0.043	ND	ND	ND	ND	ND	ND	-
SVOC	Bis(2-ethylhexyl) phthalate	136	132	129	5.8	5.9	0.15	0.1101	0.0798	ND	ND	ND	ND	CFSB-033

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		Surface	Shallow	Intermediate	Surface	Shallow	Intermediate	Surface	Shallow	Intermediate	Surface	Shallow	Intermediate	
SVOC	Butyl benzyl phthalate	136	132	129	5.6	1.9	6.3	0.1267	ND	ND	ND	ND	ND	CFSB-050
SVOC	Caprolactam	136	132	129	0.066	0.046	<0.13	ND	ND	ND	ND	ND	ND	-
SVOC	Carbazole	136	132	129	33.0	24.0	3.4	1.0396	0.6163	0.0688	0.0585	0.0099	ND	CFSB-040
SVOC	Chrysene	136	132	129	350.0	500.0	24.0	10.6379	8.9648	0.5609	0.435	0.0875	ND	CFSB-040
SVOC	Dibenz(a,h)anthracene	136	132	129	70.0	42.0	6.2	1.7133	1.1956	0.1394	0.1	ND	ND	CFSB-040
SVOC	Dibenzofuran	136	132	129	10.0	15.0	1.1	0.2877	0.2926	ND	ND	ND	ND	CFSB-040
SVOC	Diethyl phthalate	136	132	129	<1.4	2.3	<0.051	ND	ND	ND	ND	ND	ND	-
SVOC	Dimethyl phthalate	136	132	129	<1.4	<2.1	<0.052	ND	ND	ND	ND	ND	ND	-
SVOC	Di-n-butyl phthalate	136	132	129	0.085	0.48	0.66	0.0282	0.0301	ND	ND	ND	ND	CFSB-050
SVOC	Di-n-octyl phthalate	136	132	129	0.096	0.61	<0.092	ND	ND	ND	ND	ND	ND	-
SVOC	Fluoranthene	136	132	129	430.0	1,400	38.0	13.7635	18.4851	0.7649	0.47	0.0925	ND	CFSB-040
SVOC	Fluorene	136	132	129	19.0	25.0	2.3	0.5368	0.5657	0.0361	0.0155	ND	ND	CFSB-040
SVOC	Hexachlorobenzene	136	132	129	<2	0.091	<0.073	ND	ND	ND	ND	ND	ND	-
SVOC	Hexachlorobutadiene	136	132	129	<1.4	<2	<0.051	ND	ND	ND	ND	ND	ND	-
SVOC	Hexachlorocyclopentadiene	136	132	129	<3	<4.4	<0.11	ND	ND	ND	ND	ND	ND	-
SVOC	Hexachloroethane	136	132	129	<1.8	<2.6	<0.066	ND	ND	ND	ND	ND	ND	-
SVOC	Indeno[1,2,3-cd]pyrene	136	132	129	260.0	140.0	25.0	6.4798	4.5348	0.5396	0.425	0.09	ND	CFSB-040
SVOC	Isophorone	136	132	129	0.25	3.3	0.56	0.0226	ND	ND	ND	ND	ND	CFSB-095
SVOC	Naphthalene	136	132	129	6.5	10.0	1.1	0.2363	0.1946	ND	0.0096	ND	ND	CFSB-040
SVOC	Nitrobenzene	136	132	129	<1.5	<2.2	<0.057	ND	ND	ND	ND	ND	ND	-
SVOC	N-Nitrosodi-n-propylamine	136	132	129	<1.6	<2.4	<0.061	ND	ND	ND	ND	ND	ND	-
SVOC	N-Nitrosodiphenylamine	136	132	129	<4.4	<6.4	<0.16	ND	ND	ND	ND	ND	ND	-
SVOC	Pentachlorophenol	136	131	129	0.53	0.28	<0.22	ND	ND	ND	ND	ND	ND	-
SVOC	Phenanthrene	136	132	129	200.0	440.0	25.0	6.5564	7.3879	0.4097	0.245	0.0585	ND	CFSB-040
SVOC	Phenol	136	132	129	0.016	1.2	<0.059	ND	ND	ND	ND	ND	ND	-
SVOC	Pyrene	136	132	129	440.0	1,200	33.0	13.6794	14.8807	0.6762	0.56	0.11	ND	CFSB-040
VOC	1,1,1-Trichloroethane	NA	132	129	NA	<0.001	0.0004	NA	ND	ND	NA	ND	ND	CFSB-075
VOC	1,1,2,2-Tetrachloroethane	NA	132	129	NA	<0.00046	<0.00051	NA	ND	ND	NA	ND	ND	-
VOC	1,1,2-Trichloro-1,2,2-trifluoroethane	NA	132	129	NA	<0.0012	<0.0013	NA	ND	ND	NA	ND	ND	-
VOC	1,1,2-Trichloroethane	NA	132	129	NA	<0.00076	<0.00083	NA	ND	ND	NA	ND	ND	-
VOC	1,1-Dichloroethane	NA	132	129	NA	<0.00092	<0.001	NA	ND	ND	NA	ND	ND	-
VOC	1,1-Dichloroethene	NA	132	129	NA	<0.0011	<0.0012	NA	ND	ND	NA	ND	ND	-
VOC	1,2,3-Trichlorobenzene	NA	132	129	NA	<0.0003	<0.00033	NA	ND	ND	NA	ND	ND	-
VOC	1,2,4-Trichlorobenzene	NA	132	129	NA	<0.00087	<0.00095	NA	ND	ND	NA	ND	ND	-
VOC	1,2-Dibromo-3-Chloropropane	NA	132	129	NA	<0.0013	<0.0014	NA	ND	ND	NA	ND	ND	-
VOC	1,2-Dichlorobenzene	NA	132	129	NA	<0.00038	<0.00042	NA	ND	ND	NA	ND	ND	-
VOC	1,2-Dichloroethane	NA	132	129	NA	0.0001	<0.00033	NA	ND	ND	NA	ND	ND	-
VOC	1,2-Dichloropropane	NA	132	129	NA	<0.00046	<0.00051	NA	ND	ND	NA	ND	ND	-
VOC	1,3-Dichlorobenzene	NA	132	129	NA	<0.00032	<0.00036	NA	ND	ND	NA	ND	ND	-
VOC	1,4-Dichlorobenzene	NA	132	129	NA	0.0002	<0.00039	NA	ND	ND	NA	ND	ND	-
VOC	2-Butanone (MEK)	NA	132	129	NA	0.041	0.014	NA	0.0028	0.001	NA	ND	ND	CFMW-064
VOC	2-Hexanone	NA	132	129	NA	0.0036	0.0011	NA	ND	ND	NA	ND	ND	CFMW-061
VOC	4-Methyl-2-pentanone (MIBK)	NA	132	129	NA	0.0043	<0.0066	NA	ND	ND	NA	ND	ND	-
VOC	Acetone	NA	132	129	NA	0.31	0.098	NA	0.0412	0.0134	NA	0.025	0.0097	CFMW-064
VOC	Benzene	NA	132	129	NA	0.0097	0.0027	NA	0.0005	0.0004	NA	0.0003	0.0003	CFSB-065
VOC	Bromoform	NA	132	129	NA	<0.00035	<0.00039	NA	ND	ND	NA	ND	ND	-
VOC	Bromomethane	NA	132	129	NA	0.0011	0.0006	NA	ND	ND	NA	ND	ND	CFSB-055
VOC	Carbon disulfide	NA	132	129	NA	0.0077	0.003	NA	0.001	0.0005	NA	0.0004	ND	CFSB-051
VOC	Carbon tetrachloride	NA	132	129	NA	<0.0012	<0.0013	NA	ND	ND	NA	ND	ND	-
VOC	Chlorobenzene	NA	132	129	NA	<0.00038	<0.00042	NA	ND	ND	NA	ND	ND	-
VOC	Chlorobromomethane	NA	132	129	NA	<0.00046	<0.00051	NA	ND	ND	NA	ND	ND	-
VOC	Chlorodibromomethane	NA	132	129	NA	<0.00041	<0.00045	NA	ND	ND	NA	ND	ND	-
VOC	Chloroethane	NA	132	129	NA	<0.00095	<0.001	NA	ND	ND	NA	ND	ND	-
VOC	Chloroform	NA	132	129	NA	<0.00057	<0.00062	NA	ND	ND	NA	ND	ND	-
VOC	Chloromethane	NA	132	129	NA	<0.001	<0.0011	NA	ND	ND	NA	ND	ND	-
VOC	cis-1,2-Dichloroethene	NA	132	129	NA	<0.0006	<0.00065	NA	ND	ND	NA	ND	ND	-
VOC	cis-1,3-Dichloropropene	NA	132	129	NA	<0.00041	<0.00045	NA	ND	ND	NA	ND	ND	-
VOC	Cyclohexane	NA	132	129	NA	0.0086	0.0077	NA	0.0005	0.0007	NA	ND	ND	CFMW-064
VOC	Dichlorobromomethane	NA	132	129	NA	<0.001	<0.0011	NA	ND	ND	NA	ND	ND	-
VOC	Dichlorodifluoromethane	NA	132	129	NA	<0.00087	<0.00095	NA	ND	ND	NA	ND	ND	-
VOC	Ethylbenzene	NA	132	129	NA	0.0038	0.0032	NA	0.0002	0.0003	NA	ND	ND	CFMW-064
VOC	Ethylene Dibromide	NA	132	129	NA	<0.00032	<0.00036	NA	ND	ND	NA	ND	ND	-

Table 10
Summary Statistics of Constituent Concentrations in Soil by Sampling Interval
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Group	Constituent	Number of Results			Maximum Concentration By Interval (mg/kg)			Mean Concentration by Interval (mg/kg)			Median Concentration by Interval (mg/kg)			Location of Max
		Surface	Shallow	Intermediate	Surface	Shallow	Intermediate	Surface	Shallow	Intermediate	Surface	Shallow	Intermediate	
VOC	Isopropylbenzene	NA	132	129	NA	0.0005	0.0004	NA	ND	ND	NA	ND	ND	CFMW-064
VOC	Methyl acetate	NA	132	129	NA	0.36	0.015	NA	0.0096	ND	NA	ND	ND	CFMW-029
VOC	Methyl tert-butyl ether	NA	132	129	NA	<0.00046	<0.00051	NA	ND	ND	NA	ND	ND	-
VOC	Methylcyclohexane	NA	132	129	NA	0.015	0.012	NA	0.0008	0.0012	NA	ND	0.0007	CFMW-064, CFSB-065
VOC	Methylene Chloride	NA	132	129	NA	0.0027	0.003	NA	ND	ND	NA	ND	ND	CFSB-102
VOC	m-Xylene & p-Xylene	NA	132	129	NA	0.0091	0.0081	NA	0.0005	0.0008	NA	0.0001	0.0004	CFSB-065
VOC	o-Xylene	NA	132	129	NA	0.0051	0.0028	NA	0.0002	0.0003	NA	ND	0.0002	CFMW-064, CFSB-065
VOC	Styrene	NA	132	129	NA	0.0003	<0.00045	NA	ND	ND	NA	ND	ND	-
VOC	Tetrachloroethene	NA	132	129	NA	0.0003	<0.00083	NA	ND	ND	NA	ND	ND	-
VOC	Toluene	NA	132	129	NA	0.013	0.012	NA	0.001	0.0013	NA	0.0004	0.0008	CFSB-065
VOC	trans-1,2-Dichloroethene	NA	132	129	NA	<0.0011	<0.0012	NA	ND	ND	NA	ND	ND	-
VOC	trans-1,3-Dichloropropene	NA	132	129	NA	<0.00027	<0.0003	NA	ND	ND	NA	ND	ND	-
VOC	Trichloroethene	NA	132	129	NA	<0.0007	<0.00077	NA	ND	ND	NA	ND	ND	-
VOC	Trichlorofluoromethane	NA	132	129	NA	<0.00092	<0.001	NA	ND	ND	NA	ND	ND	-
VOC	Vinyl chloride	NA	132	129	NA	<0.0011	<0.0012	NA	0.0002	0.0002	NA	0.0002	0.0002	-

Notes:

NA, Sample not analyzed for constituent.

ND, Constituent not detected at a concentration above the analytical detection limit.

<, Constituent detected at a concentration below the quatitation limit.

Red cell shading indicates maximum statistic value for surface, shallow, and intermediate sampling intervals.

Green cell shading indicates minimum statistic value for surface, shallow, and intermediate sampling intervals.

Median values were only calculated if 50 percent of the results were above the limit of detection; mean values were calculated if 15 percent of the results were above the LOD; ND shown when these criteria were not met.

Table 11
List of Exposure Factors and Variables for Dietary Exposure Modeling
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Variable		Units	Values for Deterministic Estimates	Distributions for Probabilistic Estimates ^c
EDD _{total}	Estimated daily dose	mg COPEC/kg BW/day	Calculated output	Simulated output
BW	Receptor Body Weight	kg (wet)	Based on literature, mean BW	Assumed distribution based on literature data on BW
FIR _{Receptor}	Daily food ingestion rate for a receptor	kg food (dry)/day	Calculated using allometric relationships (Nagy, 2001) with receptor mean BW	Assumed distribution based on receptor BW
f_i	Fraction of diet item i in the receptor's daily diet	unitless	Literature-based typical dietary composition ^a	Simulated daily dietary composition based on literature derived preference matrix
C_i	COPEC concentration in diet item i	mg COPEC/kg diet item (dry)	Estimated based on site-specific UCL _{mean}	Site-specific distribution
SIR _{Receptor}	Incidental substrate ingestion rate for a receptor	kg substrate (dry)/day	Literature-based values or estimations (e.g., Calder and Braun, 1983; USACHPPM, 2004, EPA, 1993)	Assumed distribution based on literature data
C_{sed}	COPEC concentration in substrate	mg COPEC/kg substrate (dry)	Site-specific UCL _{mean}	Site-specific distribution
WIR _{Receptor}	Daily water ingestion rate for a receptor	L water/day	Literature-based values or estimations (e.g., Calder and Braun, 1983; USACHPPM, 2004, EPA, 1993)	Assumed distribution based on literature relationships and receptor body weights
C_{sw}	COPEC concentration in surface water	mg COPEC/L surface water (unfiltered)	Site-specific UCL _{mean}	Site-specific distribution
AUF	Area Use Factor	unitless	Based on literature data on receptor-specific home range ^b	Based on literature data on receptor-specific home range

Notes:

a. A single important diet item with the maximum contamination may be assumed for initial evaluations.

b. AUF, 1 may be assumed for initial evaluations.

c. Depending on their importance (with respect to output sensitivity) and observed variability, point estimates may be sufficient as inputs.

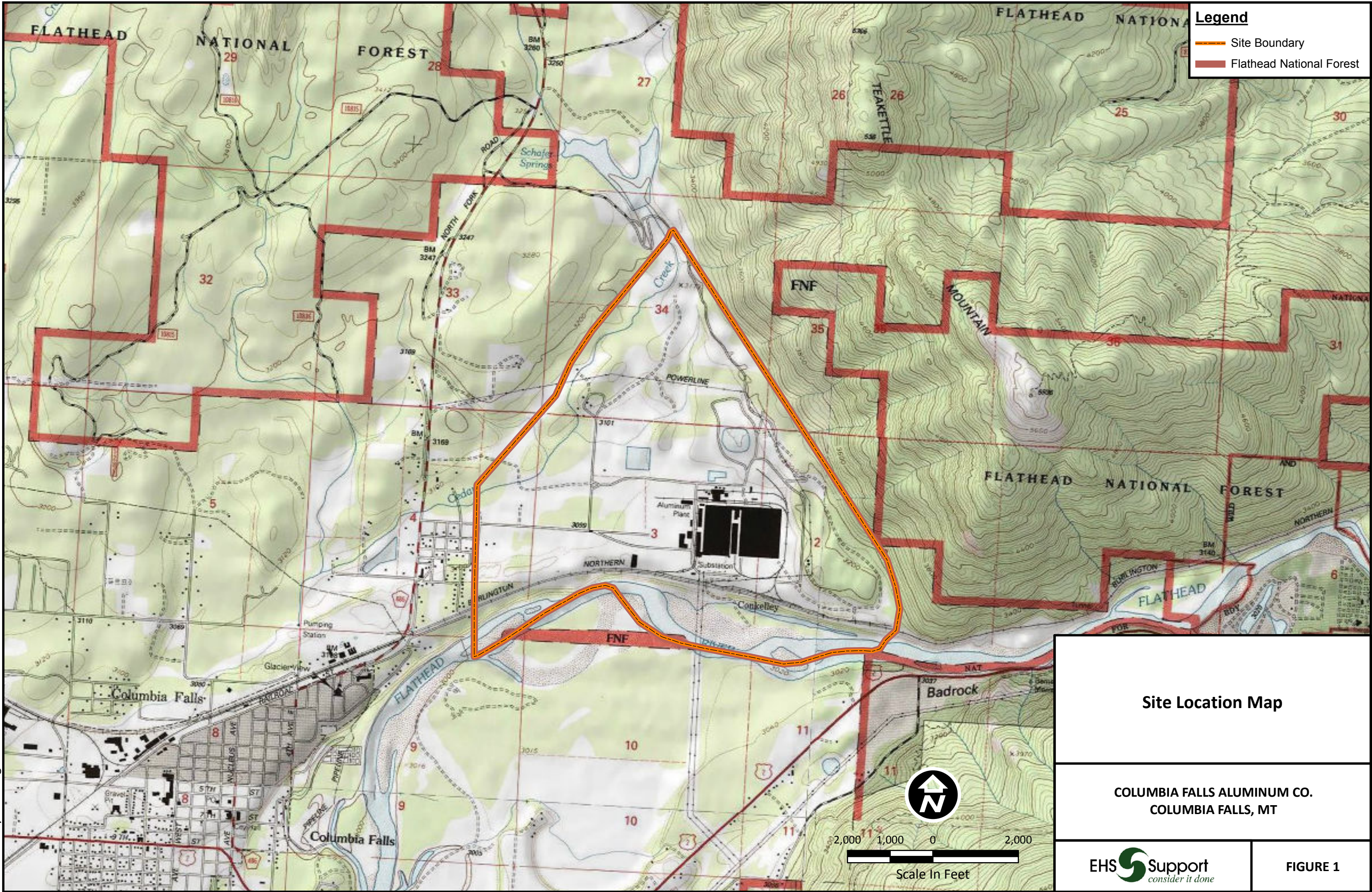
mg, milligram

kg, kilogram

BW, body weight

L, liter

FIGURES

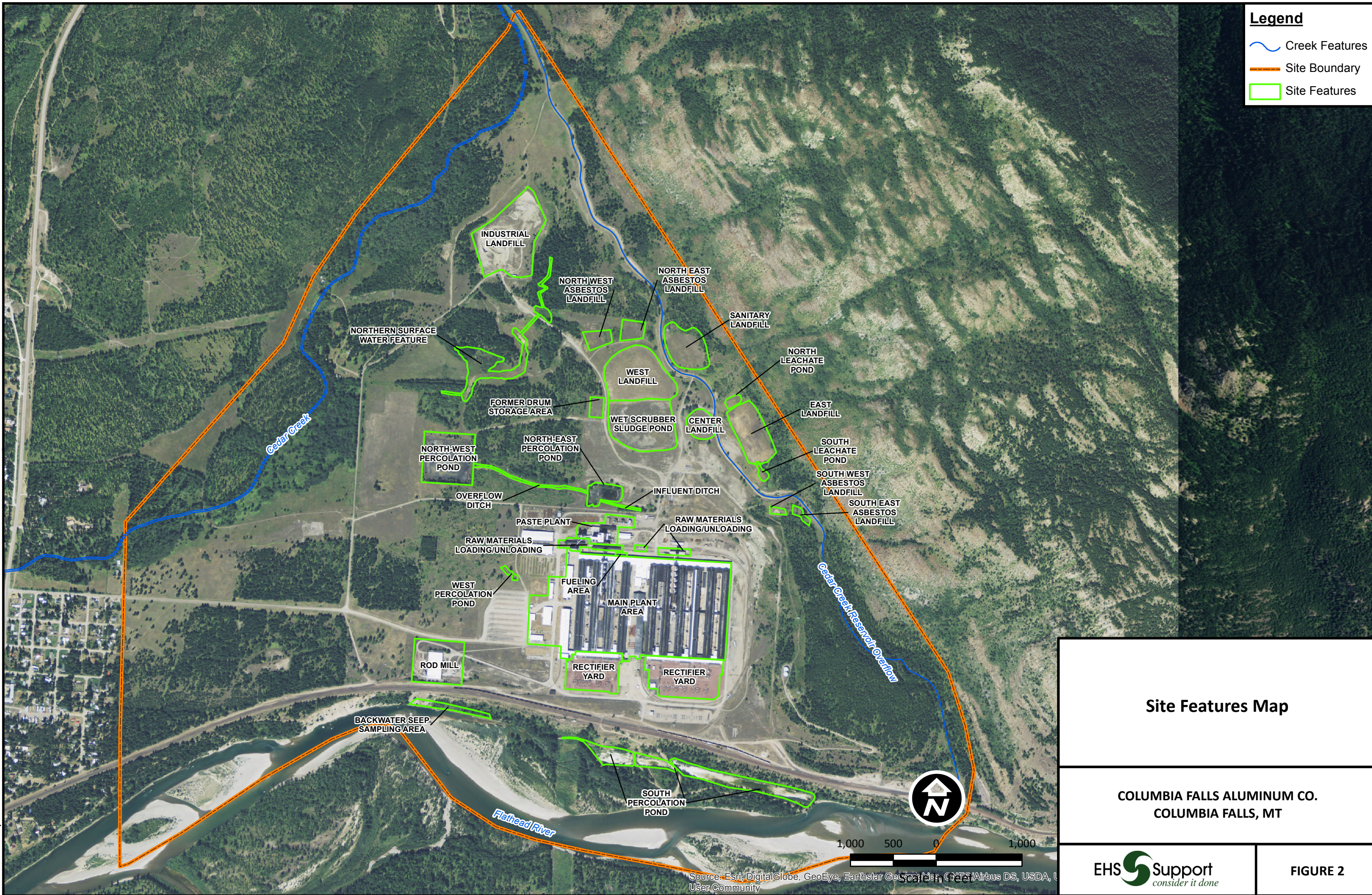


Site Location Map

COLUMBIA FALLS ALUMINUM CO.
COLUMBIA FALLS, MT



FIGURE 1



Legend

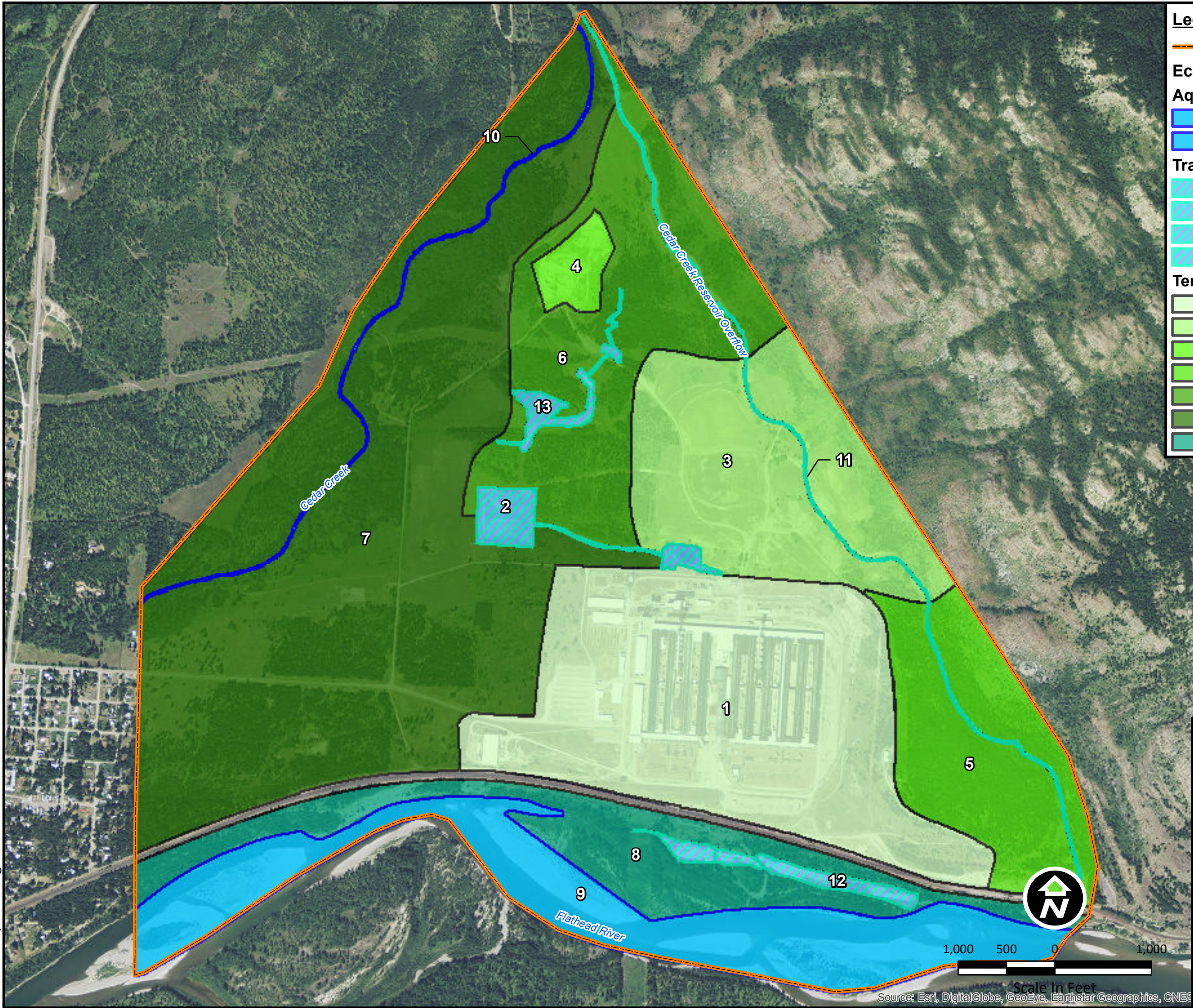
- Creek Features
- Site Boundary
- Site Features

Site Features Map

COLUMBIA FALLS ALUMINUM CO.
COLUMBIA FALLS, MT



FIGURE 2



Legend

Site Boundary

Ecological Exposure Areas

Aquatic Exposure Areas

9 - FLATHEAD RIVER AREA

10 - CEDAR CREEK

Transitional Exposure Area

2 - NORTH PERCOLATION POND AREA

11 - CEDAR CREEK RESERVOIR OVERFLOW DITCH

12 - SOUTH PERCOLATION POND AREA

13 - NORTHERN SURFACE WATER FEATURE

Terrestrial Exposure Area

1 - MAIN PLANT AREA

3 - CENTRAL LANDFILLS AREA

4 - INDUSTRIAL LANDFILL AREA

5 - EASTERN UNDEVELOPED AREA

6 - NORTH-CENTRAL UNDEVELOPED AREA

7 - WESTERN UNDEVELOPED AREA

8 - FLATHEAD RIVER RIPARIAN AREA

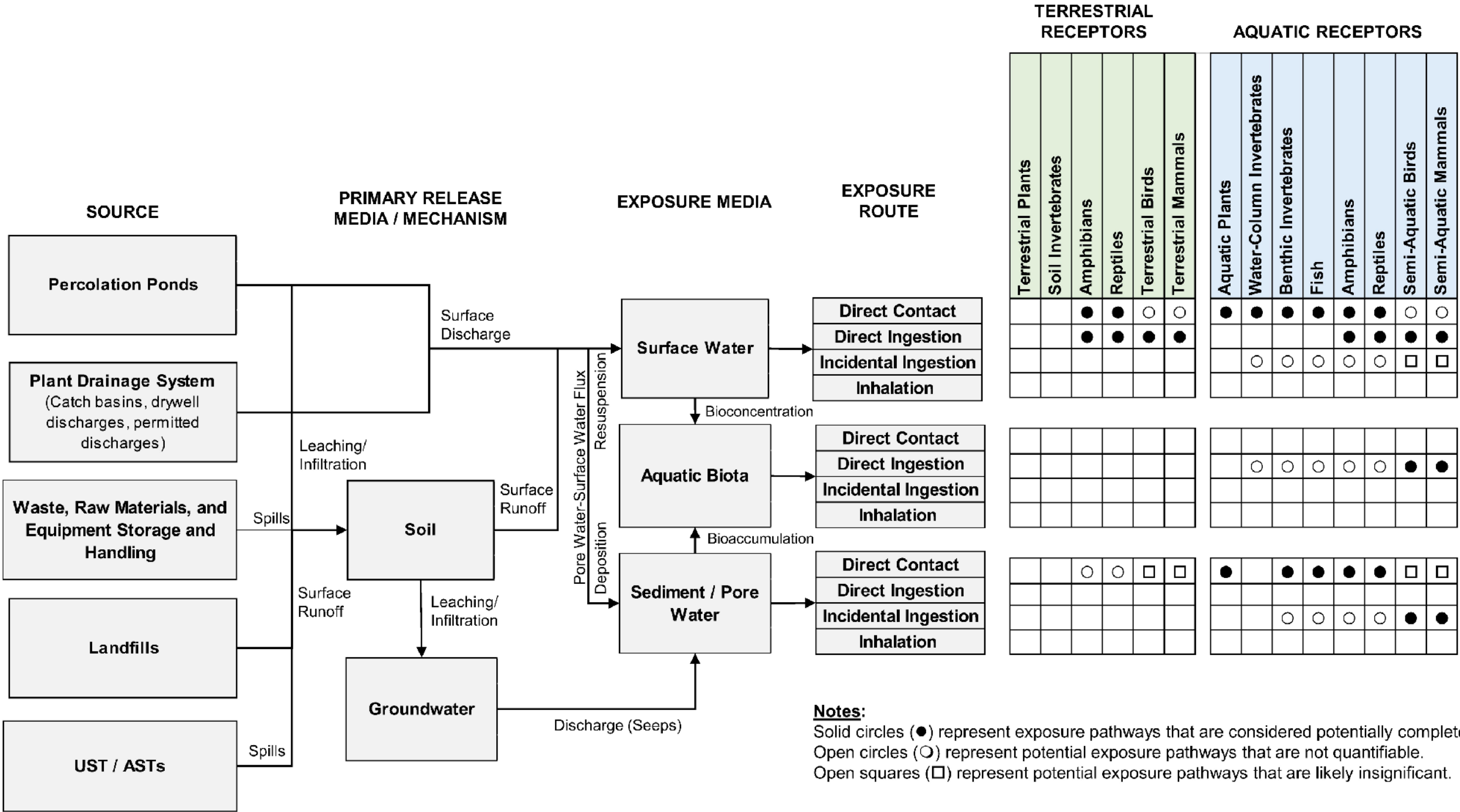
Ecological Exposure Areas Map

COLUMBIA FALLS ALUMINUM CO.
COLUMBIA FALLS, MT



FIGURE 3

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES

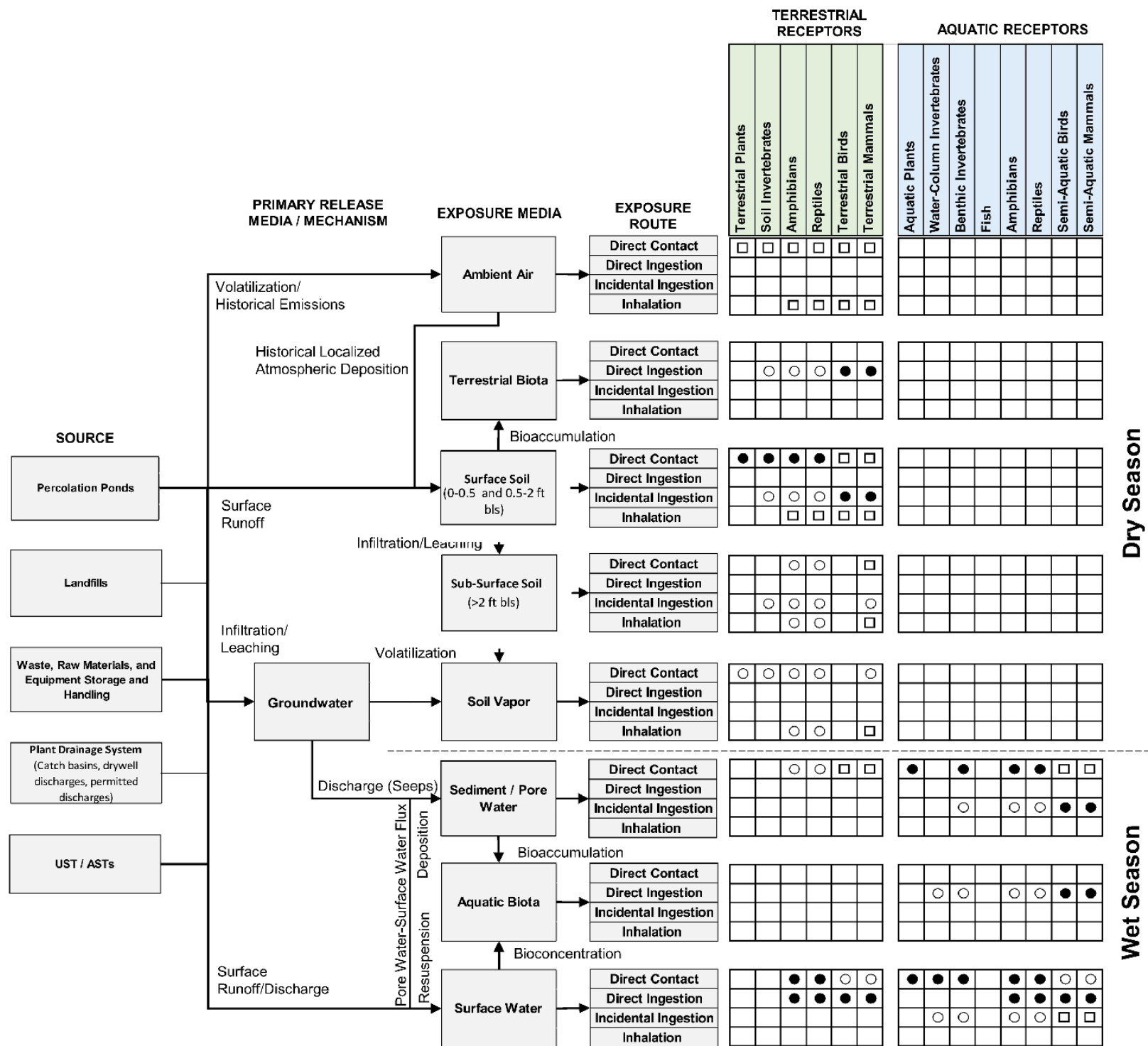


ESCM: Aquatic Exposure Areas

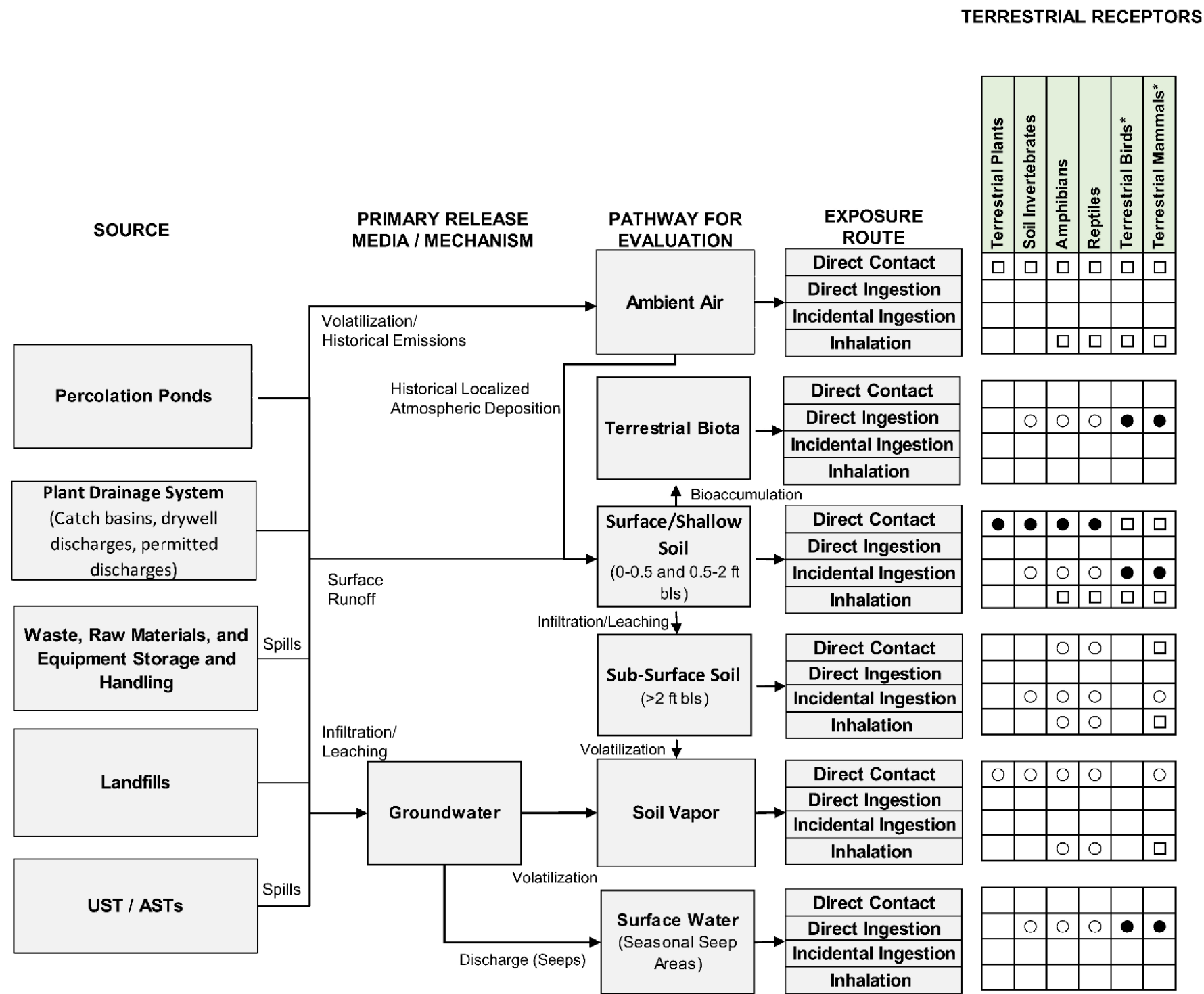
COLUMBIA FALLS ALUMINUM CO.
COLUMBIA FALLS, MT



FIGURE 4



Notes:
Solid circles (●) represent exposure pathways that are considered potentially complete.
Open circles (○) represent potential exposure pathways that are not quantifiable.
Open squares (□) represent potential exposure pathways that are likely insignificant.
Permanent aquatic communities (e.g., fish communities) are not likely to be established in transitional exposure areas.



Notes:
Solid circles (●) represent exposure pathways that are considered potentially complete.
Open circles (○) represent potential exposure pathways that are not quantifiable.
Open squares (□) represent potential exposure pathways that are likely insignificant.
*Includes semi-aquatic birds and mammals, where applicable.

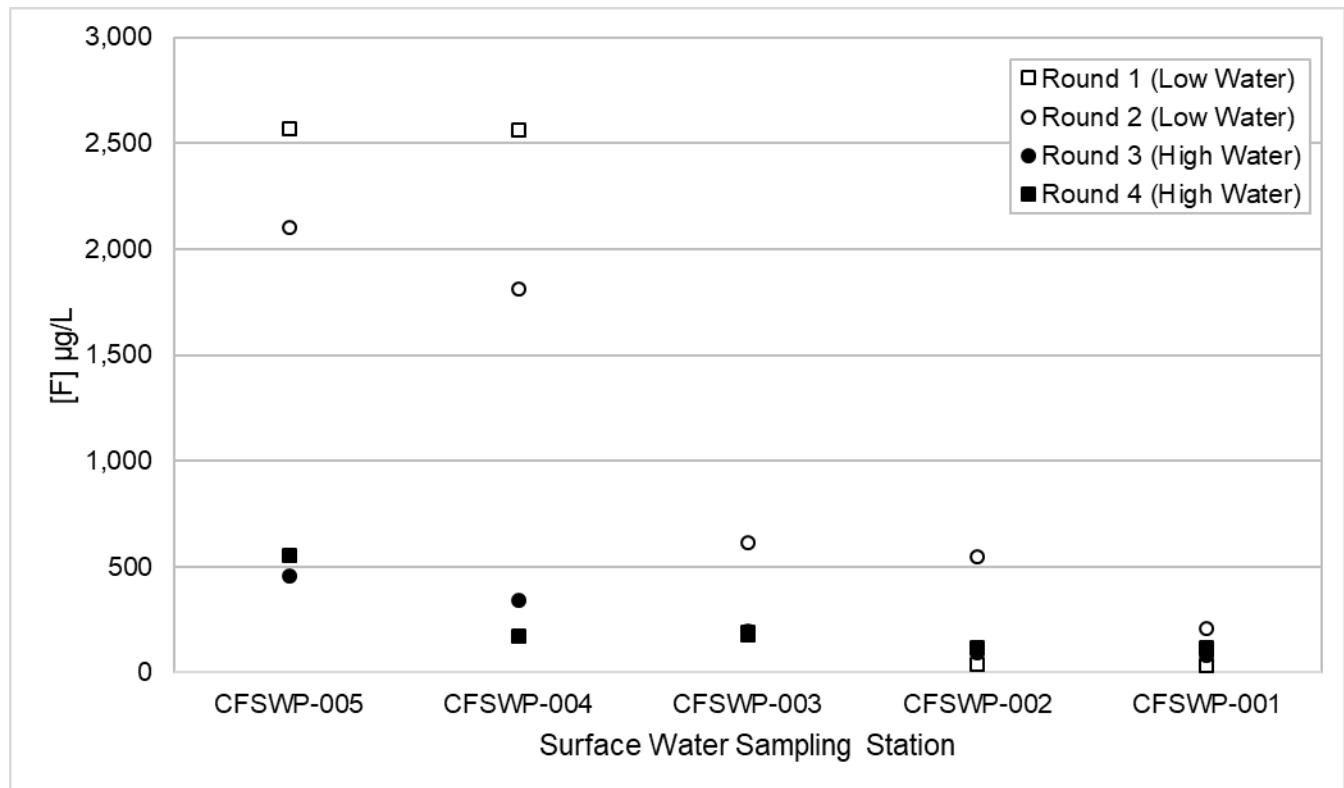
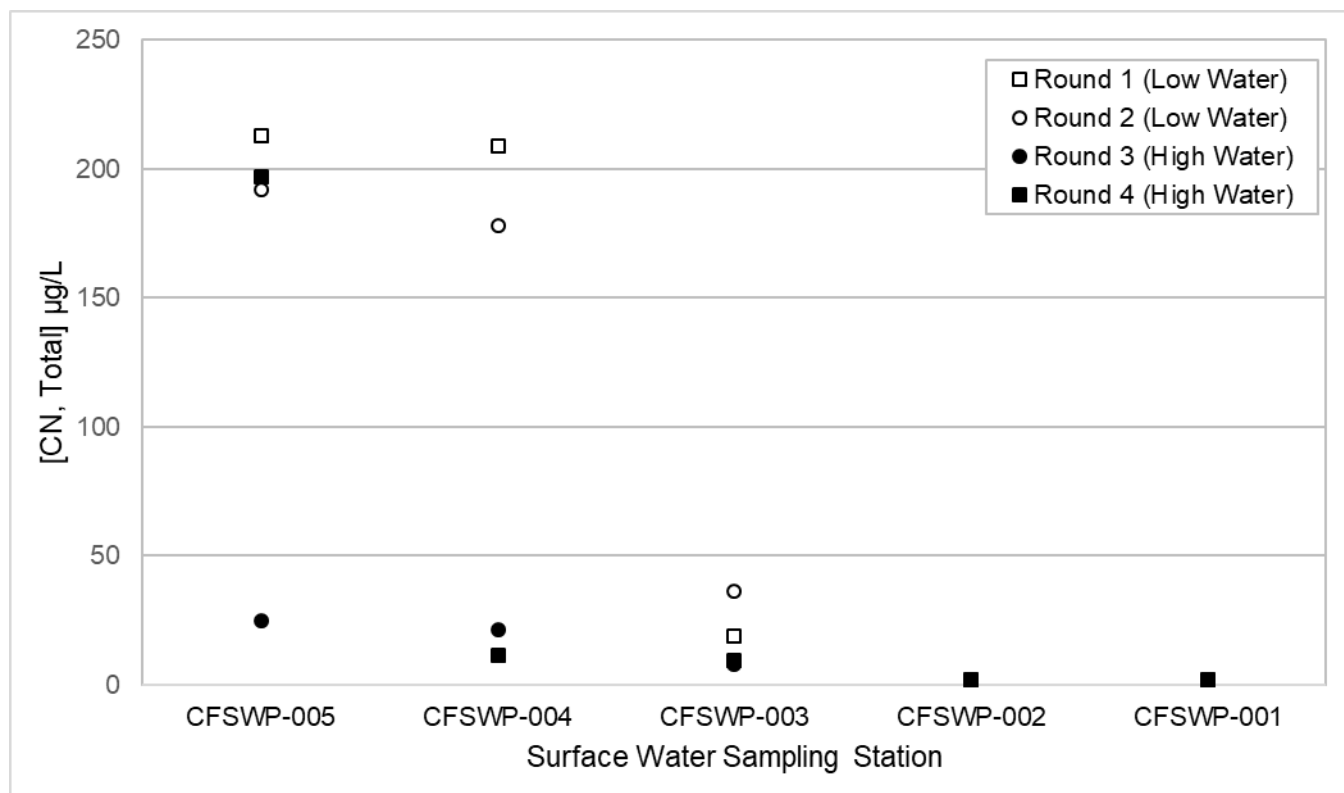
Reviewed By: G. Long

ECSM: Terrestrial Exposure Areas

COLUMBIA FALLS ALUMINUM CO.
COLUMBIA FALLS, MT

EHS Support
consider it done

FIGURE 6



APPENDIX A – REFINED COPEC SCREENING BY ECOLOGICAL EXPOSURE AREA

Table A-1	Summary of Soil and Sediment Ecological Screening Values (ESVs)
Table A-2	Summary of Surface Water and Groundwater Ecological Screening Values (ESVs)
Table A-3	Summary of Soil ESV Exceedances - Main Plant Exposure Area
Table A-4	Evaluation of Dioxin/Furan Toxicity Equivalence Concentrations (TECs) for Birds and Mammals - Main Plant Exposure Area
Table A-5	Summary of Soil ESV Exceedances - Cedar Creek Overflow Ditch Exposure Area
Table A-6	Summary of Soil ESV Exceedances - South Percolation Pond Exposure Area
Table A-7	Summary of Soil ESV Exceedances - Northern Surface Water Feature Exposure Area
Table A-8	Summary of Soil ESV Exceedances - North Percolation Pond Exposure Area
Table A-9	Summary of Soil ESV Exceedances - Central Landfill Exposure Area
Table A-10	Summary of Soil ESV Exceedances - Eastern Undeveloped Exposure Area
Table A-11	Summary of Soil ESV Exceedances - North Central Undeveloped Exposure Area
Table A-12	Summary of Soil ESV Exceedances - Western Undeveloped Exposure Area
Table A-13	Summary of Soil ESV Exceedances - Flathead River Riparian Exposure Area
Table A-14	Summary of Sediment ESV Exceedances - Cedar Creek Exposure Area
Table A-15	Summary of Sediment ESV Exceedances - Cedar Creek Overflow Ditch Exposure Area
Table A-16	Summary of Sediment ESV Exceedances - South Percolation Pond Exposure Area
Table A-17	Summary of Sediment ESV Exceedances - Northern Surface Water Feature Exposure Area
Table A-18	Summary of Sediment ESV Exceedances - North Percolation Pond Exposure Area
Table A-19	Summary of Sediment ESV Exceedances - Flathead River Exposure Area
Table A-20	Summary of Sediment ESBTU Results for PAHs
Table A-21	Summary of Soil ESBTU Results for PAHs
Table A-22	Summary of Surface Water ESV Exceedances - Cedar Creek Exposure Area
Table A-23	Summary of Surface Water ESV Exceedances - Cedar Creek Overflow Ditch Exposure Area
Table A-24	Summary of Surface Water ESV Exceedances - South Percolation Pond Exposure Area
Table A-25	Summary of Surface Water ESV Exceedances - Northern Surface Water Feature Exposure Area
Table A-26	Summary of Surface Water ESV Exceedances - North Percolation Pond Exposure Area
Table A-27	Summary of Surface Water ESV Exceedances - Flathead River Exposure Area
Table A-28	Summary of Surface Water ESV Exceedances by Groundwater - Southern Perimeter of Western Undeveloped and Main Plant Exposure Areas

Table A-1
Summary of Soil and Sediment Ecological Screening Values (ESVs)
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Soil Ecological Screening Value (ESVs)				Sediment Ecological Screening Value (ESVs)			
	SLERA ESV	Source	Preliminary BERA ESV	Source	SLERA ESV	Source	Preliminary BERA ESV	Source
METALS mg/kg								
Aluminum	50	ORNL (Plants)	50	ORNL (Plants)	26000	Ingersoll et al. (1996)	26000	Ingersoll et al. (1996)
Antimony	0.142	USEPA Region 5 ESL	0.27	USEPA Eco-SSL (Mammals)	2	USEPA Region 3 BTAG	2	USEPA Region 3 BTAG
Arsenic	0.25	Sample et al. (1996)	11.4	MSBI Mean Concentration	9.79	MacDonald et al. (2000)	9.79	MacDonald et al. (2000)
Barium	1.04	USEPA Region 5 ESL	195	MSBI Mean Concentration	No ESV	---	No ESV	---
Beryllium	1.06	USEPA Region 5 ESL	2.5	LANL ECORISK (Plants)	No ESV	---	No ESV	---
Cadmium	0.00222	USEPA Region 5 ESL	0.36	USEPA Eco-SSL (Mammals)	0.583	Ingersoll et al. (1996)	0.583	Ingersoll et al. (1996)
Calcium	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Chromium, Total	0.34	LANL ECORISK (Invertebrates)	26	USEPA Eco-SSL (Birds)	36.2	Ingersoll et al. (1996)	36.2	Ingersoll et al. (1996)
Cobalt	0.14	USEPA Region 5 ESL	13	USEPA Eco-SSL (Plants)	50	USEPA Region 3 BTAG	50	USEPA Region 3 BTAG
Copper	5.4	USEPA Region 5 ESL	28	USEPA Eco-SSL (Birds)	28	Ingersoll et al. (1996)	28	Ingersoll et al. (1996)
Iron	No ESV	---	No ESV	---	20000	USEPA Region 3 BTAG	20000	USEPA Region 3 BTAG
Lead	0.0537	USEPA Region 5 ESL	15.3	MSBI Mean Concentration	35.8	MacDonald et al. (2000)	35.8	MacDonald et al. (2000)
Magnesium	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Manganese	220	LANL ECORISK (Plants)	508	MSBI Mean Concentration	460	USEPA Region 3 BTAG	460	USEPA Region 3 BTAG
Mercury	0.005	Sample et al. (1996)	0.05	LANL ECORISK (Invertebrates)	0.174	USEPA Region 5 ESL	0.174	USEPA Region 5 ESL
Nickel	9.7	LANL ECORISK (Mammals)	38	USEPA Eco-SSL (Plants)	19.5	Ingersoll et al. (1996)	19.5	Ingersoll et al. (1996)
Potassium	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Selenium	0.0276	USEPA Region 5 ESL	0.52	LANL ECORISK (Plants)	2	USEPA Region 3 BTAG	2	USEPA Region 3 BTAG
Silver	2	ORNL (Plants)	2	ORNL (Plants)	0.5	USEPA Region 5 ESL	0.5	USEPA Region 5 ESL
Sodium	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Thallium	0.027	Sample et al. (1996)	0.25	MSBI Mean Concentration	No ESV	---	No ESV	---
Vanadium	0.714	Sample et al. (1996)	30.9	MSBI Mean Concentration	No ESV	---	No ESV	---
Zinc	6.62	USEPA Region 5 ESL	60.5	MSBI Mean Concentration	98	Ingersoll et al. (1996)	98	Ingersoll et al. (1996)
GENERAL CHEMISTRY mg/kg								
Cyanide	0.1	LANL ECORISK (Birds)	0.183	LANL ECORISK (Birds)	0.0001	USEPA Region 5 ESL	0.1	USEPA Region 3 BTAG
Fluoride	6.5	Sample et al. (1996)	30	ORNL (Invertebrates)	No ESV	---	290	Metcalfe-Smith et al. (2003)
DIOXIN/FURAN mg/kg								
1,2,3,4,6,7,8-Heptachlorodibenzofuran	No ESV	---	No ESV	---	No ESV	---	No ESV	---
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	No ESV	---	No ESV	---	No ESV	---	No ESV	---
1,2,3,4,7,8-Heptachlorodibenzofuran	No ESV	---	No ESV	---	No ESV	---	No ESV	---
1,2,3,4,7,8-Hexachlorodibenzofuran	No ESV	---	No ESV	---	No ESV	---	No ESV	---
1,2,3,4,7,8-Hexachlorodibenzo-P-Dioxin	No ESV	---	No ESV	---	No ESV	---	No ESV	---
1,2,3,6,7,8-Hexachlorodibenzofuran	No ESV	---	No ESV	---	No ESV	---	No ESV	---
1,2,3,6,7,8-Hexachlorodibenzo-P-Dioxin	No ESV	---	No ESV	---	No ESV	---	No ESV	---
1,2,3,7,8,9-Hexachlorodibenzofuran	No ESV	---	No ESV	---	No ESV	---	No ESV	---
1,2,3,7,8,9-Hexachlorodibenzo-P-Dioxin	No ESV	---	No ESV	---	No ESV	---	No ESV	---
1,2,3,7,8-Pentachlorodibenzofuran	No ESV	---	No ESV	---	No ESV	---	No ESV	---
1,2,3,7,8-Pentachlorodibenzo-P-Dioxin	No ESV	---	No ESV	---	No ESV	---	No ESV	---
2,3,4,6,7,8-Hexachlorodibenzofuran	No ESV	---	No ESV	---	No ESV	---	No ESV	---
2,3,4,7,8-Pentachlorodibenzofuran	No ESV	---	No ESV	---	No ESV	---	No ESV	---
2,3,7,8-Tetrachlorodibenzofuran	No ESV	---	No ESV	---	No ESV	---	No ESV	---
2,3,7,8-Tetrachlorodibenzo-P-Dioxin	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Heptachlorodibenzofurans	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Heptachlorodibenzo-p-dioxins (HpCDD), Total	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Hexachlorodibenzofuran	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Hexachlorodibenzo-P-Dioxin	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Octachlorodibenzofuran	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Octachlorodibenzo-P-Dioxin	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Pentachlorinated Dibenz-P-Dioxins, (Total)	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Pentachloro Dibenzofuran	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Tetrachlorinated Dibenzofurans, (Total)	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Tetrachlorodibenzo-P-Dioxin	No ESV	---	No ESV	---	No ESV	---	No ESV	---
PESTICIDES mg/kg								
Aldrin	0.00332	USEPA Region 5 ESL	0.00332	USEPA Region 5 ESL	0.002	USEPA Region 3 BTAG	0.002	USEPA Region 3 BTAG
Alpha Bhc (Alpha Hexachlorocyclohexane)	0.0994	USEPA Region 5 ESL	0.0994	USEPA Region 5 ESL	0.006	USEPA Region 3 BTAG	0.006	USEPA Region 3 BTAG
Alpha Endosulfan	0.119	USEPA Region 5 ESL	0.119	USEPA Region 5 ESL	0.00000642	EqP-Derived @ 1% TOC	0.00000642	EqP-Derived @ 1% TOC
Beta Bhc (Beta Hexachlorocyclohexane)	0.00398	USEPA Region 5 ESL	0.00398	USEPA Region 5 ESL	0.005	USEPA Region 3 BTAG	0.005	USEPA Region 3 BTAG
Beta Endosulfan	0.119	USEPA Region 5 ESL	0.119	USEPA Region 5 ESL	0.00000642	EqP-Derived @ 1% TOC	0.00000642	EqP-Derived @ 1% TOC
cis-Chlordane	0.27	USEPA Region 5 ESL	0.27	USEPA Region 5 ESL	No ESV	---	No ESV	---

Table A-1
Summary of Soil and Sediment Ecological Screening Values (ESVs)
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Soil Ecological Screening Value (ESVs)				Sediment Ecological Screening Value (ESVs)			
	SLERA ESV	Source	Preliminary BERA ESV	Source	SLERA ESV	Source	Preliminary BERA ESV	Source
Delta BHC (Delta Hexachlorocyclohexane)	0.1	Sample et al. (1996)	0.1	Sample et al. (1996)	0.138811	EqP-Derived @ 1% TOC	0.138811	EqP-Derived @ 1% TOC
Dieldrin	0.00238	USEPA Region 5 ESL	0.00238	USEPA Region 5 ESL	0.0019	USEPA Region 5 ESL	0.0019	USEPA Region 5 ESL
Endosulfan Sulfate	0.0358	USEPA Region 5 ESL	0.0358	USEPA Region 5 ESL	0.00000642	EqP-Derived @ 1% TOC	0.00000642	EqP-Derived @ 1% TOC
Endrin	0.0014	LANL ECORISK (Birds)	0.0014	LANL ECORISK (Birds)	0.00222	USEPA Region 5 ESL	0.00222	USEPA Region 5 ESL
Endrin Aldehyde	0.0105	USEPA Region 5 ESL	0.0105	USEPA Region 5 ESL	0.004428	USEPA Region 5 ESL	0.004428	USEPA Region 5 ESL
Endrin Ketone	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Gamma Bhc (Lindane)	0.005	USEPA Region 5 ESL	0.005	USEPA Region 5 ESL	0.00237	MacDonald et al. (2000)	0.00237	MacDonald et al. (2000)
Heptachlor	0.059	LANL ECORISK (Mammals)	0.059	LANL ECORISK (Mammals)	0.0006	USEPA Region 5 ESL	0.0006	USEPA Region 5 ESL
Heptachlor Epoxide	0.152	USEPA Region 5 ESL	0.152	USEPA Region 5 ESL	0.00247	MacDonald et al. (2000)	0.00247	MacDonald et al. (2000)
Methoxychlor	5	LANL ECORISK (Mammals)	5	LANL ECORISK (Mammals)	No ESV	---	No ESV	---
P,P'-DDD	0.00488	USEPA Region 5 ESL	0.00488	USEPA Region 5 ESL	0.00488	MacDonald et al. (2000)	0.00488	MacDonald et al. (2000)
P,P'-DDE	0.021	USEPA Eco-SSL (Mammals)	0.021	USEPA Eco-SSL (Mammals)	0.00316	MacDonald et al. (2000)	0.00316	MacDonald et al. (2000)
P,P'-DDT	0.0035	USEPA Region 5 ESL	0.0035	USEPA Region 5 ESL	0.00416	MacDonald et al. (2000)	0.00416	MacDonald et al. (2000)
Toxaphene	0.119	USEPA Region 5 ESL	0.119	USEPA Region 5 ESL	0.000077	USEPA Region 5 ESL	0.000077	USEPA Region 5 ESL
trans-Chlordane	2.2	LANL ECORISK (Mammals)	2.2	LANL ECORISK (Mammals)	No ESV	---	No ESV	---
POLYCHLORINATED BIPHENYLS mg/kg								
PCB-1016 (Aroclor 1016)	1	LANL ECORISK (Mammals)	1	LANL ECORISK (Mammals)	No ESV	---	No ESV	---
PCB-1221 (Aroclor 1221)	No ESV	---	No ESV	---	No ESV	---	No ESV	---
PCB-1232 (Aroclor 1232)	No ESV	---	No ESV	---	No ESV	---	No ESV	---
PCB-1242 (Aroclor 1242)	0.041	LANL ECORISK (Birds)	0.041	LANL ECORISK (Birds)	No ESV	---	No ESV	---
PCB-1248 (Aroclor 1248)	0.0072	LANL ECORISK (Mammals)	0.0072	LANL ECORISK (Mammals)	No ESV	---	No ESV	---
PCB-1254 (Aroclor 1254)	0.041	LANL ECORISK (Birds)	0.041	LANL ECORISK (Birds)	No ESV	---	No ESV	---
PCB-1260 (Aroclor 1260)	0.88	LANL ECORISK (Birds)	0.88	LANL ECORISK (Birds)	No ESV	---	No ESV	---
PCB-1262 (Aroclor 1262)	No ESV	---	No ESV	---	No ESV	---	No ESV	---
PCB-1268 (Aroclor 1268)	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Polychlorinated Biphenyl (PCBs)	40	ORNL (Plants)	40	ORNL (Plants)	0.032	Ingersoll et al. (1996)	0.032	Ingersoll et al. (1996)
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg								
2-Methylnaphthalene	3.24	USEPA Region 5 ESL	3.24	USEPA Region 5 ESL	0.0202	USEPA Region 3 BTAG	USEPA Equilibrium Partitioning Sediment Benchmark approach based on sample-specific organic carbon content (USEPA, 2003)	---
Acenaphthene	0.25	LANL ECORISK (Plants)	0.25	LANL ECORISK (Plants)	0.00671	USEPA Region 3 BTAG		---
Acenaphthylene	120	LANL ECORISK (Mammals)	120	LANL ECORISK (Mammals)	0.00587	USEPA Region 5 ESL		---
Anthracene	6.8	LANL ECORISK (Plants)	6.8	LANL ECORISK (Plants)	0.01	Ingersoll et al. (1996)		---
Benzo(A)Anthracene	0.8	LANL ECORISK (Birds)	0.8	LANL ECORISK (Birds)	0.016	Ingersoll et al. (1996)		---
Benzo(A)Pyrene	1.52	USEPA Region 5 ESL	1.52	USEPA Region 5 ESL	0.032	Ingersoll et al. (1996)		---
Benzo(B)Fluoranthene	18	LANL ECORISK (Plants)	18	LANL ECORISK (Plants)	9.79	USEPA ESB (2003)		---
Benzo(G,H,I)Perylene	24	LANL ECORISK (Mammals)	24	LANL ECORISK (Mammals)	0.016	Ingersoll et al. (1996)		---
Benzo(K)Fluoranthene	62	LANL ECORISK (Mammals)	62	LANL ECORISK (Mammals)	0.24	USEPA Region 3 BTAG		---
Chrysene	2.4	LANL ECORISK (Mammals)	2.4	LANL ECORISK (Mammals)	0.027	Ingersoll et al. (1996)		---
Dibenz(A,H)Anthracene	12	LANL ECORISK (Mammals)	12	LANL ECORISK (Mammals)	0.01	Ingersoll et al. (1996)		---
Fluoranthene	10	LANL ECORISK (Invertebrates)	10	LANL ECORISK (Invertebrates)	0.031	Ingersoll et al. (1996)		---
Fluorene	3.7	LANL ECORISK (Invertebrates)	3.7	LANL ECORISK (Invertebrates)	0.01	Ingersoll et al. (1996)		---
Indeno(1,2,3-C,D)Pyrene	62	LANL ECORISK (Mammals)	62	LANL ECORISK (Mammals)	0.017	Ingersoll et al. (1996)		---
Naphthalene	0.0994	USEPA Region 5 ESL	0.0994	USEPA Region 5 ESL	0.015	Ingersoll et al. (1996)		---
Phenanthrene	5.5	LANL ECORISK (Invertebrates)	5.5	LANL ECORISK (Invertebrates)	0.019	Ingersoll et al. (1996)		---
Pyrene	10	LANL ECORISK (Invertebrates)	10	LANL ECORISK (Invertebrates)	0.044	Ingersoll et al. (1996)		---
Total High Molecular Weight PAHs	No ESV	---	29	USEPA Eco-SSL (Invertebrates)	No ESV	---		---
Total Low Molecular Weight PAHs	No ESV	---	1.1	USEPA Eco-SSL (Mammals)	No ESV	---		---
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg								
1,2,4,5-Tetrachlorobenzene	2.02	USEPA Region 5 ESL	2.02	USEPA Region 5 ESL	No ESV	---	No ESV	---
1,4-Dioxane (P-Dioxane)	1.83	Sample et al. (1996)	1.83	Sample et al. (1996)	No ESV	---	No ESV	---
2,3,4,6-Tetrachlorophenol	No ESV	---	No ESV	---	0.129	USEPA Region 5 ESL	0.129	USEPA Region 5 ESL
2,4,5-Trichlorophenol	4	ORNL (Plants)	4	ORNL (Plants)	0.288	EqP-Derived @ 1% TOC	0.288	EqP-Derived @ 1% TOC
2,4,6-Trichlorophenol	9.94	USEPA Region 5 ESL	9.94	USEPA Region 5 ESL	0.208	USEPA Region 5 ESL	0.208	USEPA Region 5 ESL
2,4-Dichlorophenol	87.5	USEPA Region 5 ESL	87.5	USEPA Region 5 ESL	0.0817	USEPA Region 5 ESL	0.0817	USEPA Region 5 ESL
2,4-Dimethylphenol	0.01	USEPA Region 5 ESL	0.01	USEPA Region 5 ESL	0.029	USEPA Region 3 BTAG	0.029	USEPA Region 3 BTAG
2,4-Dinitrophenol	0.0609	USEPA Region 5 ESL	0.0609	USEPA Region 5 ESL	0.00621	USEPA Region 5 ESL	0.00621	USEPA Region 5 ESL
2,4-Dinitrotoluene	1.28	USEPA Region 5 ESL	1.28	USEPA Region 5 ESL	0.0144	USEPA Region 5 ESL	0.0144	USEPA Region 5 ESL
2,6-Dinitrotoluene	0.0328	USEPA Region 5 ESL	0.0328	USEPA Region 5 ESL	0.0398	USEPA Region 5 ESL	0.0398	USEPA Region 5 ESL
2-Chloronaphthalene	0.0122	USEPA Region 5 ESL	0.0122	USEPA Region 5 ESL	0.417	USEPA Region 5 ESL	0.417	USEPA Region 5 ESL
2-Chlorophenol	0.243	USEPA Region 5 ESL	0.243	USEPA Region 5 ESL	0.02716	EqP-Derived @ 1% TOC	0.02716	EqP-Derived @ 1% TOC
2-Methylphenol (O-Cresol)	0.67	LANL ECORISK (Plants)	0.67	LANL ECORISK (Plants)	0.011856	EqP-Derived @ 1% TOC	0.011856	EqP-Derived @ 1% TOC

Table A-1
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Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Soil Ecological Screening Value (ESVs)				Sediment Ecological Screening Value (ESVs)			
	SLERA ESV	Source	Preliminary BERA ESV	Source	SLERA ESV	Source	Preliminary BERA ESV	Source
2-Nitroaniline	5.4	LANL ECORISK (Plants)	5.4	LANL ECORISK (Plants)	No ESV	---	No ESV	---
2-Nitrophenol	1.6	USEPA Region 5 ESL	1.6	USEPA Region 5 ESL	No ESV	---	No ESV	---
3- And 4- Methylphenol (Total)	No ESV	---	No ESV	---	No ESV	---	No ESV	---
3,3'-Dichlorobenzidine	0.646	USEPA Region 5 ESL	0.646	USEPA Region 5 ESL	0.127	USEPA Region 5 ESL	0.127	USEPA Region 5 ESL
3-Nitroaniline	3.16	USEPA Region 5 ESL	3.16	USEPA Region 5 ESL	No ESV	---	No ESV	---
4,6-Dinitro-2-Methylphenol	0.144	USEPA Region 5 ESL	0.144	USEPA Region 5 ESL	No ESV	---	No ESV	---
4-Bromophenyl Phenyl Ether	No ESV	---	No ESV	---	0.255	EqP-Derived @ 1% TOC	0.255	EqP-Derived @ 1% TOC
4-Chloro-3-Methylphenol	No ESV	---	No ESV	---	0.388	USEPA Region 5 ESL	0.388	USEPA Region 5 ESL
4-Chloroaniline	1	LANL ECORISK (Plants)	1	LANL ECORISK (Plants)	0.146	USEPA Region 5 ESL	0.146	USEPA Region 5 ESL
4-Chlorophenyl Phenyl Ether	No ESV	---	No ESV	---	No ESV	---	No ESV	---
4-Nitroaniline	21.9	USEPA Region 5 ESL	21.9	USEPA Region 5 ESL	No ESV	---	No ESV	---
4-Nitrophenol	7	ORNL (Invertebrates)	7	ORNL (Invertebrates)	0.013	USEPA Region 5 ESL	0.013	USEPA Region 5 ESL
Acetophenone	300	USEPA Region 5 ESL	300	USEPA Region 5 ESL	No ESV	---	No ESV	---
Atrazine	No ESV	---	No ESV	---	0.00662	USEPA Region 3 BTAG	0.00662	USEPA Region 3 BTAG
Benzaldehyde	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Benzyl Butyl Phthalate	0.239	USEPA Region 5 ESL	0.239	USEPA Region 5 ESL	1.97	USEPA Region 5 ESL	1.97	USEPA Region 5 ESL
Biphenyl (Diphenyl)	60	ORNL (Plants)	60	ORNL (Plants)	1.22	EqP-Derived @ 1% TOC	1.22	EqP-Derived @ 1% TOC
Bis(2-Chloroethoxy) Methane	0.302	USEPA Region 5 ESL	0.302	USEPA Region 5 ESL	No ESV	---	No ESV	---
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	23.7	USEPA Region 5 ESL	23.7	USEPA Region 5 ESL	No ESV	---	No ESV	---
Bis(2-Chloroisopropyl) Ether	19.9	USEPA Region 5 ESL	19.9	USEPA Region 5 ESL	No ESV	---	No ESV	---
Bis(2-Ethylhexyl) Phthalate	0.02	LANL ECORISK (Birds)	0.02	LANL ECORISK (Birds)	0.18	USEPA Region 3 BTAG	0.18	USEPA Region 3 BTAG
Caprolactam	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Carbazole	80	LANL ECORISK (Mammals)	80	LANL ECORISK (Mammals)	No ESV	---	No ESV	---
Dibenzofuran	6.1	LANL ECORISK (Plants)	6.1	LANL ECORISK (Plants)	0.300736	EqP-Derived @ 1% TOC	0.300736	EqP-Derived @ 1% TOC
Diethyl Phthalate	100	LANL ECORISK (Plants)	100	LANL ECORISK (Plants)	0.603	USEPA Region 3 BTAG	0.603	USEPA Region 3 BTAG
Dimethyl Phthalate	10	LANL ECORISK (Invertebrates)	10	LANL ECORISK (Invertebrates)	No ESV	---	No ESV	---
Di-N-Butyl Phthalate	0.011	LANL ECORISK (Birds)	0.011	LANL ECORISK (Birds)	1.2	EqP-Derived @ 1% TOC	1.1989	EqP-Derived @ 1% TOC
Di-N-Octylphthalate	0.91	LANL ECORISK (Mammals)	0.91	LANL ECORISK (Mammals)	17	EqP-Derived @ 1% TOC	16.8858	EqP-Derived @ 1% TOC
Hexachlorobenzene	0.079	LANL ECORISK (Birds)	0.079	LANL ECORISK (Birds)	0.02	USEPA Region 3 BTAG	0.02	USEPA Region 3 BTAG
Hexachlorobutadiene	0.0398	USEPA Region 5 ESL	0.0398	USEPA Region 5 ESL	0.0265	USEPA Region 5 ESL	0.0265	USEPA Region 5 ESL
Hexachlorocyclopentadiene	0.755	USEPA Region 5 ESL	0.755	USEPA Region 5 ESL	0.901	USEPA Region 5 ESL	0.901	USEPA Region 5 ESL
Hexachloroethane	0.596	USEPA Region 5 ESL	0.596	USEPA Region 5 ESL	0.2136	EqP-Derived @ 1% TOC	0.2136	EqP-Derived @ 1% TOC
Isophorone	139	USEPA Region 5 ESL	139	USEPA Region 5 ESL	0.432	USEPA Region 5 ESL	0.432	USEPA Region 5 ESL
Nitrobenzene	1.31	USEPA Region 5 ESL	1.31	USEPA Region 5 ESL	0.145	USEPA Region 5 ESL	0.145	USEPA Region 5 ESL
N-Nitrosodi-N-Propylamine	0.544	USEPA Region 5 ESL	0.544	USEPA Region 5 ESL	No ESV	---	No ESV	---
N-Nitrosodiphenylamine	0.545	USEPA Region 5 ESL	0.545	USEPA Region 5 ESL	0.516	EqP-Derived @ 1% TOC	0.516	EqP-Derived @ 1% TOC
Pentachlorophenol	0.119	USEPA Region 5 ESL	0.119	USEPA Region 5 ESL	0.504	USEPA Region 3 BTAG	0.504	USEPA Region 3 BTAG
Phenol	0.79	LANL ECORISK (Plants)	0.79	LANL ECORISK (Plants)	0.001152	EqP-Derived @ 1% TOC	0.001152	EqP-Derived @ 1% TOC
VOLATILE ORGANIC COMPOUNDS mg/kg								
1,1,1-Trichloroethane	29.8	USEPA Region 5 ESL	29.8	USEPA Region 5 ESL	No ESV	---	No ESV	---
1,1,2,2-Tetrachloroethane	225	USEPA Region 5 ESL	225	USEPA Region 5 ESL	No ESV	---	No ESV	---
1,1,2-Trichloro-1,2,2-Trifluoroethane	No ESV	---	No ESV	---	No ESV	---	No ESV	---
1,1,2-Trichloroethane	28.6	USEPA Region 5 ESL	28.6	USEPA Region 5 ESL	No ESV	---	No ESV	---
1,1-Dichloroethane	20.1	USEPA Region 5 ESL	20.1	USEPA Region 5 ESL	No ESV	---	No ESV	---
1,1-Dichloroethene	8.28	USEPA Region 5 ESL	8.28	USEPA Region 5 ESL	No ESV	---	No ESV	---
1,2,3-Trichlorobenzene	11.1	USEPA Region 5 ESL	11.1	USEPA Region 5 ESL	No ESV	---	No ESV	---
1,2,4-Trichlorobenzene	0.27	LANL ECORISK (Mammals)	0.27	LANL ECORISK (Mammals)	No ESV	---	No ESV	---
1,2-Dibromo-3-Chloropropane	0.0352	USEPA Region 5 ESL	0.0352	USEPA Region 5 ESL	No ESV	---	No ESV	---
1,2-Dibromoethane (Ethylene Dibromide)	1.23	USEPA Region 5 ESL	1.23	USEPA Region 5 ESL	No ESV	---	No ESV	---
1,2-Dichlorobenzene	0.92	USEPA Region 5 ESL	0.92	USEPA Region 5 ESL	No ESV	---	No ESV	---
1,2-Dichloroethane	0.85	LANL ECORISK (Birds)	0.85	LANL ECORISK (Birds)	No ESV	---	No ESV	---
1,2-Dichloropropane	32.7	USEPA Region 5 ESL	32.7	USEPA Region 5 ESL	No ESV	---	No ESV	---
1,3-Dichlorobenzene	0.73	LANL ECORISK (Mammals)	0.73	LANL ECORISK (Mammals)	No ESV	---	No ESV	---
1,4-Dichlorobenzene	0.88	LANL ECORISK (Mammals)	0.88	LANL ECORISK (Mammals)	No ESV	---	No ESV	---
2-Hexanone	0.36	LANL ECORISK (Birds)	0.36	LANL ECORISK (Birds)	No ESV	---	No ESV	---
Acetone	1.2	LANL ECORISK (Mammals)	1.2	LANL ECORISK (Mammals)	No ESV	---	No ESV	---
Benzene	0.255	USEPA Region 5 ESL	0.255	USEPA Region 5 ESL	No ESV	---	No ESV	---
Bromochloromethane	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Bromodichloromethane	0.54	USEPA Region 5 ESL	0.54	USEPA Region 5 ESL	No ESV	---	No ESV	---
Bromoform	15.9	USEPA Region 5 ESL	15.9	USEPA Region 5 ESL	No ESV	---	No ESV	---

Table A-1
Summary of Soil and Sediment Ecological Screening Values (ESVs)
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Soil Ecological Screening Value (ESVs)				Sediment Ecological Screening Value (ESVs)			
	SLERA ESV	Source	Preliminary BERA ESV	Source	SLERA ESV	Source	Preliminary BERA ESV	Source
Bromomethane	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Carbon Disulfide	0.0941	USEPA Region 5 ESL	0.0941	USEPA Region 5 ESL	No ESV	---	No ESV	---
Carbon Tetrachloride	2.98	USEPA Region 5 ESL	2.98	USEPA Region 5 ESL	No ESV	---	No ESV	---
Chlorobenzene	2.4	LANL ECORISK (Invertebrates)	2.4	LANL ECORISK (Invertebrates)	No ESV	---	No ESV	---
Chloroethane	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Chloroform	1.19	USEPA Region 5 ESL	1.19	USEPA Region 5 ESL	No ESV	---	No ESV	---
Chloromethane	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Cis-1,2-Dichloroethylene	23	LANL ECORISK (Mammals)	23	LANL ECORISK (Mammals)	No ESV	---	No ESV	---
Cis-1,3-Dichloropropene	0.398	USEPA Region 5 ESL	0.398	USEPA Region 5 ESL	No ESV	---	No ESV	---
Cyclohexane	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Dibromochloromethane	2.05	USEPA Region 5 ESL	2.05	USEPA Region 5 ESL	No ESV	---	No ESV	---
Dichlorodifluoromethane	39.5	USEPA Region 5 ESL	39.5	USEPA Region 5 ESL	No ESV	---	No ESV	---
Ethylbenzene	5.16	USEPA Region 5 ESL	5.16	USEPA Region 5 ESL	No ESV	---	No ESV	---
Isopropylbenzene (Cumene)	No ESV	---	No ESV	---	No ESV	---	No ESV	---
M,P-Xylene	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Methyl Acetate	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Methyl Ethyl Ketone (2-Butanone)	360	LANL ECORISK (Mammals)	360	LANL ECORISK (Mammals)	No ESV	---	No ESV	---
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	9.8	LANL ECORISK (Mammals)	9.8	LANL ECORISK (Mammals)	No ESV	---	No ESV	---
Methylcyclohexane	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Methylene Chloride	2.6	LANL ECORISK (Mammals)	2.6	LANL ECORISK (Mammals)	No ESV	---	No ESV	---
O-Xylene (1,2-Dimethylbenzene)	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Styrene	1.2	LANL ECORISK (Invertebrates)	1.2	LANL ECORISK (Invertebrates)	No ESV	---	No ESV	---
Tert-Butyl Methyl Ether	No ESV	---	No ESV	---	No ESV	---	No ESV	---
Tetrachloroethylene (PCE)	0.18	LANL ECORISK (Mammals)	0.18	LANL ECORISK (Mammals)	No ESV	---	No ESV	---
Toluene	5.45	USEPA Region 5 ESL	5.45	USEPA Region 5 ESL	No ESV	---	No ESV	---
Trans-1,2-Dichloroethene	23	LANL ECORISK (Mammals)	23	LANL ECORISK (Mammals)	No ESV	---	No ESV	---
Trans-1,3-Dichloropropene	0.398	USEPA Region 5 ESL	0.398	USEPA Region 5 ESL	No ESV	---	No ESV	---
Trichloroethylene (TCE)	1.387	Sample et al. (1996)	1.387	Sample et al. (1996)	No ESV	---	No ESV	---
Trichlorofluoromethane	16.4	USEPA Region 5 ESL	16.4	USEPA Region 5 ESL	No ESV	---	No ESV	---
Vinyl Chloride	0.12	LANL ECORISK (Mammals)	0.12	LANL ECORISK (Mammals)	No ESV	---	No ESV	---

Notes:

Total high molecular weight PAHs = sum of PAHs with four or more benzene rings.
Total low molecular weight PAHs = sum of PAHs with less than four benzene rings.
No ESV, No ESV was identified for the constituent or fraction indicated.
LANL, Los Alamos National Laboratory
ORNL, Oak Ridge National Laboratory
MSBI, Montana State Background Investigation

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EqP-Derived @ 1% TOC: Derived based on the equilibrium partitioning (EqP) normalized to 1% total organic carbon (TOC)

Table A-2
Summary of Surface Water and Groundwater Ecological Screening Values (ESVs)
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Fraction ³	Surface Water Ecological Screening Value (ESVs)			
		SLERA ESV	Source	Preliminary BERA ESV	Source
GENERAL CHEMISTRY µg/L					
Cyanide	D	No ESV	CCME (2008)	No ESV	MDEQ (2017)
	T	5		5.2	
Cyanide (Free)	D	No ESV	USEPA NRWQC	No ESV	USEPA NRWQC
	T	5.2		5.2	
Fluoride	D	No ESV	CCME (2008)	No ESV	CCME (2008)
	T	120		120	
METALS µg/L					
Aluminum	D	No ESV	USEPA NRWQC; MDEQ (2017)	No ESV	USEPA NRWQC; MDEQ (2017)
	T	87		87	
Antimony	D	30	GLWQI Tier II Values	30	GLWQI Tier II Values
	T	No ESV		No ESV	
Arsenic	D	3.1	GLWQI Tier II Values	150	USEPA NRWQC; MDEQ (2017)
	T	No ESV		No ESV	
Barium	D	4	GLWQI Tier II Values	4	GLWQI Tier II Values
	T	No ESV		No ESV	
Beryllium	D	0.66	GLWQI Tier II Values	0.66	GLWQI Tier II Values
	T	No ESV		No ESV	
Cadmium	D	0.09	CCME (2008)	0.72	USEPA NRWQC - Hardness Adjusted ¹
	T	No ESV		0.27	MDEQ (2017) - Hardness Adjusted ¹
Calcium	D	116000	ORNL SW Tox Benchmarks	116000	ORNL SW Tox Benchmarks
	T	No ESV		No ESV	
Chromium, Total	D	64.3	USEPA NRWQC	74.1	USEPA NRWQC - Hardness Adjusted ¹
	T	No ESV		86.18	MDEQ (2017) - Hardness Adjusted ¹
Cobalt	D	5.1	ORNL SW Tox Benchmarks	5.1	ORNL SW Tox Benchmarks
	T	No ESV		No ESV	
Copper	D	0.23	ORNL SW Tox Benchmarks	9.2	USEPA NRWQC - Hardness Adjusted ¹
	T	No ESV		9.33	MDEQ (2017) - Hardness Adjusted ¹
Iron	D	158	ORNL SW Tox Benchmarks	No ESV	USEPA NRWQC
	T	No ESV		1000	
Lead	D	No ESV	MDEQ (2017) - Hardness Adjusted ²	2.52	USEPA NRWQC - Hardness Adjusted ¹
	T	0.54		3.18	MDEQ (2017) - Hardness Adjusted ¹
Magnesium	D	82000	ORNL SW Tox Benchmarks	82000	ORNL SW Tox Benchmarks
	T	No ESV		No ESV	
Manganese	D	120	GLWQI Tier II Values	120	GLWQI Tier II Values
	T	No ESV		No ESV	
Mercury	D	0.026	USEPA Region 3 BTAG; CCME (2008)	0.77	USEPA NRWQC
	T	No ESV		No ESV	
Nickel	D	5	ORNL SW Tox Benchmarks	52.01	USEPA NRWQC - Hardness Adjusted ¹

Table A-2
Summary of Surface Water and Groundwater Ecological Screening Values (ESVs)
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Fraction ³	Surface Water Ecological Screening Value (ESVs)			
		SLERA ESV	Source	Preliminary BERA ESV	Source
	T	No ESV	ORNL SW Tox Benchmarks	52.16	MDEQ (2017) - Hardness Adjusted ¹
Potassium	D	53000	ORNL SW Tox Benchmarks	53000	ORNL SW Tox Benchmarks
	T	No ESV		No ESV	
Selenium	D	1	USEPA Region 3 BTAG	No ESV	MDEQ (2017)
	T	No ESV		5	
Silver	D	0.067	USEPA NRWQC (2004)	0.12	ORNL SW Tox Benchmarks
	T	No ESV		No ESV	
Sodium	D	680000	ORNL SW Tox Benchmarks	680000	ORNL SW Tox Benchmarks
	T	No ESV		No ESV	
Thallium	D	0.8	USEPA Region 3 BTAG; CCME (2008)	0.8	USEPA Region 3 BTAG; CCME (2008)
	T	No ESV		No ESV	
Vanadium	D	20	GLWQI Tier II Values	20	GLWQI Tier II Values
	T	No ESV		No ESV	
Zinc	D	30	ORNL SW Tox Benchmarks	118.1	USEPA NRWQC - Hardness Adjusted ¹
	T	No ESV		119.8	MDEQ (2017) - Hardness Adjusted ¹
PESTICIDES µg/L					
Endrin	T	0.0023	CCME (2008)	0.036	MDEQ (2017); USEPA NRWQC
Aldrin	T	0.004	CCME (2008)	0.3	USEPA NRWQC
Alpha Bhc (Alpha Hexachlorocyclohexane)	T	2.2	GLWQI Tier II Values	2.2	GLWQI Tier II Values
Alpha Endosulfan	T	0.003	CCME (2008)	0.056	MDEQ (2017); USEPA NRWQC
Beta Bhc (Beta Hexachlorocyclohexane)	T	2.2	GLWQI Tier II Values	2.2	GLWQI Tier II Values
Beta Endosulfan	T	0.051	GLWQI Tier II Values	0.056	MDEQ (2017); USEPA NRWQC
cis-Chlordane	T	0.0043	MDEQ (2017); USEPA NRWQC	0.0043	MDEQ (2017); USEPA NRWQC
Delta BHC (Delta Hexachlorocyclohexane)	T	2.2	GLWQI Tier II Values	2.2	GLWQI Tier II Values
Dieldrin	T	0.056	MDEQ (2017); USEPA NRWQC	0.056	MDEQ (2017); USEPA NRWQC
Endosulfan Sulfate	T	0.051	GLWQI Tier II Values	0.056	USEPA NRWQC
Endrin	T	0.0023	MDEQ (2017); USEPA NRWQC	0.036	MDEQ (2017); USEPA NRWQC
Endrin Aldehyde	T	0.036	USEPA NRWQC	0.036	USEPA NRWQC
Endrin Ketone	T	0.036	USEPA NRWQC	0.036	USEPA NRWQC
Gamma Bhc (Lindane)	T	0.01	USEPA Region 3 BTAG	0.095	MDEQ (2017); USEPA NRWQC
Heptachlor	T	0.0019	USEPA Region 3 BTAG	0.0038	MDEQ (2017); USEPA NRWQC
Heptachlor Epoxide	T	0.0019	USEPA Region 3 BTAG	0.0038	MDEQ (2017); USEPA NRWQC
Methoxychlor	T	0.019	GLWQI Tier II Values	0.03	MDEQ (2017); USEPA NRWQC
P,P'-DDD	T	0.001	CCME (2008)	0.001	CCME (2008)
P,P'-DDE	T	0.001	CCME (2008)	0.001	CCME (2008)
P,P'-DDT	T	0.0005	USEPA Region 3 BTAG	0.001	MDEQ (2017); USEPA NRWQC
Toxaphene	T	0.0002	MDEQ (2017); USEPA NRWQC	0.0002	MDEQ (2017); USEPA NRWQC
trans-Chlordane	T	0.0043	MDEQ (2017); USEPA NRWQC	0.0043	MDEQ (2017); USEPA NRWQC
POLYCHLORINATED BIPHENYLS µg/L					

Table A-2
Summary of Surface Water and Groundwater Ecological Screening Values (ESVs)
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Fraction ³	Surface Water Ecological Screening Value (ESVs)			
		SLERA ESV	Source	Preliminary BERA ESV	Source
PCB-1016 (Aroclor 1016)	T	0.000074	USEPA Region 3 BTAG	0.014	MDEQ (2017)
PCB-1221 (Aroclor 1221)	T	0.000074	USEPA Region 3 BTAG	0.014	MDEQ (2017)
PCB-1232 (Aroclor 1232)	T	0.000074	USEPA Region 3 BTAG	0.014	MDEQ (2017)
PCB-1242 (Aroclor 1242)	T	0.000074	USEPA Region 3 BTAG	0.014	MDEQ (2017)
PCB-1248 (Aroclor 1248)	T	0.000074	USEPA Region 3 BTAG	0.014	MDEQ (2017)
PCB-1254 (Aroclor 1254)	T	0.000074	USEPA Region 3 BTAG	0.014	MDEQ (2017)
PCB-1260 (Aroclor 1260)	T	0.000074	USEPA Region 3 BTAG	0.014	MDEQ (2017)
PCB-1262 (Aroclor 1262)	T	No ESV	---	No ESV	---
PCB-1268 (Aroclor 1268)	T	0.014	MDEQ (2017)	0.014	MDEQ (2017)
Polychlorinated Biphenyl (PCBs)	T	0.000074	USEPA Region 3 BTAG	0.014	MDEQ (2017); USEPA NRWQC
POLYCYCLIC AROMATIC HYDROCARBONS µg/L					
2-Methylnaphthalene	T	4.7	USEPA Region 3 BTAG	4.7	USEPA Region 3 BTAG
Acenaphthene	T	5.8	USEPA Region 3 BTAG	5.8	USEPA Region 3 BTAG
Acenaphthylene	T	No ESV	---	No ESV	---
Anthracene	T	0.012	USEPA Region 3 BTAG	0.012	USEPA Region 3 BTAG
Benzo(A)Anthracene	T	0.018	USEPA Region 3 BTAG	0.018	USEPA Region 3 BTAG
Benzo(A)Pyrene	T	0.014	GLWQI Tier II Values	0.014	GLWQI Tier II Values
Benzo(B)Fluoranthene	T	No ESV	---	No ESV	---
Benzo(G,H,I)Perylene	T	No ESV	---	No ESV	---
Benzo(K)Fluoranthene	T	No ESV	---	No ESV	---
Chrysene	T	No ESV	---	No ESV	---
Dibenz(A,H)Anthracene	T	No ESV	---	No ESV	---
Fluoranthene	T	0.04	USEPA Region 3 BTAG	0.04	USEPA Region 3 BTAG
Fluorene	T	3	USEPA Region 3 BTAG	3	USEPA Region 3 BTAG
Indeno(1,2,3-C,D)Pyrene	T	No ESV	---	No ESV	---
Naphthalene	T	1.1	USEPA Region 3 BTAG	1.1	USEPA Region 3 BTAG
Phenanthrene	T	0.4	USEPA Region 3 BTAG	0.4	USEPA Region 3 BTAG
Pyrene	T	0.025	USEPA Region 3 BTAG	0.025	USEPA Region 3 BTAG
OTHER SEMIVOLATILE ORGANIC COMPOUNDS µg/L					
1,2,4,5-Tetrachlorobenzene	T	3	USEPA Region 3 BTAG	3	USEPA Region 3 BTAG
1,4-Dioxane (P-Dioxane)	T	No ESV	---	No ESV	---
2,3,4,6-Tetrachlorophenol	T	1	CCME WQG	1	CCME WQG
2,4,5-Trichlorophenol	T	No ESV	---	No ESV	---
2,4,6-Trichlorophenol	T	4.9	USEPA Region 3 BTAG	4.9	USEPA Region 3 BTAG
2,4-Dichlorophenol	T	11	USEPA Region 3 BTAG	11	USEPA Region 3 BTAG
2,4-Dimethylphenol	T	No ESV	---	No ESV	---
2,4-Dinitrophenol	T	No ESV	---	No ESV	---
2,4-Dinitrotoluene	T	44	USEPA Region 3 BTAG	44	USEPA Region 3 BTAG
2,6-Dinitrotoluene	T	81	USEPA Region 3 BTAG	81	USEPA Region 3 BTAG

Table A-2
Summary of Surface Water and Groundwater Ecological Screening Values (ESVs)
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Fraction ³	Surface Water Ecological Screening Value (ESVs)			
		SLERA ESV	Source	Preliminary BERA ESV	Source
2-Chloronaphthalene	T	No ESV	---	No ESV	---
2-Chlorophenol	T	24	USEPA Region 3 BTAG	24	USEPA Region 3 BTAG
2-Methylphenol (O-Cresol)	T	13	USEPA Region 3 BTAG	13	USEPA Region 3 BTAG
2-Nitroaniline	T	No ESV	---	No ESV	---
2-Nitrophenol	T	300	GLWQI Tier II Values	300	GLWQI Tier II Values
3,3'-Dichlorobenzidine	T	4.5	USEPA Region 3 BTAG	4.5	USEPA Region 3 BTAG
3- And 4- Methylphenol (Total)	T	No ESV	---	No ESV	---
3-Nitroaniline	T	No ESV	---	No ESV	---
4,6-Dinitro-2-Methylphenol	T	No ESV	---	No ESV	---
4-Bromophenyl Phenyl Ether	T	1.5	USEPA Region 3 BTAG	1.5	USEPA Region 3 BTAG
4-Chloro-3-Methylphenol	T	No ESV	---	No ESV	---
4-Chloroaniline	T	232	USEPA Region 3 BTAG	232	USEPA Region 3 BTAG
4-Chlorophenyl Phenyl Ether	T	No ESV	---	No ESV	---
4-Nitroaniline	T	No ESV	---	No ESV	---
4-Nitrophenol	T	60	USEPA Region 3 BTAG	60	USEPA Region 3 BTAG
Acetophenone	T	No ESV	---	No ESV	---
Atrazine	T	1.8	USEPA Region 3 BTAG	1.8	USEPA Region 3 BTAG
Benzaldehyde	T	No ESV	---	No ESV	---
Benzyl Butyl Phthalate	T	19	USEPA Region 3 BTAG	19	USEPA Region 3 BTAG
Biphenyl (Diphenyl)	T	14	USEPA Region 3 BTAG	14	USEPA Region 3 BTAG
Bis(2-Chloroethoxy) Methane	T	No ESV	---	No ESV	---
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	T	No ESV	---	No ESV	---
Bis(2-Chloroisopropyl) Ether	T	No ESV	---	No ESV	---
Bis(2-Ethylhexyl) Phthalate	T	3	GLWQI Tier II Values	3	GLWQI Tier II Values
Caprolactam	T	No ESV	---	No ESV	---
Carbazole	T	No ESV	---	No ESV	---
Di-N-Butyl Phthalate	T	19	USEPA Region 3 BTAG	19	USEPA Region 3 BTAG
Di-N-Octylphthalate	T	22	USEPA Region 3 BTAG	22	USEPA Region 3 BTAG
Dibenzofuran	T	3.7	USEPA Region 3 BTAG	3.7	USEPA Region 3 BTAG
Diethyl Phthalate	T	210	USEPA Region 3 BTAG	210	USEPA Region 3 BTAG
Dimethyl Phthalate	T	No ESV	---	No ESV	---
Hexachlorobenzene	T	0.0003	USEPA Region 3 BTAG	0.0003	USEPA Region 3 BTAG
Hexachlorobutadiene	T	1.3	USEPA Region 3 BTAG	1.3	USEPA Region 3 BTAG
Hexachlorocyclopentadiene	T	No ESV	---	No ESV	---
Hexachloroethane	T	12	USEPA Region 3 BTAG	12	USEPA Region 3 BTAG
Isophorone	T	No ESV	---	No ESV	---
N-Nitrosodi-N-Propylamine	T	No ESV	---	No ESV	---
N-Nitrosodiphenylamine	T	210	USEPA Region 3 BTAG	210	USEPA Region 3 BTAG
Nitrobenzene	T	No ESV	---	No ESV	---

Table A-2
Summary of Surface Water and Groundwater Ecological Screening Values (ESVs)
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Fraction ³	Surface Water Ecological Screening Value (ESVs)			
		SLERA ESV	Source	Preliminary BERA ESV	Source
Pentachlorophenol	T	0.5	USEPA Region 3 BTAG	4	MDEQ (2017)
Phenol	T	4	USEPA Region 3 BTAG	4	USEPA Region 3 BTAG
VOLATILE ORGANIC COMPOUNDS µg/L					
1,1,1-Trichloroethane	T	11	USEPA Region 3 BTAG	11	USEPA Region 3 BTAG
1,1,2,2-Tetrachloroethane	T	610	USEPA Region 3 BTAG	610	USEPA Region 3 BTAG
1,1,2-Trichloro-1,2,2-Trifluoroethane	T	No ESV	---	No ESV	---
1,1,2-Trichloroethane	T	1200	USEPA Region 3 BTAG	1200	USEPA Region 3 BTAG
1,1-Dichloroethane	T	47	USEPA Region 3 BTAG	47	USEPA Region 3 BTAG
1,1-Dichloroethene	T	25	USEPA Region 3 BTAG	25	USEPA Region 3 BTAG
1,2,3-Trichlorobenzene	T	8	CCME WQG	8	CCME WQG
1,2,4-Trichlorobenzene	T	24	USEPA Region 3 BTAG	24	USEPA Region 3 BTAG
1,2-Dibromo-3-Chloropropane	T	No ESV	---	No ESV	---
1,2-Dibromoethane (Ethylene Dibromide)	T	No ESV	---	No ESV	---
1,2-Dichlorobenzene	T	0.7	USEPA Region 3 BTAG	0.7	USEPA Region 3 BTAG
1,2-Dichloroethane	T	100	USEPA Region 3 BTAG	100	USEPA Region 3 BTAG
1,2-Dichloropropane	T	No ESV	---	No ESV	---
1,3-Dichlorobenzene	T	71	GLWQI Tier II Values	71	GLWQI Tier II Values
1,4-Dichlorobenzene	T	15	GLWQI Tier II Values	15	GLWQI Tier II Values
2-Hexanone	T	99	USEPA Region 3 BTAG	99	USEPA Region 3 BTAG
Acetone	T	1500	USEPA Region 3 BTAG	1500	USEPA Region 3 BTAG
Benzene	T	130	GLWQI Tier II Values	130	GLWQI Tier II Values
Bromochloromethane	T	No ESV	---	No ESV	---
Bromodichloromethane	T	No ESV	---	No ESV	---
Bromoform	T	320	USEPA Region 3 BTAG	320	USEPA Region 3 BTAG
Bromomethane	T	No ESV	---	No ESV	---
Carbon Disulfide	T	0.92	USEPA Region 3 BTAG	0.92	USEPA Region 3 BTAG
Carbon Tetrachloride	T	9.8	GLWQI Tier II Values	9.8	GLWQI Tier II Values
Chlorobenzene	T	1.3	USEPA Region 3 BTAG	1.3	USEPA Region 3 BTAG
Chloroethane	T	No ESV	---	No ESV	---
Chloroform	T	1.8	USEPA Region 3 BTAG	1.8	USEPA Region 3 BTAG
Chloromethane	T	No ESV	---	No ESV	---
Cis-1,2-Dichloroethylene	T	590	GLWQI Tier II Values	590	GLWQI Tier II Values
Cis-1,3-Dichloropropene	T	0.055	GLWQI Tier II Values	0.055	GLWQI Tier II Values
Cyclohexane	T	No ESV	---	No ESV	---
Dibromochloromethane	T	No ESV	---	No ESV	---
Dichlorodifluoromethane	T	No ESV	---	No ESV	---
Ethylbenzene	T	7.3	GLWQI Tier II Values	7.3	GLWQI Tier II Values
Isopropylbenzene (Cumene)	T	2.6	USEPA Region 3 BTAG	2.6	USEPA Region 3 BTAG
M,P-Xylene	T	1.8	GLWQI Tier II Values	1.8	GLWQI Tier II Values

Table A-2
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Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Fraction ³	Surface Water Ecological Screening Value (ESVs)			
		SLERA ESV	Source	Preliminary BERA ESV	Source
Methyl Acetate	T	No ESV	---	No ESV	---
Methyl Ethyl Ketone (2-Butanone)	T	14000	GLWQI Tier II Values	14000	GLWQI Tier II Values
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	T	170	USEPA Region 3 BTAG	170	USEPA Region 3 BTAG
Methylcyclohexane	T	No ESV	---	No ESV	---
Methylene Chloride	T	98.1	USEPA Region 3 BTAG	98.1	USEPA Region 3 BTAG
O-Xylene (1,2-Dimethylbenzene)	T	13	GLWQI Tier II Values	13	GLWQI Tier II Values
Styrene	T	72	USEPA Region 3 BTAG	72	USEPA Region 3 BTAG
Tert-Butyl Methyl Ether	T	10000	CCME WQG	10000	CCME WQG
Tetrachloroethylene (PCE)	T	98	GLWQI Tier II Values	98	GLWQI Tier II Values
Toluene	T	2	USEPA Region 3 BTAG	2	USEPA Region 3 BTAG
Trans-1,2-Dichloroethene	T	590	GLWQI Tier II Values	590	GLWQI Tier II Values
Trans-1,3-Dichloropropene	T	0.055	USEPA Region 3 BTAG	0.055	USEPA Region 3 BTAG
Trichloroethylene (TCE)	T	21	USEPA Region 3 BTAG	21	USEPA Region 3 BTAG
Trichlorofluoromethane	T	No ESV	---	No ESV	---
Vinyl Chloride	T	930	USEPA Region 3 BTAG	930	USEPA Region 3 BTAG

Notes:

No ESV, No ESV was identified for the constituent or fraction indicated.

GLWQI, Great Lakes Water Quality Initiative

ORNL, Oak Ridge National Laboratory

1, Hardness dependent criteria expressed at 100 mg/L hardness (as CaCO₃); sample-specific criteria will be calculated based on measured hardness values in each sample.

2, Hardness dependent criteria expressed at 25 mg/L hardness (as CaCO₃); sample-specific criteria will be calculated based on measured hardness values in each sample.

3, Fraction: T, total recoverable; D, dissolved based on a filtration through a 0.45-µm filter.

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Table A-3
Summary of Soil ESV Exceedances - Main Plant Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
METALS mg/kg											
Aluminum	140	140	140 / 140	0.81	20.6	5540	51200	50	140		
Antimony	34	140	34 / 140	0.018	0.54	0.11	8.6	0.142	29	0.27	20
Arsenic	140	140	140 / 140	0.034	0.58	1.6	31.3	0.25	140	11.4	3
Barium	140	140	140 / 140	0.29	0.87	32.6	392	1.04	140	195	18
Beryllium	140	140	140 / 140	0.014	0.17	0.16	1.5	1.06	3	2.5	0
Cadmium	42	140	42 / 140	0.0048	0.41	0.082	1.7	0.00222	42	0.36	20
Calcium	140	140	140 / 140	27.2	46.9	1700	81500				
Chromium, Total	140	140	140 / 140	0.079	1	5.3	74.2	0.34	140	26	11
Cobalt	140	140	140 / 140	0.0022	1	2.8	13.5	0.14	140	13	1
Copper	140	140	140 / 140	0.13	0.88	5.6	887	5.4	140	28	15
Iron	140	140	140 / 140	4.2	34	6170	66700				
Lead	154	154	154 / 154	0.059	0.92	2.9	184	0.0537	154	15.3	57
Magnesium	140	140	140 / 140	5.2	47.1	4610	27500				
Manganese	140	140	140 / 140	0.16	2.1	161	1270	220	135	508	27
Mercury	108	140	108 / 140	0.011	0.019	0.012	0.058	0.005	108	0.05	1
Nickel	140	140	140 / 140	0.051	1	6.3	140	9.7	123	38	16
Potassium	140	140	140 / 140	6.4	44.6	324	2110				
Selenium	35	140	35 / 140	0.052	0.5	0.33	2.6	0.0276	35	0.52	31
Silver	29	140	29 / 140	0.0018	0.99	0.029	1.3	2	0	2	0
Sodium	103	140	103 / 140	11.4	50.3	31.3	3350				
Thallium	28	140	28 / 140	0.025	0.2	0.079	0.22	0.027	28	0.25	0
Vanadium	140	140	140 / 140	0.048	1	4.4	44.5	0.714	140	30.9	3
Zinc	140	140	140 / 140	0.66	3.2	22.2	1720	6.62	140	60.5	40
GENERAL CHEMISTRY mg/kg											
Cyanide	128	140	128 / 140	0.014	0.033	0.017	2.4	0.1	49	0.183148	30
Fluoride	140	140	140 / 140	0.19	3.97	1.55	709	6.5	135	30	98
DIOXIN/FURAN mg/kg											
1,2,3,4,6,7,8-Heptachlorodibenzofuran	26	26	26 / 26	1.40E-08	1.47E-06	1.40E-07	6.64E-05				
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	26	26	26 / 26	1.80E-08	4.42E-06	1.90E-07	3.12E-04				
1,2,3,4,7,8,9-Heptachlorodibenzofuran	14	26	14 / 26	1.60E-08	1.89E-06	4.10E-08	1.77E-06				
1,2,3,4,7,8-Hexachlorodibenzofuran	19	26	19 / 26	1.70E-08	1.20E-06	4.80E-08	9.63E-06				
1,2,3,4,7,8-Hexachlorodibenzo-P-Dioxin	13	26	13 / 26	1.50E-08	5.40E-07	3.70E-08	3.42E-06				
1,2,3,6,7,8-Hexachlorodibenzofuran	16	26	16 / 26	1.50E-08	1.09E-06	4.40E-08	2.86E-06				
1,2,3,6,7,8-Hexachlorodibenzo-P-Dioxin	21	26	21 / 26	1.40E-08	5.30E-07	7.50E-08	1.08E-05				
1,2,3,7,8,9-Hexachlorodibenzofuran	2	26	2 / 26	1.60E-08	1.22E-06	5.20E-08	7.70E-08				
1,2,3,7,8,9-Hexachlorodibenzo-P-Dioxin	25	26	25 / 26	1.20E-08	4.60E-07	6.10E-08	5.14E-06				
1,2,3,7,8-Pentachlorodibenzofuran	10	26	10 / 26	1.50E-08	4.80E-07	1.10E-07	2.10E-06				
1,2,3,7,8-Pentachlorodibenzo-P-Dioxin	6	26	6 / 26	1.80E-08	6.90E-07	2.80E-08	1.21E-06				

Table A-3
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Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
2,3,4,6,7,8-Hexachlorodibenzofuran	13	26	13 / 26	1.60E-08	1.17E-06	3.10E-08	4.58E-06				
2,3,4,7,8-Pentachlorodibenzofuran	10	26	10 / 26	1.50E-08	4.90E-07	6.50E-08	1.88E-06				
2,3,7,8-Tetrachlorodibenzofuran	20	26	20 / 26	1.40E-08	1.60E-06	4.80E-08	5.26E-06				
2,3,7,8-Tetrachlorodibenzo-P-Dioxin	4	26	4 / 26	1.60E-08	5.80E-07	1.10E-07	5.80E-07				
Heptachlorodibenzofurans	26	26	26 / 26	1.50E-08	1.68E-06	2.50E-07	2.39E-04				
Heptachlorodibenzo-p-dioxins (HpCDD), Total	26	26	26 / 26	1.80E-08	4.42E-06	4.60E-07	5.58E-04				
Hexachlorodibenzofuran	24	26	24 / 26	1.60E-08	1.17E-06	4.40E-08	1.78E-04				
Hexachlorodibenzo-P-Dioxin	25	26	25 / 26	1.40E-08	5.10E-07	6.20E-08	3.98E-05				
Octachlorodibenzofuran	26	26	26 / 26	1.20E-08	5.90E-07	1.80E-07	9.72E-05				
Octachlorodibenzo-P-Dioxin	26	26	26 / 26	2.20E-08	3.74E-06	2.07E-06	4.35E-03				
Pentachlorinated Dibenzo-P-Dioxins, (Total)	7	26	7 / 26	1.80E-08	6.90E-07	6.50E-08	4.67E-06				
Pentachloro Dibenzofuran	21	26	21 / 26	1.50E-08	4.80E-07	1.30E-07	2.27E-05				
Tetrachlorinated Dibenzofurans, (Total)	23	26	23 / 26	1.40E-08	5.20E-07	4.70E-08	2.41E-05				
Tetrachlorodibenzo-P-Dioxin	14	26	14 / 26	1.60E-08	5.80E-07	3.20E-08	5.61E-06				
PESTICIDES mg/kg											
Aldrin	0	31	0 / 31	0.00078	0.0013			0.00332	0	0.00332	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	31	0 / 31	0.00059	0.00097			0.0994	0	0.0994	0
Alpha Endosulfan	0	31	0 / 31	0.0009	0.0015			0.119	0	0.119	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	31	0 / 31	0.00063	0.001			0.00398	0	0.00398	0
Beta Endosulfan	0	31	0 / 31	0.001	0.0017			0.119	0	0.119	0
cis-Chlordane	0	31	0 / 31	0.0011	0.0017			0.27	0	0.27	0
Delta BHC (Delta Hexachlorocyclohexane)	0	31	0 / 31	0.0007	0.0012			0.1	0	0.1	0
Dieldrin	0	31	0 / 31	0.00084	0.0014			0.00238	0	0.00238	0
Endosulfan Sulfate	0	31	0 / 31	0.00075	0.0012			0.0358	0	0.0358	0
Endrin	0	31	0 / 31	0.00082	0.0013			0.0014	0	0.0014	0
Endrin Aldehyde	0	31	0 / 31	0.0008	0.0013			0.0105	0	0.0105	0
Endrin Ketone	0	31	0 / 31	0.0009	0.0015						
Gamma Bhc (Lindane)	0	31	0 / 31	0.00058	0.00095			0.005	0	0.005	0
Heptachlor	0	31	0 / 31	0.00083	0.0014			0.059	0	0.059	0
Heptachlor Epoxide	0	31	0 / 31	0.0013	0.0021			0.152	0	0.152	0
Methoxychlor	0	31	0 / 31	0.0014	0.0023			5	0	5	0
P,P'-DDD	0	31	0 / 31	0.00085	0.0014			0.00488	0	0.00488	0
P,P'-DDE	0	31	0 / 31	0.00094	0.0015			0.021	0	0.021	0
P,P'-DDT	0	31	0 / 31	0.00067	0.0011			0.0035	0	0.0035	0
Toxaphene	0	31	0 / 31	0.019	0.031			0.119	0	0.119	0
trans-Chlordane	0	31	0 / 31	0.0014	0.0023			2.2	0	2.2	0
POLYCHLORINATED BIPHENYLS mg/kg											
PCB-1016 (Aroclor 1016)	0	140	0 / 140	0.0086	0.014			1	0	1	0
PCB-1221 (Aroclor 1221)	0	140	0 / 140	0.0086	0.014						

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Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
PCB-1232 (Aroclor 1232)	0	140	0 / 140	0.0086	0.014						
PCB-1242 (Aroclor 1242)	0	140	0 / 140	0.0086	0.014			0.041	0	0.041	0
PCB-1248 (Aroclor 1248)	0	140	0 / 140	0.0086	0.014			0.0072	0	0.0072	0
PCB-1254 (Aroclor 1254)	0	140	0 / 140	0.0089	0.015			0.041	0	0.041	0
PCB-1260 (Aroclor 1260)	0	140	0 / 140	0.0089	0.015			0.88	0	0.88	0
PCB-1262 (Aroclor 1262)	0	140	0 / 140	0.0089	0.015						
PCB-1268 (Aroclor 1268)	0	140	0 / 140	0.0089	0.015						
Polychlorinated Biphenyl (PCBs)	0	140	0 / 140	0.0089	0.015			40	0	40	0
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg											
Benzo(A)Anthracene	124	140	124 / 140	0.027	1.5	0.029	110	0.8	57		
Benzo(A)Pyrene	132	140	132 / 140	0.0096	0.54	0.012	130	1.52	49		
Benzo(B)Fluoranthene	134	140	134 / 140	0.012	0.69	0.017	150	18	11		
Benzo(G,H,I)Perylene	128	140	128 / 140	0.018	1	0.022	99	24	6		
Benzo(K)Fluoranthene	120	140	120 / 140	0.014	0.77	0.018	68	62	1		
Chrysene	134	140	134 / 140	0.0087	0.48	0.012	130	2.4	41		
Dibenz(A,H)Anthracene	107	140	107 / 140	0.017	0.92	0.024	28	12	2		
Indeno(1,2,3-C,D)Pyrene	127	140	127 / 140	0.021	1.2	0.023	100	62	2		
Pyrene	133	140	133 / 140	0.014	0.81	0.018	220	10	17		
Total High Molecular Weight PAHs	134	140	134 / 140			0.044	1035			1.1	105
2-Methylnaphthalene	66	140	66 / 140	0.007	0.39	0.0079	1.7	3.24	0		
Acenaphthene	107	140	107 / 140	0.0077	0.43	0.0093	15	0.25	33		
Acenaphthylene	14	140	14 / 140	0.0082	0.46	0.01	0.048	120	0		
Anthracene	92	140	92 / 140	0.03	1.7	0.033	22	6.8	5		
Fluoranthene	134	140	134 / 140	0.0094	0.53	0.013	170	10	17		
Fluorene	100	140	100 / 140	0.0069	0.39	0.0085	10	3.7	1		
Naphthalene	82	140	82 / 140	0.0081	0.45	0.009	4	0.0994	27		
Phenanthrene	133	140	133 / 140	0.0085	0.47	0.012	120	5.5	22		
Total Low Molecular Weight PAHs	134	140	134 / 140			0.013	341.4			29	12
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg											
1,2,4,5-Tetrachlorobenzene	0	140	0 / 140	0.024	1.3			2.02	0	2.02	0
1,4-Dioxane (P-Dioxane)	0	140	0 / 140	0.085	4.7			1.83	0	1.83	0
2,3,4,6-Tetrachlorophenol	0	140	0 / 140	0.03	1.7						
2,4,5-Trichlorophenol	0	140	0 / 140	0.032	1.8			4	0	4	0
2,4,6-Trichlorophenol	0	140	0 / 140	0.0091	0.5			9.94	0	9.94	0
2,4-Dichlorophenol	0	140	0 / 140	0.0075	0.42			87.5	0	87.5	0
2,4-Dimethylphenol	0	140	0 / 140	0.07	3.9			0.01	0	0.01	0
2,4-Dinitrophenol	0	140	0 / 140	0.24	13			0.0609	0	0.0609	0
2,4-Dinitrotoluene	0	140	0 / 140	0.013	0.7			1.28	0	1.28	0
2,6-Dinitrotoluene	0	140	0 / 140	0.017	0.94			0.0328	0	0.0328	0

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								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
2-Chloronaphthalene	0	140	0 / 140	0.0072	0.4			0.0122	0	0.0122	0
2-Chlorophenol	0	140	0 / 140	0.0081	0.45			0.243	0	0.243	0
2-Methylphenol (O-Cresol)	0	140	0 / 140	0.014	0.77			0.67	0	0.67	0
2-Nitroaniline	0	140	0 / 140	0.011	0.59			5.4	0	5.4	0
2-Nitrophenol	0	140	0 / 140	0.011	0.6			1.6	0	1.6	0
3- And 4- Methylphenol (Total)	5	140	5 / 140	0.0085	0.47	0.011	0.036				
3,3'-Dichlorobenzidine	0	140	0 / 140	0.036	2			0.646	0	0.646	0
3-Nitroaniline	0	140	0 / 140	0.0094	0.53			3.16	0	3.16	0
4,6-Dinitro-2-Methylphenol	0	140	0 / 140	0.085	4.7			0.144	0	0.144	0
4-Bromophenyl Phenyl Ether	0	140	0 / 140	0.01	0.56						
4-Chloro-3-Methylphenol	0	140	0 / 140	0.014	0.76						
4-Chloroaniline	0	140	0 / 140	0.0082	0.46			1	0	1	0
4-Chlorophenyl Phenyl Ether	0	140	0 / 140	0.0095	0.53						
4-Nitroaniline	0	140	0 / 140	0.012	0.67			21.9	0	21.9	0
4-Nitrophenol	0	140	0 / 140	0.15	8.5			7	0	7	0
Acetophenone	5	140	5 / 140	0.0069	0.39	0.0076	0.046	300	0	300	0
Atrazine	0	140	0 / 140	0.014	0.79						
Benzaldehyde	1	140	1 / 140	0.024	1.4	0.037	0.037				
Benzyl Butyl Phthalate	37	140	37 / 140	0.0098	0.55	0.013	5.6	0.239	11	0.239	11
Biphenyl (Diphenyl)	4	140	4 / 140	0.027	1.5	0.034	0.11	60	0	60	0
Bis(2-Chloroethoxy) Methane	0	140	0 / 140	0.0099	0.55			0.302	0	0.302	0
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	140	0 / 140	0.0075	0.42			23.7	0	23.7	0
Bis(2-Chloroisopropyl) Ether	0	140	0 / 140	0.013	0.73			19.9	0	19.9	0
Bis(2-Ethylhexyl) Phthalate	45	140	45 / 140	0.012	0.69	0.016	5.8	0.02	42	0.02	42
Caprolactam	0	140	0 / 140	0.023	1.3						
Carbazole	110	140	110 / 140	0.0079	0.44	0.01	17	80	0	80	0
Dibenzofuran	78	140	78 / 140	0.0096	0.54	0.011	4.8	6.1	0	6.1	0
Diethyl Phthalate	0	140	0 / 140	0.0091	0.5			100	0	100	0
Dimethyl Phthalate	0	140	0 / 140	0.0093	0.52			10	0	10	0
Di-N-Butyl Phthalate	33	140	33 / 140	0.0095	0.53	0.011	0.19	0.011	32	0.011	32
Di-N-Octylphthalate	0	140	0 / 140	0.016	0.9			0.91	0	0.91	0
Hexachlorobenzene	1	140	1 / 140	0.013	0.72	0.091	0.091	0.079	1	0.079	1
Hexachlorobutadiene	0	140	0 / 140	0.009	0.5			0.0398	0	0.0398	0
Hexachlorocyclopentadiene	0	140	0 / 140	0.02	1.1			0.755	0	0.755	0
Hexachloroethane	0	140	0 / 140	0.012	0.65			0.596	0	0.596	0
Isophorone	9	140	9 / 140	0.0068	0.38	0.0099	3.3	139	0	139	0
Nitrobenzene	0	140	0 / 140	0.01	0.56			1.31	0	1.31	0
N-Nitrosodi-N-Propylamine	0	140	0 / 140	0.011	0.6			0.544	0	0.544	0
N-Nitrosodiphenylamine	0	140	0 / 140	0.029	1.6			0.545	0	0.545	0

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								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Pentachlorophenol	5	139	5 / 139	0.039	2.1	0.1	0.53	0.119	4	0.119	4
Phenol	4	140	4 / 140	0.01	0.58	0.016	0.033	0.79	0	0.79	0
VOLATILE ORGANIC COMPOUNDS mg/kg											
1,1,1-Trichloroethane	0	60	0 / 60	0.00027	0.001			29.8	0	29.8	0
1,1,2,2-Tetrachloroethane	0	60	0 / 60	0.00012	0.00046			225	0	225	0
1,1,2-Trichloro-1,2,2-Trifluoroethane	0	60	0 / 60	0.00032	0.0012						
1,1,2-Trichloroethane	0	60	0 / 60	0.0002	0.00076			28.6	0	28.6	0
1,1-Dichloroethane	0	60	0 / 60	0.00024	0.00092			20.1	0	20.1	0
1,1-Dichloroethene	0	60	0 / 60	0.00029	0.0011			8.28	0	8.28	0
1,2,3-Trichlorobenzene	0	60	0 / 60	0.000079	0.0003			11.1	0	11.1	0
1,2,4-Trichlorobenzene	0	60	0 / 60	0.00023	0.00087			0.27	0	0.27	0
1,2-Dibromo-3-Chloropropane	0	60	0 / 60	0.00034	0.0013			0.0352	0	0.0352	0
1,2-Dibromoethane (Ethylene Dibromide)	0	60	0 / 60	0.000086	0.00032			1.23	0	1.23	0
1,2-Dichlorobenzene	0	60	0 / 60	0.0001	0.00038			0.92	0	0.92	0
1,2-Dichloroethane	1	60	1 / 60	0.000079	0.0003	0.00014	0.00014	0.85	0	0.85	0
1,2-Dichloropropane	0	60	0 / 60	0.00012	0.00046			32.7	0	32.7	0
1,3-Dichlorobenzene	0	60	0 / 60	0.000086	0.00032			0.73	0	0.73	0
1,4-Dichlorobenzene	0	60	0 / 60	0.000093	0.00035			0.88	0	0.88	0
2-Hexanone	1	60	1 / 60	0.00067	0.0025	0.0012	0.0012	0.36	0	0.36	0
Acetone	58	60	58 / 60	0.00076	0.0029	0.0055	0.11	1.2	0	1.2	0
Benzene	42	60	42 / 60	0.00014	0.00054	0.00019	0.0013	0.255	0	0.255	0
Bromochloromethane	0	60	0 / 60	0.00012	0.00046						
Bromodichloromethane	0	60	0 / 60	0.00027	0.001			0.54	0	0.54	0
Bromoform	0	60	0 / 60	0.000093	0.00035			15.9	0	15.9	0
Bromomethane	1	60	1 / 60	0.00023	0.00087	0.0011	0.0011				
Carbon Disulfide	35	60	35 / 60	0.00031	0.0012	0.00038	0.0028	0.0941	0	0.0941	0
Carbon Tetrachloride	0	60	0 / 60	0.00031	0.0012			2.98	0	2.98	0
Chlorobenzene	0	60	0 / 60	0.0001	0.00038			2.4	0	2.4	0
Chloroethane	0	60	0 / 60	0.00025	0.00095						
Chloroform	0	60	0 / 60	0.00015	0.00057			1.19	0	1.19	0
Chloromethane	0	60	0 / 60	0.00027	0.001						
Cis-1,2-Dichloroethylene	0	60	0 / 60	0.00016	0.0006			23	0	23	0
Cis-1,3-Dichloropropene	0	60	0 / 60	0.00011	0.00041			0.398	0	0.398	0
Cyclohexane	17	60	17 / 60	0.00033	0.0012	0.00039	0.0055				
Dibromochloromethane	0	60	0 / 60	0.00011	0.00041			2.05	0	2.05	0
Dichlorodifluoromethane	0	60	0 / 60	0.00023	0.00087			39.5	0	39.5	0
Ethylbenzene	17	60	17 / 60	0.00013	0.00049	0.00017	0.0011	5.16	0	5.16	0
Isopropylbenzene (Cumene)	1	60	1 / 60	0.00012	0.00046	0.0003	0.0003				
M,P-Xylene	40	60	40 / 60	0.000079	0.0003	0.000091	0.0042				

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								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Methyl Acetate	10	60	10 / 60	0.00065	0.0024	0.0016	0.32				
Methyl Ethyl Ketone (2-Butanone)	23	60	23 / 60	0.00055	0.0021	0.0012	0.014	360	0	360	0
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	1	60	1 / 60	0.0016	0.006	0.0043	0.0043	9.8	0	9.8	0
Methylcyclohexane	28	60	28 / 60	0.00036	0.0014	0.00047	0.0076				
Methylene Chloride	3	60	3 / 60	0.00023	0.00087	0.00068	0.0027	2.6	0	2.6	0
O-Xylene (1,2-Dimethylbenzene)	20	60	20 / 60	0.00011	0.00043	0.00015	0.0051				
Styrene	1	60	1 / 60	0.00011	0.00041	0.0003	0.0003	1.2	0	1.2	0
Tert-Butyl Methyl Ether	0	60	0 / 60	0.00012	0.00046						
Tetrachloroethylene (PCE)	1	60	1 / 60	0.0002	0.00076	0.00033	0.00033	0.18	0	0.18	0
Toluene	51	60	51 / 60	0.00014	0.00051	0.00016	0.012	5.45	0	5.45	0
Trans-1,2-Dichloroethene	0	60	0 / 60	0.00028	0.0011			23	0	23	0
Trans-1,3-Dichloropropene	0	60	0 / 60	0.000072	0.00027			0.398	0	0.398	0
Trichloroethylene (TCE)	0	60	0 / 60	0.00019	0.0007			1.387	0	1.387	0
Trichlorofluoromethane	0	60	0 / 60	0.00024	0.00092			16.4	0	16.4	0
Vinyl Chloride	0	60	0 / 60	0.00028	0.0011			0.12	0	0.12	0

Notes:

All soil samples from the 0-2' depth interval within the Main Plant exposure area included in screening assessment.

Quantitation limit used as the detection limit.

Concentration results evaluated against SLERA and BERA soil ESVs.

Total high molecular weight PAHs = sum of PAHs with four or more benzene rings.

Total low molecular weight PAHs = sum of PAHs with less than four benzene rings.

Table A-4
Evaluation of Dioxin/Furan Toxicity Equivalence Concentrations (TECs) for Birds and Mammals - Main Plant Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Dioxin/Furan Compound	Toxicity Equivalency Factor (TEF)		CFMW-038-SO-0-0.5			CFMW-038-SO-0.5-2			CFMW-040-SO-0-0.5			CFMW-040-SO-0.5-2		
	TEF _{mammal}	TEF _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}
2,3,7,8-Tetrachlorodibenzo-P-Dioxin	1	1.00	1.45E-08	1.45E-08	1.45E-08	1.40E-08	1.40E-08	1.40E-08	5.80E-07	5.80E-07	5.80E-07	1.70E-08	1.70E-08	1.70E-08
1,2,3,7,8-Pentachlorodibenzo-P-Dioxin	1	1.00	2.05E-08	2.05E-08	2.05E-08	1.75E-08	1.75E-08	1.75E-08	1.21E-06	1.21E-06	1.21E-06	1.70E-08	1.70E-08	1.70E-08
1,2,3,4,7,8-Hexachlorodibenzo-P-Dioxin	0.1	0.05	5.70E-08	5.70E-09	2.85E-09	1.05E-08	1.05E-09	5.25E-10	3.42E-06	3.42E-07	1.71E-07	1.05E-08	1.05E-09	5.25E-10
1,2,3,6,7,8-Hexachlorodibenzo-P-Dioxin	0.1	0.01	1.20E-07	1.20E-08	1.20E-09	7.50E-08	7.50E-09	7.50E-10	5.07E-06	5.07E-07	5.07E-08	1.00E-08	1.00E-09	1.00E-10
1,2,3,7,8,9-Hexachlorodibenzo-P-Dioxin	0.1	0.10	1.10E-07	1.10E-08	1.10E-08	9.10E-08	9.10E-09	9.10E-09	4.60E-06	4.60E-07	4.60E-07	7.10E-08	7.10E-09	7.10E-09
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	0.01	0.00	2.01E-06	2.01E-08	2.01E-09	1.03E-06	1.03E-08	1.03E-09	9.98E-05	9.98E-07	9.98E-08	1.30E-08	1.30E-10	1.30E-11
Octachlorodibenzo-P-Dioxin	0.0003	0.00	2.12E-05	6.36E-09	2.12E-09	1.18E-05	3.54E-09	1.18E-09	6.64E-04	1.99E-07	6.64E-08	3.02E-06	9.06E-10	3.02E-10
2,3,7,8-Tetrachlorodibenzofuran	0.1	1.00	8.90E-08	8.90E-09	8.90E-08	4.80E-08	4.80E-09	4.80E-08	5.26E-06	5.26E-07	5.26E-06	2.20E-08	2.20E-09	2.20E-08
1,2,3,7,8-Pentachlorodibenzofuran	0.03	0.10	1.40E-08	4.20E-10	1.40E-09	1.25E-08	3.75E-10	1.25E-09	1.59E-06	4.77E-08	1.59E-07	1.35E-08	4.05E-10	1.35E-09
2,3,4,7,8-Pentachlorodibenzofuran	0.3	1.00	1.45E-08	4.35E-09	1.45E-08	1.30E-08	3.90E-09	1.30E-08	1.71E-06	5.13E-07	1.71E-06	1.40E-08	4.20E-09	1.40E-08
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	0.10	1.40E-07	1.40E-08	1.40E-08	7.30E-08	7.30E-09	7.30E-09	2.56E-06	2.56E-07	2.56E-07	4.80E-08	4.80E-09	4.80E-09
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	0.10	7.60E-08	7.60E-09	7.60E-09	1.20E-08	1.20E-09	1.20E-09	7.60E-07	7.60E-08	7.60E-08	8.50E-09	8.50E-10	8.50E-10
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	0.10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	0.10	1.30E-08	1.30E-09	1.30E-09	1.30E-08	1.30E-09	1.30E-09	5.40E-07	5.40E-08	5.40E-08	3.10E-08	3.10E-09	3.10E-09
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	0.01	4.80E-07	4.80E-09	4.80E-09	2.60E-07	2.60E-09	2.60E-09	2.69E-05	2.69E-07	2.69E-07	1.10E-08	1.10E-10	1.10E-10
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	0.01	7.80E-08	7.80E-10	7.80E-10	4.10E-08	4.10E-10	4.10E-10	1.70E-07	1.70E-09	1.70E-09	1.35E-08	1.35E-10	1.35E-10
Octachlorodibenzofuran	0.0003	0.00	1.99E-06	5.97E-10	1.99E-10	9.30E-07	2.79E-10	9.30E-11	9.72E-05	2.92E-08	9.72E-09	1.35E-08	4.05E-12	1.35E-12
			TEC:	1.33E-07	1.88E-07	TEC:	8.52E-08	1.19E-07	TEC:	6.07E-06	1.04E-05	TEC:	6.00E-08	8.84E-08
			HQ:	<1	<1	HQ:	<1	<1	HQ:	20.9	6.6	HQ:	<1	<1

Notes:

1, 2,3,7,8-TCDD toxicity equivalence concentrations (TEC_{2,3,7,8-TCDD}):

Receptor Group	TEC _{2,3,7,8-TCDD} ESV	ESV Source
Mammals	2.90E-07	LANL ECORISK
Birds	1.58E-06	Efroymson et al (1997); Sample et al. (1996)

- Soil samples from the 0-2' depth interval within the Main Plant exposure area included in screening assessment.
- Toxicity equivalency factors (TEFs) developed for birds and mammals by the World Health Organization (WHO).
- Dioxin/furan concentrations that were below the detection limit were estimated as 0.5 times the quantitation limit in the TEC calculation for constituents that were detected in at least one other sample in the soil dataset; constituents that were below detection in all soil samples were assigned a concentration of 0 in the TEC calculation (USEPA, 2008).

Table A-4
Evaluation of Dioxin/Furan Toxicity Equivalence Concentrations (TECs) for Birds and Mammals - Main Plant Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Dioxin/Furan Compound	Toxicity Equivalency Factor (TEF)		CFSB-073-SO-0-0.5			CFSB-073-SO-0.5-2			CFSB-074-SO-0-0.5			CFSB-074-SO-0.5-2		
	TEF _{mammal}	TEF _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}
2,3,7,8-Tetrachlorodibenzo-P-Dioxin	1	1.00	1.65E-07	1.65E-07	1.65E-07	2.45E-08	2.45E-08	2.45E-08	4.40E-07	4.40E-07	4.40E-07	1.70E-08	1.70E-08	1.70E-08
1,2,3,7,8-Pentachlorodibenzo-P-Dioxin	1	1.00	2.90E-07	2.90E-07	2.90E-07	2.60E-08	2.60E-08	2.60E-08	4.40E-07	4.40E-07	4.40E-07	2.35E-08	2.35E-08	2.35E-08
1,2,3,4,7,8-Hexachlorodibenzo-P-Dioxin	0.1	0.05	1.52E-06	1.52E-07	7.60E-08	1.60E-08	1.60E-09	8.00E-10	4.55E-08	4.55E-09	2.28E-09	1.70E-08	1.70E-09	8.50E-10
1,2,3,6,7,8-Hexachlorodibenzo-P-Dioxin	0.1	0.01	2.72E-06	2.72E-07	2.72E-08	1.50E-08	1.50E-09	1.50E-10	3.13E-06	3.13E-07	3.13E-08	1.50E-07	1.50E-08	1.50E-09
1,2,3,7,8,9-Hexachlorodibenzo-P-Dioxin	0.1	0.10	2.47E-06	2.47E-07	2.47E-07	6.10E-08	6.10E-09	6.10E-09	1.71E-06	1.71E-07	1.71E-07	9.90E-08	9.90E-09	9.90E-09
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	0.01	0.00	5.09E-05	5.09E-07	5.09E-08	5.80E-07	5.80E-09	5.80E-10	4.71E-05	4.71E-07	4.71E-08	1.72E-06	1.72E-08	1.72E-09
Octachlorodibenzo-P-Dioxin	0.0003	0.00	3.69E-04	1.11E-07	3.69E-08	4.12E-06	1.24E-09	4.12E-10	4.00E-04	1.20E-07	4.00E-08	1.33E-05	3.99E-09	1.33E-09
2,3,7,8-Tetrachlorodibenzofuran	0.1	1.00	1.16E-06	1.16E-07	1.16E-06	1.40E-08	1.40E-09	1.40E-08	8.00E-07	8.00E-08	8.00E-07	1.00E-07	1.00E-08	1.00E-07
1,2,3,7,8-Pentachlorodibenzofuran	0.03	0.10	1.50E-07	4.50E-09	1.50E-08	1.90E-08	5.70E-10	1.90E-09	9.00E-07	2.70E-08	9.00E-08	1.85E-08	5.55E-10	1.85E-09
2,3,4,7,8-Pentachlorodibenzofuran	0.3	1.00	1.55E-07	4.65E-08	1.55E-07	2.00E-08	6.00E-09	2.00E-08	8.70E-07	2.61E-07	8.70E-07	1.90E-08	5.70E-09	1.90E-08
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	0.10	1.77E-06	1.77E-07	1.77E-07	2.30E-08	2.30E-09	2.30E-09	2.04E-06	2.04E-07	2.04E-07	8.80E-08	8.80E-09	8.80E-09
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	0.10	1.05E-06	1.05E-07	1.05E-07	2.10E-08	2.10E-09	2.10E-09	9.60E-07	9.60E-08	9.60E-08	2.00E-08	2.00E-09	2.00E-09
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	0.10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	0.10	1.47E-06	1.47E-07	1.47E-07	2.25E-08	2.25E-09	2.25E-09	8.50E-08	8.50E-09	8.50E-09	2.15E-08	2.15E-09	2.15E-09
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	0.01	1.55E-05	1.55E-07	1.55E-07	1.40E-08	1.40E-10	1.40E-10	1.27E-05	1.27E-07	1.27E-07	1.00E-08	1.00E-10	1.00E-10
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	0.01	9.45E-07	9.45E-09	9.45E-09	1.65E-08	1.65E-10	1.65E-10	1.77E-06	1.77E-08	1.77E-08	1.20E-08	1.20E-10	1.20E-10
Octachlorodibenzofuran	0.0003	0.00	3.68E-05	1.10E-08	3.68E-09	2.05E-08	6.15E-12	2.05E-12	4.14E-05	1.24E-08	4.14E-09	1.55E-08	4.65E-12	1.55E-12
			TEC:	2.52E-06	2.82E-06	TEC:	8.17E-08	1.01E-07	TEC:	2.79E-06	3.39E-06	TEC:	1.18E-07	1.90E-07
			HQ:	8.7	1.8	HQ:	<1	<1	HQ:	9.6	2.1	HQ:	<1	<1

Notes:

1, 2,3,7,8-TCDD toxicity equivalence concentrations (TEC_{2,3,7,8-TCDD}):

Receptor Group	TEC _{2,3,7,8-TCDD} ESV	ESV Source
Mammals	2.90E-07	LANL ECORISK
Birds	1.58E-06	Efroymson et al (1997); Sample et al. (1996)

- 2, Soil samples from the 0-2' depth interval within the Main Plant exposure area included in screening assessment.
- 3, Toxicity equivalency factors (TEFs) developed for birds and mammals by the World Health Organization (WHO).
- 4, Dioxin/furan concentrations that were below the detection limit were estimated as 0.5 times the quantitation limit in the TEC calculation for constituents that were detected in at least one other sample in the soil dataset; constituents that were below detection in all soil samples were assigned a concentration of 0 in the TEC calculation (USEPA, 2008).

Table A-4
Evaluation of Dioxin/Furan Toxicity Equivalence Concentrations (TECs) for Birds and Mammals - Main Plant Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Dioxin/Furan Compound	Toxicity Equivalency Factor (TEF)		CFSB-075-SO-0-0.5			CFSB-075-SO-0.5-2			CFSB-079-SO-0-0.5			CFSB-079-SO-0.5-2		
	TEF _{mammal}	TEF _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}
2,3,7,8-Tetrachlorodibenzo-P-Dioxin	1	1.00	1.15E-07	1.15E-07	1.15E-07	8.00E-09	8.00E-09	8.00E-09	1.45E-08	1.45E-08	1.45E-08	2.20E-08	2.20E-08	2.20E-08
1,2,3,7,8-Pentachlorodibenzo-P-Dioxin	1	1.00	1.70E-07	1.70E-07	1.70E-07	2.80E-08	2.80E-08	2.80E-08	2.50E-08	2.50E-08	2.50E-08	1.95E-08	1.95E-08	1.95E-08
1,2,3,4,7,8-Hexachlorodibenzo-P-Dioxin	0.1	0.05	6.70E-07	6.70E-08	3.35E-08	3.70E-08	3.70E-09	1.85E-09	1.50E-08	1.50E-09	7.50E-10	1.15E-08	1.15E-09	5.75E-10
1,2,3,6,7,8-Hexachlorodibenzo-P-Dioxin	0.1	0.01	1.15E-06	1.15E-07	1.15E-08	1.30E-07	1.30E-08	1.30E-09	1.45E-08	1.45E-09	1.45E-10	1.10E-08	1.10E-09	1.10E-10
1,2,3,7,8,9-Hexachlorodibenzo-P-Dioxin	0.1	0.10	1.42E-06	1.42E-07	1.42E-07	8.70E-08	8.70E-09	8.70E-09	1.30E-08	1.30E-09	1.30E-09	9.50E-09	9.50E-10	9.50E-10
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	0.01	0.00	1.62E-05	1.62E-07	1.62E-08	2.91E-06	2.91E-08	2.91E-09	1.45E-08	1.45E-10	1.45E-11	9.00E-09	9.00E-11	9.00E-12
Octachlorodibenzo-P-Dioxin	0.0003	0.00	1.08E-04	3.24E-08	1.08E-08	2.49E-05	7.47E-09	2.49E-09	1.25E-08	3.75E-12	1.25E-12	1.20E-08	3.60E-12	1.20E-12
2,3,7,8-Tetrachlorodibenzofuran	0.1	1.00	1.22E-06	1.22E-07	1.22E-06	2.40E-07	2.40E-08	2.40E-07	1.20E-08	1.20E-09	1.20E-08	1.90E-08	1.90E-09	1.90E-08
1,2,3,7,8-Pentachlorodibenzofuran	0.03	0.10	1.05E-07	3.15E-09	1.05E-08	7.50E-09	2.25E-10	7.50E-10	2.10E-08	6.30E-10	2.10E-09	1.80E-08	5.40E-10	1.80E-09
2,3,4,7,8-Pentachlorodibenzofuran	0.3	1.00	1.05E-07	3.15E-08	1.05E-07	6.50E-08	1.95E-08	6.50E-08	2.10E-08	6.30E-09	2.10E-08	1.80E-08	5.40E-09	1.80E-08
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	0.10	5.80E-07	5.80E-08	5.80E-08	1.10E-07	1.10E-08	1.10E-08	1.85E-08	1.85E-09	1.85E-09	1.40E-08	1.40E-09	1.40E-09
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	0.10	4.50E-07	4.50E-08	4.50E-08	6.20E-08	6.20E-09	6.20E-09	6.70E-08	6.70E-09	6.70E-09	1.30E-08	1.30E-09	1.30E-09
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	0.10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	0.10	1.75E-07	1.75E-08	1.75E-08	4.00E-08	4.00E-09	4.00E-09	1.80E-08	1.80E-09	1.80E-09	1.40E-08	1.40E-09	1.40E-09
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	0.01	6.16E-06	6.16E-08	6.16E-08	7.20E-07	7.20E-09	7.20E-09	1.50E-08	1.50E-10	1.50E-10	1.05E-08	1.05E-10	1.05E-10
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	0.01	5.70E-07	5.70E-09	5.70E-09	8.00E-09	8.00E-11	8.00E-11	1.95E-08	1.95E-10	1.95E-10	1.35E-08	1.35E-10	1.35E-10
Octachlorodibenzofuran	0.0003	0.00	1.19E-05	3.57E-09	1.19E-09	1.95E-06	5.85E-10	1.95E-10	1.25E-08	3.75E-12	1.25E-12	1.25E-08	3.75E-12	1.25E-12
			TEC:	1.15E-06	2.02E-06	TEC:	1.71E-07	3.88E-07	TEC:	6.27E-08	8.75E-08	TEC:	5.70E-08	8.63E-08
			HQ:	4	1.3	HQ:	<1	<1	HQ:	<1	<1	HQ:	<1	<1

Notes:

1, 2,3,7,8-TCDD toxicity equivalence concentrations (TEC_{2,3,7,8-TCDD}):

Receptor Group	TEC _{2,3,7,8-TCDD} ESV	ESV Source
Mammals	2.90E-07	LANL ECORISK
Birds	1.58E-06	Efroymson et al (1997); Sample et al. (1996)

- 2, Soil samples from the 0-2' depth interval within the Main Plant exposure area included in screening assessment.
- 3, Toxicity equivalency factors (TEFs) developed for birds and mammals by the World Health Organization (WHO).
- 4, Dioxin/furan concentrations that were below the detection limit were estimated as 0.5 times the quantitation limit in the TEC calculation for constituents that were detected in at least one other sample in the soil dataset; constituents that were below detection in all soil samples were assigned a concentration of 0 in the TEC calculation (USEPA, 2008).

Table A-4
Evaluation of Dioxin/Furan Toxicity Equivalence Concentrations (TECs) for Birds and Mammals - Main Plant Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Dioxin/Furan Compound	Toxicity Equivalency Factor (TEF)		CFSB-080-SO-0-0.5			CFSB-080-SO-0.5-2			CFSB-082-SO-0-0.5			CFSB-082-SO-0.5-2		
	TEF _{mammal}	TEF _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}
2,3,7,8-Tetrachlorodibenzo-P-Dioxin	1	1.00	1.10E-08	1.10E-08	1.10E-08	2.90E-07	2.90E-07	2.90E-07	1.15E-07	1.15E-07	1.15E-07	2.10E-08	2.10E-08	2.10E-08
1,2,3,7,8-Pentachlorodibenzo-P-Dioxin	1	1.00	1.75E-08	1.75E-08	1.75E-08	3.45E-07	3.45E-07	3.45E-07	1.50E-07	1.50E-07	1.50E-07	1.75E-08	1.75E-08	1.75E-08
1,2,3,4,7,8-Hexachlorodibenzo-P-Dioxin	0.1	0.05	1.55E-08	1.55E-09	7.75E-10	2.34E-06	2.34E-07	1.17E-07	8.60E-07	8.60E-08	4.30E-08	1.20E-08	1.20E-09	6.00E-10
1,2,3,6,7,8-Hexachlorodibenzo-P-Dioxin	0.1	0.01	1.50E-08	1.50E-09	1.50E-10	1.08E-05	1.08E-06	1.08E-07	3.13E-06	3.13E-07	3.13E-08	1.10E-07	1.10E-08	1.10E-09
1,2,3,7,8,9-Hexachlorodibenzo-P-Dioxin	0.1	0.10	1.30E-08	1.30E-09	1.30E-09	5.14E-06	5.14E-07	5.14E-07	2.08E-06	2.08E-07	2.08E-07	1.00E-08	1.00E-09	1.00E-09
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	0.01	0.00	1.15E-08	1.15E-10	1.15E-11	3.12E-04	3.12E-06	3.12E-07	1.11E-04	1.11E-06	1.11E-07	1.15E-08	1.15E-10	1.15E-11
Octachlorodibenzo-P-Dioxin	0.0003	0.00	1.10E-08	3.30E-12	1.10E-12	4.35E-03	1.31E-06	4.35E-07	1.73E-03	5.19E-07	1.73E-07	9.36E-06	2.81E-09	9.36E-10
2,3,7,8-Tetrachlorodibenzofuran	0.1	1.00	9.50E-09	9.50E-10	9.50E-09	2.02E-06	2.02E-07	2.02E-06	7.90E-07	7.90E-08	7.90E-07	1.00E-07	1.00E-08	1.00E-07
1,2,3,7,8-Pentachlorodibenzofuran	0.03	0.10	1.55E-08	4.65E-10	1.55E-09	2.10E-06	6.30E-08	2.10E-07	6.60E-07	1.98E-08	6.60E-08	1.10E-07	3.30E-09	1.10E-08
2,3,4,7,8-Pentachlorodibenzofuran	0.3	1.00	1.55E-08	4.65E-09	1.55E-08	1.88E-06	5.64E-07	1.88E-06	6.00E-07	1.80E-07	6.00E-07	2.05E-08	6.15E-09	2.05E-08
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	0.10	1.15E-08	1.15E-09	1.15E-09	9.63E-06	9.63E-07	9.63E-07	3.07E-06	3.07E-07	3.07E-07	1.40E-07	1.40E-08	1.40E-08
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	0.10	4.40E-08	4.40E-09	4.40E-09	2.86E-06	2.86E-07	2.86E-07	9.80E-07	9.80E-08	9.80E-08	1.10E-07	1.10E-08	1.10E-08
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	0.10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	0.10	1.15E-08	1.15E-09	1.15E-09	4.58E-06	4.58E-07	4.58E-07	1.70E-06	1.70E-07	1.70E-07	1.85E-08	1.85E-09	1.85E-09
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	0.01	1.35E-08	1.35E-10	1.35E-10	6.64E-05	6.64E-07	6.64E-07	2.17E-05	2.17E-07	2.17E-07	1.35E-08	1.35E-10	1.35E-10
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	0.01	1.70E-08	1.70E-10	1.70E-10	8.35E-07	8.35E-09	8.35E-09	6.45E-07	6.45E-09	6.45E-09	1.75E-08	1.75E-10	1.75E-10
Octachlorodibenzofuran	0.0003	0.00	1.05E-08	3.15E-12	1.05E-12	7.96E-05	2.39E-08	7.96E-09	3.10E-05	9.30E-09	3.10E-09	1.35E-08	4.05E-12	1.35E-12
			TEC:	4.60E-08	6.43E-08	TEC:	1.01E-05	8.62E-06	TEC:	3.59E-06	3.09E-06	TEC:	1.01E-07	2.01E-07
			HQ:	<1	<1	HQ:	34.9	5.5	HQ:	12.4	2	HQ:	<1	<1

Notes:

1, 2,3,7,8-TCDD toxicity equivalence concentrations (TEC_{2,3,7,8-TCDD}):

Receptor Group	TEC _{2,3,7,8-TCDD} ESV	ESV Source
Mammals	2.90E-07	LANL ECORISK
Birds	1.58E-06	Efroymson et al (1997); Sample et al. (1996)

- 2, Soil samples from the 0-2' depth interval within the Main Plant exposure area included in screening assessment.
- 3, Toxicity equivalency factors (TEFs) developed for birds and mammals by the World Health Organization (WHO).
- 4, Dioxin/furan concentrations that were below the detection limit were estimated as 0.5 times the quantitation limit in the TEC calculation for constituents that were detected in at least one other sample in the soil dataset; constituents that were below detection in all soil samples were assigned a concentration of 0 in the TEC calculation (USEPA, 2008).

Table A-4
Evaluation of Dioxin/Furan Toxicity Equivalence Concentrations (TECs) for Birds and Mammals - Main Plant Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Dioxin/Furan Compound	Toxicity Equivalency Factor (TEF)		CFSB-084-SO-0-0.5			CFSB-084-SO-0.5-2			CFSB-086-SO-0-0.5			CFSB-086-SO-0.5-2		
	TEF _{mammal}	TEF _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}
2,3,7,8-Tetrachlorodibenzo-P-Dioxin	1	1.00	1.45E-07	1.45E-07	1.45E-07	2.40E-08	2.40E-08	2.40E-08	1.65E-07	1.65E-07	1.65E-07	1.70E-08	1.70E-08	1.70E-08
1,2,3,7,8-Pentachlorodibenzo-P-Dioxin	1	1.00	1.55E-07	1.55E-07	1.55E-07	9.40E-08	9.40E-08	9.40E-08	1.95E-07	1.95E-07	1.95E-07	3.05E-08	3.05E-08	3.05E-08
1,2,3,4,7,8-Hexachlorodibenzo-P-Dioxin	0.1	0.05	6.10E-07	6.10E-08	3.05E-08	2.05E-08	2.05E-09	1.03E-09	1.25E-07	1.25E-08	6.25E-09	6.40E-08	6.40E-09	3.20E-09
1,2,3,6,7,8-Hexachlorodibenzo-P-Dioxin	0.1	0.01	1.44E-06	1.44E-07	1.44E-08	4.50E-07	4.50E-08	4.50E-09	1.57E-06	1.57E-07	1.57E-08	1.50E-07	1.50E-08	1.50E-09
1,2,3,7,8,9-Hexachlorodibenzo-P-Dioxin	0.1	0.10	8.00E-07	8.00E-08	8.00E-08	3.10E-07	3.10E-08	3.10E-08	9.00E-07	9.00E-08	9.00E-08	8.40E-08	8.40E-09	8.40E-09
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	0.01	0.00	2.48E-05	2.48E-07	2.48E-08	5.06E-06	5.06E-08	5.06E-09	2.34E-05	2.34E-07	2.34E-08	2.46E-06	2.46E-08	2.46E-09
Octachlorodibenzo-P-Dioxin	0.0003	0.00	1.79E-04	5.37E-08	1.79E-08	3.41E-05	1.02E-08	3.41E-09	1.56E-04	4.68E-08	1.56E-08	1.74E-05	5.22E-09	1.74E-09
2,3,7,8-Tetrachlorodibenzofuran	0.1	1.00	2.14E-06	2.14E-07	2.14E-06	3.90E-07	3.90E-08	3.90E-07	1.41E-06	1.41E-07	1.41E-06	2.20E-07	2.20E-08	2.20E-07
1,2,3,7,8-Pentachlorodibenzofuran	0.03	0.10	6.10E-07	1.83E-08	6.10E-08	1.70E-07	5.10E-09	1.70E-08	1.10E-07	3.30E-09	1.10E-08	1.70E-08	5.10E-10	1.70E-09
2,3,4,7,8-Pentachlorodibenzofuran	0.3	1.00	4.50E-07	1.35E-07	4.50E-07	2.55E-08	7.65E-09	2.55E-08	1.15E-07	3.45E-08	1.15E-07	1.75E-08	5.25E-09	1.75E-08
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	0.10	1.35E-06	1.35E-07	1.35E-07	3.30E-07	3.30E-08	3.30E-08	2.00E-07	2.00E-08	2.00E-08	1.50E-07	1.50E-08	1.50E-08
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	0.10	7.80E-07	7.80E-08	7.80E-08	3.25E-08	3.25E-09	3.25E-09	1.80E-07	1.80E-08	1.80E-08	9.10E-08	9.10E-09	9.10E-09
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	0.10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	0.10	5.00E-07	5.00E-08	5.00E-08	1.30E-07	1.30E-08	1.30E-08	1.95E-07	1.95E-08	1.95E-08	4.00E-08	4.00E-09	4.00E-09
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	0.01	9.64E-06	9.64E-08	9.64E-08	1.85E-06	1.85E-08	1.85E-08	4.94E-06	4.94E-08	4.94E-08	1.00E-08	1.00E-10	1.00E-10
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	0.01	8.60E-07	8.60E-09	8.60E-09	2.95E-08	2.95E-10	2.95E-10	6.50E-07	6.50E-09	6.50E-09	1.20E-08	1.20E-10	1.20E-10
Octachlorodibenzofuran	0.0003	0.00	2.22E-05	6.66E-09	2.22E-09	4.06E-06	1.22E-09	4.06E-10	1.11E-05	3.33E-09	1.11E-09	1.10E-08	3.30E-12	1.10E-12
			TEC:	1.63E-06	3.49E-06	TEC:	3.78E-07	6.64E-07	TEC:	1.20E-06	2.16E-06	TEC:	1.63E-07	3.32E-07
			HQ:	5.6	2.2	HQ:	1.3	<1	HQ:	4.1	1.4	HQ:	<1	<1

Notes:

1, 2,3,7,8-TCDD toxicity equivalence concentrations (TEC_{2,3,7,8-TCDD}):

Receptor Group	TEC _{2,3,7,8-TCDD} ESV	ESV Source
Mammals	2.90E-07	LANL ECORISK
Birds	1.58E-06	Efroymson et al (1997); Sample et al. (1996)

- 2, Soil samples from the 0-2' depth interval within the Main Plant exposure area included in screening assessment.
- 3, Toxicity equivalency factors (TEFs) developed for birds and mammals by the World Health Organization (WHO).
- 4, Dioxin/furan concentrations that were below the detection limit were estimated as 0.5 times the quantitation limit in the TEC calculation for constituents that were detected in at least one other sample in the soil dataset; constituents that were below detection in all soil samples were assigned a concentration of 0 in the TEC calculation (USEPA, 2008).

Table A-4
Evaluation of Dioxin/Furan Toxicity Equivalence Concentrations (TECs) for Birds and Mammals - Main Plant Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Dioxin/Furan Compound	Toxicity Equivalency Factor (TEF)		CFSB-087-SO-0-0.5			CFSB-087-SO-0.5-2			CFSB-088-SO-0-0.5			CFSB-088-SO-0.5-2		
	TEF _{mammal}	TEF _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}
2,3,7,8-Tetrachlorodibenzo-P-Dioxin	1	1.00	1.00E-07	1.00E-07	1.00E-07	1.95E-08	1.95E-08	1.95E-08	9.00E-08	9.00E-08	9.00E-08	2.10E-07	2.10E-07	2.10E-07
1,2,3,7,8-Pentachlorodibenzo-P-Dioxin	1	1.00	1.30E-07	1.30E-07	1.30E-07	3.30E-08	3.30E-08	3.30E-08	1.05E-07	1.05E-07	1.05E-07	2.35E-07	2.35E-07	2.35E-07
1,2,3,4,7,8-Hexachlorodibenzo-P-Dioxin	0.1	0.05	8.50E-08	8.50E-09	4.25E-09	2.00E-08	2.00E-09	1.00E-09	3.30E-07	3.30E-08	1.65E-08	5.60E-07	5.60E-08	2.80E-08
1,2,3,6,7,8-Hexachlorodibenzo-P-Dioxin	0.1	0.01	1.19E-06	1.19E-07	1.19E-08	3.70E-07	3.70E-08	3.70E-09	1.25E-06	1.25E-07	1.25E-08	9.60E-07	9.60E-08	9.60E-09
1,2,3,7,8,9-Hexachlorodibenzo-P-Dioxin	0.1	0.10	9.80E-07	9.80E-08	9.80E-08	1.90E-07	1.90E-08	1.90E-08	7.80E-07	7.80E-08	7.80E-08	9.70E-07	9.70E-08	9.70E-08
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	0.01	0.00	1.64E-05	1.64E-07	1.64E-08	5.19E-06	5.19E-08	5.19E-09	2.13E-05	2.13E-07	2.13E-08	1.96E-05	1.96E-07	1.96E-08
Octachlorodibenzo-P-Dioxin	0.0003	0.00	1.08E-04	3.24E-08	1.08E-08	3.74E-05	1.12E-08	3.74E-09	1.45E-04	4.35E-08	1.45E-08	1.11E-04	3.33E-08	1.11E-08
2,3,7,8-Tetrachlorodibenzofuran	0.1	1.00	2.16E-06	2.16E-07	2.16E-06	9.40E-07	9.40E-08	9.40E-07	1.31E-06	1.31E-07	1.31E-06	1.09E-06	1.09E-07	1.09E-06
1,2,3,7,8-Pentachlorodibenzofuran	0.03	0.10	4.70E-07	1.41E-08	4.70E-08	2.30E-07	6.90E-09	2.30E-08	8.00E-08	2.40E-09	8.00E-09	1.90E-07	5.70E-09	1.90E-08
2,3,4,7,8-Pentachlorodibenzofuran	0.3	1.00	5.20E-07	1.56E-07	5.20E-07	2.40E-07	7.20E-08	2.40E-07	8.50E-08	2.55E-08	8.50E-08	2.00E-07	6.00E-08	2.00E-07
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	0.10	1.40E-07	1.40E-08	1.40E-08	4.00E-07	4.00E-08	4.00E-08	9.20E-07	9.20E-08	9.20E-08	5.20E-07	5.20E-08	5.20E-08
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	0.10	1.25E-07	1.25E-08	1.25E-08	1.40E-07	1.40E-08	1.40E-08	1.05E-07	1.05E-08	1.05E-08	1.50E-07	1.50E-08	1.50E-08
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	0.10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	0.10	1.35E-07	1.35E-08	1.35E-08	1.40E-07	1.40E-08	1.40E-08	2.80E-07	2.80E-08	2.80E-08	1.60E-07	1.60E-08	1.60E-08
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	0.01	3.10E-06	3.10E-08	3.10E-08	1.29E-06	1.29E-08	1.29E-08	7.18E-06	7.18E-08	7.18E-08	5.63E-06	5.63E-08	5.63E-08
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	0.01	7.50E-08	7.50E-10	7.50E-10	2.40E-08	2.40E-10	2.40E-10	8.50E-08	8.50E-10	8.50E-10	1.10E-07	1.10E-09	1.10E-09
Octachlorodibenzofuran	0.0003	0.00	7.90E-06	2.37E-09	7.90E-10	3.09E-06	9.27E-10	3.09E-10	2.32E-05	6.96E-09	2.32E-09	1.73E-05	5.19E-09	1.73E-09
			TEC:	1.11E-06	3.17E-06	TEC:	4.29E-07	1.37E-06	TEC:	1.06E-06	1.95E-06	TEC:	1.24E-06	2.06E-06
			HQ:	3.8	2	HQ:	1.5	<1	HQ:	3.6	1.2	HQ:	4.3	1.3

Notes:

1, 2,3,7,8-TCDD toxicity equivalence concentrations (TEC_{2,3,7,8-TCDD}):

Receptor Group	TEC _{2,3,7,8-TCDD} ESV	ESV Source
Mammals	2.90E-07	LANL ECORISK
Birds	1.58E-06	Efroymson et al (1997); Sample et al. (1996)

- 2, Soil samples from the 0-2' depth interval within the Main Plant exposure area included in screening assessment.
- 3, Toxicity equivalency factors (TEFs) developed for birds and mammals by the World Health Organization (WHO).
- 4, Dioxin/furan concentrations that were below the detection limit were estimated as 0.5 times the quantitation limit in the TEC calculation for constituents that were detected in at least one other sample in the soil dataset; constituents that were below detection in all soil samples were assigned a concentration of 0 in the TEC calculation (USEPA, 2008).

Table A-4
Evaluation of Dioxin/Furan Toxicity Equivalence Concentrations (TECs) for Birds and Mammals - Main Plant Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Dioxin/Furan Compound	Toxicity Equivalency Factor (TEF)		CFSB-092-SO-0-0.5			CFSB-092-SO-0.5-2		
	TEF _{mammal}	TEF _{bird}	Result	TEC _{mammal}	TEC _{bird}	Result	TEC _{mammal}	TEC _{bird}
2,3,7,8-Tetrachlorodibenzo-P-Dioxin	1	1.00	1.40E-07	1.40E-07	1.40E-07	1.10E-07	1.10E-07	1.10E-07
1,2,3,7,8-Pentachlorodibenzo-P-Dioxin	1	1.00	2.60E-07	2.60E-07	2.60E-07	2.20E-07	2.20E-07	2.20E-07
1,2,3,4,7,8-Hexachlorodibenzo-P-Dioxin	0.1	0.05	3.80E-07	3.80E-08	1.90E-08	2.50E-07	2.50E-08	1.25E-08
1,2,3,6,7,8-Hexachlorodibenzo-P-Dioxin	0.1	0.01	9.70E-07	9.70E-08	9.70E-09	5.30E-07	5.30E-08	5.30E-09
1,2,3,7,8,9-Hexachlorodibenzo-P-Dioxin	0.1	0.10	6.70E-07	6.70E-08	6.70E-08	4.60E-07	4.60E-08	4.60E-08
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	0.01	0.00	1.47E-05	1.47E-07	1.47E-08	9.04E-06	9.04E-08	9.04E-09
Octachlorodibenzo-P-Dioxin	0.0003	0.00	1.04E-04	3.12E-08	1.04E-08	6.81E-05	2.04E-08	6.81E-09
2,3,7,8-Tetrachlorodibenzofuran	0.1	1.00	1.06E-06	1.06E-07	1.06E-06	6.00E-07	6.00E-08	6.00E-07
1,2,3,7,8-Pentachlorodibenzofuran	0.03	0.10	2.90E-07	8.70E-09	2.90E-08	1.90E-08	5.70E-10	1.90E-09
2,3,4,7,8-Pentachlorodibenzofuran	0.3	1.00	2.90E-07	8.70E-08	2.90E-07	1.60E-07	4.80E-08	1.60E-07
1,2,3,4,7,8-Hexachlorodibenzofuran	0.1	0.10	4.50E-08	4.50E-09	4.50E-09	3.10E-07	3.10E-08	3.10E-08
1,2,3,6,7,8-Hexachlorodibenzofuran	0.1	0.10	4.20E-07	4.20E-08	4.20E-08	1.90E-07	1.90E-08	1.90E-08
1,2,3,7,8,9-Hexachlorodibenzofuran	0.1	0.10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
2,3,4,6,7,8-Hexachlorodibenzofuran	0.1	0.10	3.10E-07	3.10E-08	3.10E-08	1.20E-07	1.20E-08	1.20E-08
1,2,3,4,6,7,8-Heptachlorodibenzofuran	0.01	0.01	4.18E-06	4.18E-08	4.18E-08	2.43E-06	2.43E-08	2.43E-08
1,2,3,4,7,8,9-Heptachlorodibenzofuran	0.01	0.01	4.90E-07	4.90E-09	4.90E-09	2.30E-08	2.30E-10	2.30E-10
Octachlorodibenzofuran	0.0003	0.00	1.01E-05	3.03E-09	1.01E-09	6.02E-06	1.81E-09	6.02E-10
			TEC:	1.11E-06	2.03E-06	TEC:	7.62E-07	1.26E-06
			HQ:	3.8	1.3	HQ:	2.6	<1

Notes:

1, 2,3,7,8-TCDD toxicity equivalence concentrations (TEC_{2,3,7,8-TCDD}):

Receptor Group	TEC _{2,3,7,8-TCDD} ESV	ESV Source
Mammals	2.90E-07	LANL ECORISK
Birds	1.58E-06	Efroymson et al (1997); Sample et al. (1996)

- 2, Soil samples from the 0-2' depth interval within the Main Plant exposure area included in screening assessment.
- 3, Toxicity equivalency factors (TEFs) developed for birds and mammals by the World Health Organization (WHO).
- 4, Dioxin/furan concentrations that were below the detection limit were estimated as 0.5 times the quantitation limit in the TEC calculation for constituents that were detected in at least one other sample in the soil dataset; constituents that were below detection in all soil samples were assigned a concentration of 0 in the TEC calculation (USEPA, 2008).

Table A-5
Summary of Soil ESV Exceedances - Cedar Creek Overflow Ditch Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
METALS mg/kg											
Aluminum	5	5	5 / 5	8.9	12.9	14700	22700	50	5		
Antimony	0	5	0 / 5	0.32	0.46			0.142	0	0.27	0
Arsenic	5	5	5 / 5	0.32	0.46	4.1	6.8	0.25	5	11.4	0
Barium	5	5	5 / 5	0.63	0.91	180	295	1.04	5	195	4
Beryllium	5	5	5 / 5	0.097	0.14	0.64	1	1.06	0	2.5	0
Cadmium	0	5	0 / 5	0.33	0.48			0.00222	0	0.36	0
Calcium	5	5	5 / 5	43.4	62.8	11500	30100				
Chromium, Total	5	5	5 / 5	0.6	0.87	11.8	15	0.34	5	26	0
Cobalt	5	5	5 / 5	0.6	0.87	5.8	8.4	0.14	5	13	0
Copper	5	5	5 / 5	0.61	0.88	19.8	27.8	5.4	5	28	0
Iron	5	5	5 / 5	18.9	27.3	14100	19500				
Lead	5	5	5 / 5	0.18	0.26	13	18.5	0.0537	5	15.3	3
Magnesium	5	5	5 / 5	30	43.5	8750	12200				
Manganese	5	5	5 / 5	1.2	1.8	517	1250	220	5	508	5
Mercury	5	5	5 / 5	0.013	0.019	0.029	0.045	0.005	5	0.05	0
Nickel	5	5	5 / 5	0.61	0.88	16	43.8	9.7	5	38	1
Potassium	5	5	5 / 5	29.5	42.7	922	1700				
Selenium	4	5	4 / 5	0.29	0.43	0.34	1.4	0.0276	4	0.52	2
Silver	0	5	0 / 5	0.62	0.89			2	0	2	0
Sodium	5	5	5 / 5	42.8	62	60	171				
Thallium	0	5	0 / 5	0.13	0.18			0.027	0	0.25	0
Vanadium	5	5	5 / 5	0.88	1.3	11.5	18	0.714	5	30.9	0
Zinc	5	5	5 / 5	3.2	4.6	59	129	6.62	5	60.5	4
GENERAL CHEMISTRY mg/kg											
Cyanide	5	5	5 / 5	0.03	0.052	0.3	1.5	0.1	5	0.183148	5
Fluoride	5	5	5 / 5	0.22	0.5	1.3	4.27	6.5	0	30	0
PESTICIDES mg/kg											
Aldrin	0	5	0 / 5	0.00097	0.0015			0.00332	0	0.00332	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	5	0 / 5	0.00073	0.0011			0.0994	0	0.0994	0
Alpha Endosulfan	0	5	0 / 5	0.0011	0.0017			0.119	0	0.119	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	5	0 / 5	0.00078	0.0012			0.00398	0	0.00398	0
Beta Endosulfan	0	5	0 / 5	0.0013	0.0019			0.119	0	0.119	0
cis-Chlordane	0	5	0 / 5	0.0013	0.002			0.27	0	0.27	0
Delta BHC (Delta Hexachlorocyclohexane)	0	5	0 / 5	0.00087	0.0013			0.1	0	0.1	0

Table A-5
Summary of Soil ESV Exceedances - Cedar Creek Overflow Ditch Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Dieldrin	0	5	0 / 5	0.001	0.0016			0.00238	0	0.00238	0
Endosulfan Sulfate	0	5	0 / 5	0.00093	0.0014			0.0358	0	0.0358	0
Endrin	0	5	0 / 5	0.001	0.0015			0.0014	0	0.0014	0
Endrin Aldehyde	0	5	0 / 5	0.00099	0.0015			0.0105	0	0.0105	0
Endrin Ketone	0	5	0 / 5	0.0011	0.0017						
Gamma Bhc (Lindane)	0	5	0 / 5	0.00072	0.0011			0.005	0	0.005	0
Heptachlor	0	5	0 / 5	0.001	0.0016			0.059	0	0.059	0
Heptachlor Epoxide	0	5	0 / 5	0.0016	0.0024			0.152	0	0.152	0
Methoxychlor	0	5	0 / 5	0.0017	0.0026			5	0	5	0
P,P'-DDD	0	5	0 / 5	0.0011	0.0016			0.00488	0	0.00488	0
P,P'-DDE	0	5	0 / 5	0.0012	0.0018			0.021	0	0.021	0
P,P'-DDT	0	5	0 / 5	0.00083	0.0012			0.0035	0	0.0035	0
Toxaphene	0	5	0 / 5	0.023	0.035			0.119	0	0.119	0
trans-Chlordane	0	5	0 / 5	0.0017	0.0026			2.2	0	2.2	0
Clay	5	5	5 / 5			0.7	3.9				
Coarse Sand	5	5	5 / 5			3.1	24.7				
Fine Sand	5	5	5 / 5			10.7	34.6				
POLYCHLORINATED BIPHENYLS mg/kg											
PCB-1242 (Aroclor 1242)	0	5	0 / 5	0.011	0.016			0.041	0	0.041	0
PCB-1248 (Aroclor 1248)	0	5	0 / 5	0.011	0.016			0.0072	0	0.0072	0
PCB-1254 (Aroclor 1254)	0	5	0 / 5	0.011	0.017			0.041	0	0.041	0
PCB-1260 (Aroclor 1260)	0	5	0 / 5	0.011	0.017			0.88	0	0.88	0
PCB-1262 (Aroclor 1262)	0	5	0 / 5	0.011	0.017						
PCB-1268 (Aroclor 1268)	0	5	0 / 5	0.011	0.017						
Polychlorinated Biphenyl (PCBs)	0	5	0 / 5	0.011	0.017			40	0	40	0
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg											
Benzo(A)Anthracene	5	5	5 / 5	0.033	0.05	0.093	0.82	0.8	1		
Benzo(A)Pyrene	5	5	5 / 5	0.012	0.018	0.11	1.1	1.52	0		
Benzo(B)Fluoranthene	5	5	5 / 5	0.015	0.023	0.19	1.8	18	0		
Benzo(G,H,I)Perylene	5	5	5 / 5	0.023	0.034	0.11	1.3	24	0		
Benzo(K)Fluoranthene	5	5	5 / 5	0.017	0.026	0.051	0.49	62	0		
Chrysene	5	5	5 / 5	0.011	0.016	0.13	1.1	2.4	0		
Dibenz(A,H)Anthracene	3	5	3 / 5	0.021	0.031	0.16	0.28	12	0		
Indeno(1,2,3-C,D)Pyrene	5	5	5 / 5	0.026	0.04	0.11	1.3	62	0		
Pyrene	5	5	5 / 5	0.018	0.027	0.13	1.5	10	0		

Table A-5
Summary of Soil ESV Exceedances - Cedar Creek Overflow Ditch Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Total High Molecular Weight PAHs	5	5	5 / 5			0.944	9.67			1.1	3
2-Methylnaphthalene	1	5	1 / 5	0.0087	0.013	0.012	0.012	3.24	0		
Acenaphthene	3	5	3 / 5	0.0096	0.014	0.043	0.075	0.25	0		
Acenaphthylene	0	5	0 / 5	0.01	0.015			120	0		
Anthracene	3	5	3 / 5	0.038	0.057	0.082	0.14	6.8	0		
Fluoranthene	5	5	5 / 5	0.012	0.018	0.13	1.1	10	0		
Fluorene	3	5	3 / 5	0.0086	0.013	0.028	0.053	3.7	0		
Naphthalene	3	5	3 / 5	0.01	0.015	0.013	0.02	0.0994	0		
Phenanthrene	5	5	5 / 5	0.011	0.016	0.065	0.69	5.5	0		
Total Low Molecular Weight PAHs	5	5	5 / 5			0.195	2.09			29	0
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg											
1,2,4,5-Tetrachlorobenzene	0	5	0 / 5	0.029	0.044			2.02	0	2.02	0
1,4-Dioxane (P-Dioxane)	0	5	0 / 5	0.11	0.16			1.83	0	1.83	0
2,3,4,6-Tetrachlorophenol	0	5	0 / 5	0.037	0.056						
2,4,5-Trichlorophenol	0	5	0 / 5	0.039	0.059			4	0	4	0
2,4,6-Trichlorophenol	0	5	0 / 5	0.011	0.017			9.94	0	9.94	0
2,4-Dichlorophenol	0	5	0 / 5	0.0093	0.014			87.5	0	87.5	0
2,4-Dimethylphenol	0	5	0 / 5	0.087	0.13			0.01	0	0.01	0
2,4-Dinitrophenol	0	5	0 / 5	0.3	0.45			0.0609	0	0.0609	0
2,4-Dinitrotoluene	0	5	0 / 5	0.016	0.024			1.28	0	1.28	0
2,6-Dinitrotoluene	0	5	0 / 5	0.021	0.032			0.0328	0	0.0328	0
2-Chloronaphthalene	0	5	0 / 5	0.009	0.014			0.0122	0	0.0122	0
2-Chlorophenol	0	5	0 / 5	0.01	0.015			0.243	0	0.243	0
2-Methylphenol (O-Cresol)	0	5	0 / 5	0.017	0.026			0.67	0	0.67	0
2-Nitroaniline	0	5	0 / 5	0.013	0.02			5.4	0	5.4	0
2-Nitrophenol	0	5	0 / 5	0.013	0.02			1.6	0	1.6	0
3- And 4- Methylphenol (Total)	0	5	0 / 5	0.011	0.016						
3,3'-Dichlorobenzidine	0	5	0 / 5	0.044	0.067			0.646	0	0.646	0
3-Nitroaniline	0	5	0 / 5	0.012	0.018			3.16	0	3.16	0
4,6-Dinitro-2-Methylphenol	0	5	0 / 5	0.11	0.16			0.144	0	0.144	0
4-Bromophenyl Phenyl Ether	0	5	0 / 5	0.012	0.019						
4-Chloro-3-Methylphenol	0	5	0 / 5	0.017	0.026						
4-Chloroaniline	0	5	0 / 5	0.01	0.015			1	0	1	0
4-Chlorophenyl Phenyl Ether	0	5	0 / 5	0.012	0.018			0	0	0	0
4-Nitroaniline	0	5	0 / 5	0.015	0.023			21.9	0	21.9	0

Table A-5
Summary of Soil ESV Exceedances - Cedar Creek Overflow Ditch Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
4-Nitrophenol	0	5	0 / 5	0.19	0.29			7	0	7	0
Acetophenone	1	5	1 / 5	0.0086	0.013	0.011	0.011	300	0	300	0
Atrazine	0	5	0 / 5	0.018	0.027						
Benzaldehyde	1	5	1 / 5	0.03	0.046	0.069	0.069				
Benzyl Butyl Phthalate	1	5	1 / 5	0.012	0.018	0.031	0.031	0.239	0	0.239	0
Biphenyl (Diphenyl)	0	5	0 / 5	0.034	0.051			60	0	60	0
Bis(2-Chloroethoxy) Methane	0	5	0 / 5	0.012	0.019			0.302	0	0.302	0
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	5	0 / 5	0.0093	0.014			23.7	0	23.7	0
Bis(2-Chloroisopropyl) Ether	0	5	0 / 5	0.016	0.025			19.9	0	19.9	0
Bis(2-Ethylhexyl) Phthalate	1	5	1 / 5	0.015	0.023	0.045	0.045	0.02	1	0.02	1
Caprolactam	0	5	0 / 5	0.028	0.043						
Carbazole	5	5	5 / 5	0.0098	0.015	0.011	0.1	80	0	80	0
Dibenzofuran	2	5	2 / 5	0.012	0.018	0.015	0.024	6.1	0	6.1	0
Diethyl Phthalate	0	5	0 / 5	0.011	0.017			100	0	100	0
Dimethyl Phthalate	0	5	0 / 5	0.011	0.017			10	0	10	0
Di-N-Butyl Phthalate	1	5	1 / 5	0.012	0.018	0.039	0.039	0.011	1	0.011	1
Di-N-Octylphthalate	0	5	0 / 5	0.02	0.03			0.91	0	0.91	0
Hexachlorobenzene	0	5	0 / 5	0.016	0.024			0.079	0	0.079	0
Hexachlorobutadiene	0	5	0 / 5	0.011	0.017			0.0398	0	0.0398	0
Hexachlorocyclopentadiene	0	5	0 / 5	0.025	0.037			0.755	0	0.755	0
Hexachloroethane	0	5	0 / 5	0.014	0.022			0.596	0	0.596	0
Isophorone	4	5	4 / 5	0.0085	0.013	0.012	0.016	139	0	139	0
Nitrobenzene	0	5	0 / 5	0.012	0.019			1.31	0	1.31	0
N-Nitrosodi-N-Propylamine	0	5	0 / 5	0.013	0.02			0.544	0	0.544	0
N-Nitrosodiphenylamine	0	5	0 / 5	0.036	0.054			0.545	0	0.545	0
Pentachlorophenol	0	5	0 / 5	0.048	0.072			0.119	0	0.119	0
Phenol	0	5	0 / 5	0.013	0.02			0.79	0	0.79	0

Notes:

All sediment samples from the 0-0.5' depth interval within the Cedar Creek Overflow Ditch exposure area included in screening assessment.

Quantitation limit used as the detection limit.

Concentration results evaluated against SLERA and BERA soil ESVs.

Total high molecular weight PAHs = sum of PAHs with four or more benzene rings.

Total low molecular weight PAHs = sum of PAHs with less than four benzene rings.

Table A-6
Summary of Soil ESV Exceedances - South Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
METALS mg/kg											
Aluminum	21	21	21 / 21	7.5	18.1	2360	11800	50	21		
Antimony	0	21	0 / 21	0.3	0.91			0.142	0	0.27	0
Arsenic	18	21	18 / 21	0.3	0.99	0.46	3.2	0.25	18	11.4	0
Barium	21	21	21 / 21	0.6	6	43.1	972	1.04	21	195	12
Beryllium	18	21	18 / 21	0.092	0.28	0.11	0.65	1.06	0	2.5	0
Cadmium	0	21	0 / 21	0.32	0.69			0.00222	0	0.36	0
Calcium	21	21	21 / 21	36.3	88.4	5140	313000				
Chromium, Total	21	21	21 / 21	0.57	1.7	2.6	10.5	0.34	21	26	0
Cobalt	20	21	20 / 21	0.57	1.7	1.2	5.5	0.14	20	13	0
Copper	21	21	21 / 21	0.57	1.5	3.3	204	5.4	20	28	11
Iron	21	21	21 / 21	17.9	57.2	1490	12600				
Lead	22	22	22 / 22	0.17	0.97	2.1	22.3	0.0537	22	15.3	2
Magnesium	21	21	21 / 21	28.5	79.3	2510	10300				
Manganese	21	21	21 / 21	1.2	3.5	10.7	215	220	0	508	0
Mercury	20	21	20 / 21	0.012	0.027	0.015	0.14	0.005	20	0.05	7
Nickel	21	21	21 / 21	0.58	1.7	4.3	17.5	9.7	15	38	0
Potassium	21	21	21 / 21	28	75.1	194	1080				
Selenium	2	21	2 / 21	0.28	0.85	0.4	0.57	0.0276	2	0.52	1
Silver	0	21	0 / 21	0.59	1.7			2	0	2	0
Sodium	16	21	16 / 21	38.9	87.3	43.6	410				
Thallium	0	21	0 / 21	0.12	0.34			0.027	0	0.25	0
Vanadium	21	21	21 / 21	0.78	1.8	2.3	15.3	0.714	21	30.9	0
Zinc	21	21	21 / 21	2.5	6.4	13.1	131	6.62	21	60.5	9
GENERAL CHEMISTRY mg/kg											
Cyanide	20	21	20 / 21	0.019	0.066	0.038	1.3	0.1	16	0.183148	15
Fluoride	21	21	21 / 21	0.28	0.86	1.26	29.4	6.5	12	30	0
PESTICIDES mg/kg											
Aldrin	0	9	0 / 9	0.001	0.0019			0.00332	0	0.00332	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	9	0 / 9	0.00076	0.0015			0.0994	0	0.0994	0
Alpha Endosulfan	0	9	0 / 9	0.0012	0.0022			0.119	0	0.119	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	9	0 / 9	0.00081	0.0016			0.00398	0	0.00398	0
Beta Endosulfan	0	9	0 / 9	0.0013	0.0025			0.119	0	0.119	0
cis-Chlordane	0	9	0 / 9	0.0014	0.0026			0.27	0	0.27	0
Delta BHC (Delta Hexachlorocyclohexane)	0	9	0 / 9	0.00091	0.0017			0.1	0	0.1	0
Dieldrin	0	9	0 / 9	0.0011	0.0021			0.00238	0	0.00238	0
Endosulfan Sulfate	0	9	0 / 9	0.00098	0.0019			0.0358	0	0.0358	0
Endrin	0	9	0 / 9	0.0011	0.002			0.0014	0	0.0014	0

Table A-6
Summary of Soil ESV Exceedances - South Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Endrin Aldehyde	0	9	0 / 9	0.001	0.002			0.0105	0	0.0105	0
Endrin Ketone	0	9	0 / 9	0.0012	0.0022						
Gamma Bhc (Lindane)	0	9	0 / 9	0.00075	0.0014			0.005	0	0.005	0
Heptachlor	0	9	0 / 9	0.0011	0.0021			0.059	0	0.059	0
Heptachlor Epoxide	0	9	0 / 9	0.0016	0.0031			0.152	0	0.152	0
Methoxychlor	0	9	0 / 9	0.0018	0.0034			5	0	5	0
P,P'-DDD	0	9	0 / 9	0.0011	0.0021			0.00488	0	0.00488	0
P,P'-DDE	0	9	0 / 9	0.0012	0.0023			0.021	0	0.021	0
P,P'-DDT	0	9	0 / 9	0.00086	0.0017			0.0035	0	0.0035	0
Toxaphene	0	9	0 / 9	0.024	0.047			0.119	0	0.119	0
trans-Chlordane	0	9	0 / 9	0.0018	0.0035			2.2	0	2.2	0
POLYCHLORINATED BIPHENYLS mg/kg											
PCB-1016 (Aroclor 1016)	0	21	0 / 21	0.0094	0.021			1	0	1	0
PCB-1221 (Aroclor 1221)	0	21	0 / 21	0.0094	0.021						
PCB-1232 (Aroclor 1232)	0	21	0 / 21	0.0094	0.021						
PCB-1242 (Aroclor 1242)	0	21	0 / 21	0.0094	0.021			0.041	0	0.041	0
PCB-1248 (Aroclor 1248)	0	21	0 / 21	0.0094	0.021			0.0072	0	0.0072	0
PCB-1254 (Aroclor 1254)	0	21	0 / 21	0.0097	0.022			0.041	0	0.041	0
PCB-1260 (Aroclor 1260)	0	21	0 / 21	0.0097	0.022			0.88	0	0.88	0
PCB-1262 (Aroclor 1262)	0	21	0 / 21	0.0097	0.022						
PCB-1268 (Aroclor 1268)	0	21	0 / 21	0.0097	0.022						
Polychlorinated Biphenyl (PCBs)	0	21	0 / 21	0.0097	0.022			40	0	40	0
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg											
Benzo(A)Anthracene	16	21	16 / 21	0.029	0.13	0.04	0.36	0.8	0		
Benzo(A)Pyrene	16	21	16 / 21	0.011	0.048	0.018	0.48	1.52	0		
Benzo(B)Fluoranthene	18	21	18 / 21	0.014	0.062	0.029	0.62	18	0		
Benzo(G,H,I)Perylene	17	21	17 / 21	0.02	0.091	0.057	1.1	24	0		
Benzo(K)Fluoranthene	17	21	17 / 21	0.015	0.069	0.022	0.25	62	0		
Chrysene	18	21	18 / 21	0.0095	0.043	0.026	0.55	2.4	0		
Dibenz(A,H)Anthracene	9	21	9 / 21	0.018	0.082	0.035	0.17	12	0		
Indeno(1,2,3-C,D)Pyrene	17	21	17 / 21	0.023	0.11	0.061	0.91	62	0		
Pyrene	18	21	18 / 21	0.016	0.072	0.032	0.57	10	0		
Total High Molecular Weight PAHs	18	21	18 / 21			0.105	3.57			1.1	11
2-Methylnaphthalene	2	21	2 / 21	0.0077	0.035	0.01	0.013	3.24	0		
Acenaphthene	3	21	3 / 21	0.0084	0.038	0.01	0.02	0.25	0		
Acenaphthylene	0	21	0 / 21	0.0089	0.041			120	0		
Anthracene	1	21	1 / 21	0.033	0.15	0.05	0.05	6.8	0		
Fluoranthene	18	21	18 / 21	0.01	0.047	0.033	0.56	10	0		

Table A-6
Summary of Soil ESV Exceedances - South Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Fluorene	1	21	1 / 21	0.0076	0.034	0.02	0.02	3.7	0		
Naphthalene	1	21	1 / 21	0.0088	0.04	0.015	0.015	0.0994	0		
Phenanthrene	18	21	18 / 21	0.0092	0.042	0.013	0.27	5.5	0		
Total Low Molecular Weight PAHs	18	21	18 / 21			0.059	0.87			29	0
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg											
1,2,4,5-Tetrachlorobenzene	0	21	0 / 21	0.026	0.12			2.02	0	2.02	0
1,4-Dioxane (P-Dioxane)	0	21	0 / 21	0.093	0.42			1.83	0	1.83	0
2,3,4,6-Tetrachlorophenol	0	21	0 / 21	0.033	0.15						
2,4,5-Trichlorophenol	0	21	0 / 21	0.035	0.16			4	0	4	0
2,4,6-Trichlorophenol	0	21	0 / 21	0.0099	0.045			9.94	0	9.94	0
2,4-Dichlorophenol	0	21	0 / 21	0.0082	0.037			87.5	0	87.5	0
2,4-Dimethylphenol	0	21	0 / 21	0.076	0.35			0.01	0	0.01	0
2,4-Dinitrophenol	0	21	0 / 21	0.26	1.2			0.0609	0	0.0609	0
2,4-Dinitrotoluene	0	21	0 / 21	0.014	0.063			1.28	0	1.28	0
2,6-Dinitrotoluene	0	21	0 / 21	0.018	0.084			0.0328	0	0.0328	0
2-Chloronaphthalene	0	21	0 / 21	0.0079	0.036			0.0122	0	0.0122	0
2-Chlorophenol	0	21	0 / 21	0.0088	0.04			0.243	0	0.243	0
2-Methylphenol (O-Cresol)	0	21	0 / 21	0.015	0.069			0.67	0	0.67	0
2-Nitroaniline	0	21	0 / 21	0.011	0.052			5.4	0	5.4	0
2-Nitrophenol	0	21	0 / 21	0.012	0.053			1.6	0	1.6	0
3- And 4- Methylphenol (Total)	0	21	0 / 21	0.0092	0.042						
3,3'-Dichlorobenzidine	0	21	0 / 21	0.039	0.18			0.646	0	0.646	0
3-Nitroaniline	0	21	0 / 21	0.01	0.047			3.16	0	3.16	0
4,6-Dinitro-2-Methylphenol	0	21	0 / 21	0.093	0.42			0.144	0	0.144	0
4-Bromophenyl Phenyl Ether	0	21	0 / 21	0.011	0.05						
4-Chloro-3-Methylphenol	0	21	0 / 21	0.015	0.068						
4-Chloroaniline	1	21	1 / 21	0.0089	0.041	0.019	0.019	1	0	1	0
4-Chlorophenyl Phenyl Ether	0	21	0 / 21	0.01	0.047						
4-Nitroaniline	0	21	0 / 21	0.013	0.06			21.9	0	21.9	0
4-Nitrophenol	0	21	0 / 21	0.17	0.76			7	0	7	0
Acetophenone	0	21	0 / 21	0.0076	0.034			300	0	300	0
Atrazine	0	21	0 / 21	0.015	0.07						
Benzaldehyde	1	21	1 / 21	0.026	0.12	0.038	0.038				
Benzyl Butyl Phthalate	0	21	0 / 21	0.011	0.049			0.239	0	0.239	0
Biphenyl (Diphenyl)	0	21	0 / 21	0.03	0.13			60	0	60	0
Bis(2-Chloroethoxy) Methane	0	21	0 / 21	0.011	0.049			0.302	0	0.302	0
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	1	21	1 / 21	0.0082	0.037	0.017	0.017	23.7	0	23.7	0
Bis(2-Chloroisopropyl) Ether	0	21	0 / 21	0.014	0.065			19.9	0	19.9	0

Table A-6
Summary of Soil ESV Exceedances - South Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Bis(2-Ethylhexyl) Phthalate	0	21	0 / 21	0.014	0.062			0.02	0	0.02	0
Caprolactam	0	21	0 / 21	0.025	0.11						
Carbazole	12	21	12 / 21	0.0086	0.039	0.011	0.1	80	0	80	0
Dibenzofuran	0	21	0 / 21	0.011	0.048			6.1	0	6.1	0
Diethyl Phthalate	0	21	0 / 21	0.0099	0.045			100	0	100	0
Dimethyl Phthalate	0	21	0 / 21	0.01	0.046			10	0	10	0
Di-N-Butyl Phthalate	6	21	6 / 21	0.01	0.047	0.019	0.058	0.011	6	0.011	6
Di-N-Octylphthalate	0	21	0 / 21	0.018	0.08			0.91	0	0.91	0
Hexachlorobenzene	0	21	0 / 21	0.014	0.064			0.079	0	0.079	0
Hexachlorobutadiene	0	21	0 / 21	0.0098	0.044			0.0398	0	0.0398	0
Hexachlorocyclopentadiene	0	21	0 / 21	0.022	0.098			0.755	0	0.755	0
Hexachloroethane	0	21	0 / 21	0.013	0.058			0.596	0	0.596	0
Isophorone	3	21	3 / 21	0.0075	0.034	0.0095	0.024	139	0	139	0
Nitrobenzene	0	21	0 / 21	0.011	0.05			1.31	0	1.31	0
N-Nitrosodi-N-Propylamine	0	21	0 / 21	0.012	0.053			0.544	0	0.544	0
N-Nitrosodiphenylamine	0	21	0 / 21	0.032	0.14			0.545	0	0.545	0
Pentachlorophenol	0	21	0 / 21	0.042	0.19			0.119	0	0.119	0
Phenol	0	21	0 / 21	0.011	0.052			0.79	0	0.79	0
VOLATILE ORGANIC COMPOUNDS mg/kg											
1,1,1-Trichloroethane	0	9	0 / 9	0.00023	0.00068			29.8	0	29.8	0
1,1,2,2-Tetrachloroethane	0	9	0 / 9	0.0001	0.0003			225	0	225	0
1,1,2-Trichloro-1,2,2-Trifluoroethane	0	9	0 / 9	0.00026	0.00079						
1,1,2-Trichloroethane	0	9	0 / 9	0.00017	0.0005			28.6	0	28.6	0
1,1-Dichloroethane	0	9	0 / 9	0.0002	0.00061			20.1	0	20.1	0
1,1-Dichloroethene	0	9	0 / 9	0.00025	0.00073			8.28	0	8.28	0
1,2,3-Trichlorobenzene	0	9	0 / 9	0.000066	0.0002			11.1	0	11.1	0
1,2,4-Trichlorobenzene	0	9	0 / 9	0.00019	0.00057			0.27	0	0.27	0
1,2-Dibromo-3-Chloropropane	0	9	0 / 9	0.00028	0.00084			0.0352	0	0.0352	0
1,2-Dibromoethane (Ethylene Dibromide)	0	9	0 / 9	0.000072	0.00021			1.23	0	1.23	0
1,2-Dichlorobenzene	0	9	0 / 9	0.000084	0.00025			0.92	0	0.92	0
1,2-Dichloroethane	0	9	0 / 9	0.000066	0.0002			0.85	0	0.85	0
1,2-Dichloropropane	0	9	0 / 9	0.0001	0.0003			32.7	0	32.7	0
1,3-Dichlorobenzene	0	9	0 / 9	0.000072	0.00021			0.73	0	0.73	0
1,4-Dichlorobenzene	1	9	1 / 9	0.000078	0.00023	0.00021	0.00021	0.88	0	0.88	0
2-Hexanone	0	9	0 / 9	0.00056	0.0017			0.36	0	0.36	0
Acetone	9	9	9 / 9	0.00064	0.0019	0.011	0.087	1.2	0	1.2	0
Benzene	8	9	8 / 9	0.00012	0.00036	0.0002	0.0019	0.255	0	0.255	0
Bromochloromethane	0	9	0 / 9	0.0001	0.0003						

Table A-6
Summary of Soil ESV Exceedances - South Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Bromodichloromethane	0	9	0 / 9	0.00023	0.00068			0.54	0	0.54	0
Bromoform	0	9	0 / 9	0.000078	0.00023			15.9	0	15.9	0
Bromomethane	0	9	0 / 9	0.00019	0.00057						
Carbon Disulfide	8	9	8 / 9	0.00026	0.00077	0.00051	0.0077	0.0941	0	0.0941	0
Carbon Tetrachloride	0	9	0 / 9	0.00026	0.00077			2.98	0	2.98	0
Chlorobenzene	0	9	0 / 9	0.000084	0.00025			2.4	0	2.4	0
Chloroethane	0	9	0 / 9	0.00021	0.00063						
Chloroform	0	9	0 / 9	0.00013	0.00038			1.19	0	1.19	0
Chloromethane	0	9	0 / 9	0.00023	0.00068						
Cis-1,2-Dichloroethylene	0	9	0 / 9	0.00013	0.00039			23	0	23	0
Cis-1,3-Dichloropropene	0	9	0 / 9	0.00009	0.00027			0.398	0	0.398	0
Cyclohexane	3	9	3 / 9	0.00028	0.00082	0.00073	0.004				
Dibromochloromethane	0	9	0 / 9	0.00009	0.00027			2.05	0	2.05	0
Dichlorodifluoromethane	0	9	0 / 9	0.00019	0.00057			39.5	0	39.5	0
Ethylbenzene	4	9	4 / 9	0.00011	0.00032	0.00012	0.0011	5.16	0	5.16	0
Isopropylbenzene (Cumene)	0	9	0 / 9	0.0001	0.0003						
M,P-Xylene	6	9	6 / 9	0.000066	0.0002	0.00035	0.0026				
Methyl Acetate	3	9	3 / 9	0.00054	0.0016	0.0043	0.0089				
Methyl Ethyl Ketone (2-Butanone)	7	9	7 / 9	0.00046	0.0014	0.0012	0.0078	360	0	360	0
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	0	9	0 / 9	0.0013	0.004			9.8	0	9.8	0
Methylcyclohexane	4	9	4 / 9	0.0003	0.0009	0.00056	0.006				
Methylene Chloride	0	9	0 / 9	0.00019	0.00057			2.6	0	2.6	0
O-Xylene (1,2-Dimethylbenzene)	4	9	4 / 9	0.000096	0.00029	0.00011	0.00091				
Styrene	0	9	0 / 9	0.00009	0.00027			1.2	0	1.2	0
Tert-Butyl Methyl Ether	0	9	0 / 9	0.0001	0.0003						
Tetrachloroethylene (PCE)	0	9	0 / 9	0.00017	0.0005			0.18	0	0.18	0
Toluene	8	9	8 / 9	0.00011	0.00034	0.00044	0.0051	5.45	0	5.45	0
Trans-1,2-Dichloroethene	0	9	0 / 9	0.00023	0.0007			23	0	23	0
Trans-1,3-Dichloropropene	0	9	0 / 9	0.00006	0.00018			0.398	0	0.398	0
Trichloroethylene (TCE)	0	9	0 / 9	0.00016	0.00047			1.387	0	1.387	0
Trichlorofluoromethane	0	9	0 / 9	0.0002	0.00061			16.4	0	16.4	0
Vinyl Chloride	0	9	0 / 9	0.00023	0.0007			0.12	0	0.12	0

Notes:

All soil samples from the 0-2' depth interval and sediment samples from the 0-0.5' depth interval within the South Percolation Pond exposure area included in screening assessment.

Quantitation limit used as the detection limit.

Concentration results evaluated against SLERA and BERA soil ESVs.

Total high molecular weight PAHs = sum of PAHs with four or more benzene rings.

Total low molecular weight PAHs = sum of PAHs with less than four benzene rings.

Table A-7
Summary of Soil ESV Exceedances - Northern Surface Water Feature Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
METALS mg/kg											
Aluminum	2	2	2 / 2	8.8	12.4	15500	34700	50	2		
Antimony	0	2	0 / 2	0.31	0.44			0.142	0	0.27	0
Arsenic	2	2	2 / 2	0.32	0.45	6.2	7.6	0.25	2	11.4	0
Barium	2	2	2 / 2	0.63	4.4	191	905	1.04	2	195	1
Beryllium	2	2	2 / 2	0.096	0.13	0.62	1.1	1.06	1	2.5	0
Cadmium	0	2	0 / 2	0.33	0.47			0.00222	0	0.36	0
Calcium	2	2	2 / 2	43.2	60.6	10900	11000				
Chromium, Total	2	2	2 / 2	0.6	0.84	9.1	11.3	0.34	2	26	0
Cobalt	2	2	2 / 2	0.6	0.84	4	5.6	0.14	2	13	0
Copper	2	2	2 / 2	0.6	0.85	12.3	32.1	5.4	2	28	1
Iron	2	2	2 / 2	18.8	26.3	12700	14000				
Lead	2	2	2 / 2	0.18	0.25	10.6	14.6	0.0537	2	15.3	0
Magnesium	2	2	2 / 2	29.9	41.9	5590	5690				
Manganese	2	2	2 / 2	1.2	1.7	175	234	220	1	508	0
Mercury	2	2	2 / 2	0.012	0.017	0.012	0.025	0.005	2	0.05	0
Nickel	2	2	2 / 2	0.61	0.85	9.8	13.3	9.7	2	38	0
Potassium	2	2	2 / 2	29.3	41.2	1040	1180				
Selenium	1	2	1 / 2	0.29	0.41	0.81	0.81	0.0276	1	0.52	1
Silver	0	2	0 / 2	0.61	0.86			2	0	2	0
Sodium	2	2	2 / 2	42.6	59.8	152	477				
Thallium	0	2	0 / 2	0.12	0.17			0.027	0	0.25	0
Vanadium	2	2	2 / 2	0.87	1.2	11	13.3	0.714	2	30.9	0
Zinc	2	2	2 / 2	3.1	4.4	41	41.6	6.62	2	60.5	0
GENERAL CHEMISTRY mg/kg											
Cyanide	2	2	2 / 2	0.033	0.039	0.24	0.84	0.1	2	0.183148	2
Fluoride	2	2	2 / 2	0.41	0.57	2.6	3.79	6.5	0	30	0
PESTICIDES mg/kg											
Aldrin	0	2	0 / 2	0.00093	0.0013			0.00332	0	0.00332	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	2	0 / 2	0.0007	0.00097			0.0994	0	0.0994	0
Alpha Endosulfan	0	2	0 / 2	0.0011	0.0015			0.119	0	0.119	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	2	0 / 2	0.00075	0.001			0.00398	0	0.00398	0
Beta Endosulfan	0	2	0 / 2	0.0012	0.0017			0.119	0	0.119	0
cis-Chlordane	0	2	0 / 2	0.0013	0.0017			0.27	0	0.27	0
Delta BHC (Delta Hexachlorocyclohexane)	0	2	0 / 2	0.00084	0.0012			0.1	0	0.1	0
Dieldrin	0	2	0 / 2	0.001	0.0014			0.00238	0	0.00238	0
Endosulfan Sulfate	0	2	0 / 2	0.0009	0.0012			0.0358	0	0.0358	0
Endrin	0	2	0 / 2	0.00098	0.0013			0.0014	0	0.0014	0

Table A-7
Summary of Soil ESV Exceedances - Northern Surface Water Feature Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Endrin Aldehyde	0	2	0 / 2	0.00095	0.0013			0.0105	0	0.0105	0
Endrin Ketone	0	2	0 / 2	0.0011	0.0015						
Gamma Bhc (Lindane)	0	2	0 / 2	0.00069	0.00095			0.005	0	0.005	0
Heptachlor	0	2	0 / 2	0.00099	0.0014			0.059	0	0.059	0
Heptachlor Epoxide	0	2	0 / 2	0.0015	0.0021			0.152	0	0.152	0
Methoxychlor	0	2	0 / 2	0.0016	0.0022			5	0	5	0
P,P'-DDD	0	2	0 / 2	0.001	0.0014			0.00488	0	0.00488	0
P,P'-DDE	0	2	0 / 2	0.0011	0.0015			0.021	0	0.021	0
P,P'-DDT	0	2	0 / 2	0.00079	0.0011			0.0035	0	0.0035	0
Toxaphene	0	2	0 / 2	0.022	0.031			0.119	0	0.119	0
trans-Chlordane	0	2	0 / 2	0.0017	0.0023			2.2	0	2.2	0
POLYCHLORINATED BIPHENYLS mg/kg											
PCB-1016 (Aroclor 1016)	0	2	0 / 2	0.01	0.014			1	0	1	0
PCB-1221 (Aroclor 1221)	0	2	0 / 2	0.01	0.014						
PCB-1232 (Aroclor 1232)	0	2	0 / 2	0.01	0.014						
PCB-1242 (Aroclor 1242)	0	2	0 / 2	0.01	0.014			0.041	0	0.041	0
PCB-1248 (Aroclor 1248)	0	2	0 / 2	0.01	0.014			0.0072	0	0.0072	0
PCB-1254 (Aroclor 1254)	0	2	0 / 2	0.011	0.015			0.041	0	0.041	0
PCB-1260 (Aroclor 1260)	0	2	0 / 2	0.011	0.015			0.88	0	0.88	0
PCB-1262 (Aroclor 1262)	0	2	0 / 2	0.011	0.015						
PCB-1268 (Aroclor 1268)	0	2	0 / 2	0.011	0.015						
Polychlorinated Biphenyl (PCBs)	0	2	0 / 2	0.011	0.015			40	0	40	0
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg											
Benzo(A)Anthracene	1	2	1 / 2	0.032	0.044	0.074	0.074	0.8	0		
Benzo(A)Pyrene	2	2	2 / 2	0.011	0.016	0.021	0.091	1.52	0		
Benzo(B)Fluoranthene	2	2	2 / 2	0.015	0.02	0.036	0.15	18	0		
Benzo(G,H,I)Perylene	2	2	2 / 2	0.022	0.03	0.027	0.1	24	0		
Benzo(K)Fluoranthene	1	2	1 / 2	0.017	0.023	0.053	0.053	62	0		
Chrysene	2	2	2 / 2	0.01	0.014	0.019	0.13	2.4	0		
Dibenz(A,H)Anthracene	0	2	0 / 2	0.02	0.027			12	0		
Indeno(1,2,3-C,D)Pyrene	2	2	2 / 2	0.025	0.035	0.025	0.093	62	0		
Pyrene	2	2	2 / 2	0.017	0.024	0.027	0.11	10	0		
Total High Molecular Weight PAHs	2	2	2 / 2			0.155	0.801			1.1	0
2-Methylnaphthalene	0	2	0 / 2	0.0084	0.012			3.24	0		
Acenaphthene	0	2	0 / 2	0.0092	0.013			0.25	0		
Acenaphthylene	0	2	0 / 2	0.0098	0.013			120	0		
Anthracene	0	2	0 / 2	0.036	0.05			6.8	0		
Fluoranthene	2	2	2 / 2	0.011	0.016	0.018	0.12	10	0		

Table A-7
Summary of Soil ESV Exceedances - Northern Surface Water Feature Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Fluorene	0	2	0 / 2	0.0083	0.011			3.7	0		
Naphthalene	0	2	0 / 2	0.0096	0.013			0.0994	0		
Phenanthrene	2	2	2 / 2	0.01	0.014	0.011	0.058	5.5	0		
Total Low Molecular Weight PAHs	2	2	2 / 2			0.029	0.178			29	0
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg											
1,2,4,5-Tetrachlorobenzene	0	2	0 / 2	0.028	0.039			2.02	0	2.02	0
1,4-Dioxane (P-Dioxane)	0	2	0 / 2	0.1	0.14			1.83	0	1.83	0
2,3,4,6-Tetrachlorophenol	0	2	0 / 2	0.036	0.049						
2,4,5-Trichlorophenol	0	2	0 / 2	0.038	0.052			4	0	4	0
2,4,6-Trichlorophenol	0	2	0 / 2	0.011	0.015			9.94	0	9.94	0
2,4-Dichlorophenol	0	2	0 / 2	0.009	0.012			87.5	0	87.5	0
2,4-Dimethylphenol	0	2	0 / 2	0.083	0.12			0.01	0	0.01	0
2,4-Dinitrophenol	0	2	0 / 2	0.29	0.4			0.0609	0	0.0609	0
2,4-Dinitrotoluene	0	2	0 / 2	0.015	0.021			1.28	0	1.28	0
2,6-Dinitrotoluene	0	2	0 / 2	0.02	0.028			0.0328	0	0.0328	0
2-Chloronaphthalene	0	2	0 / 2	0.0086	0.012			0.0122	0	0.0122	0
2-Chlorophenol	0	2	0 / 2	0.0096	0.013			0.243	0	0.243	0
2-Methylphenol (O-Cresol)	0	2	0 / 2	0.017	0.023			0.67	0	0.67	0
2-Nitroaniline	0	2	0 / 2	0.013	0.017			5.4	0	5.4	0
2-Nitrophenol	0	2	0 / 2	0.013	0.018			1.6	0	1.6	0
3- And 4- Methylphenol (Total)	0	2	0 / 2	0.01	0.014						
3,3'-Dichlorobenzidine	0	2	0 / 2	0.042	0.058			0.646	0	0.646	0
3-Nitroaniline	0	2	0 / 2	0.011	0.016			3.16	0	3.16	0
4,6-Dinitro-2-Methylphenol	0	2	0 / 2	0.1	0.14			0.144	0	0.144	0
4-Bromophenyl Phenyl Ether	0	2	0 / 2	0.012	0.016						
4-Chloro-3-Methylphenol	0	2	0 / 2	0.016	0.023						
4-Chloroaniline	0	2	0 / 2	0.0098	0.013			1	0	1	0
4-Chlorophenyl Phenyl Ether	0	2	0 / 2	0.011	0.016						
4-Nitroaniline	0	2	0 / 2	0.014	0.02			21.9	0	21.9	0
4-Nitrophenol	0	2	0 / 2	0.18	0.25			7	0	7	0
Acetophenone	0	2	0 / 2	0.0083	0.011			300	0	300	0
Atrazine	0	2	0 / 2	0.017	0.023						
Benzaldehyde	0	2	0 / 2	0.029	0.04						
Benzyl Butyl Phthalate	0	2	0 / 2	0.012	0.016			0.239	0	0.239	0
Biphenyl (Diphenyl)	0	2	0 / 2	0.032	0.045			60	0	60	0
Bis(2-Chloroethoxy) Methane	0	2	0 / 2	0.012	0.016			0.302	0	0.302	0
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	2	0 / 2	0.009	0.012			23.7	0	23.7	0
Bis(2-Chloroisopropyl) Ether	0	2	0 / 2	0.016	0.022			19.9	0	19.9	0

Table A-7
Summary of Soil ESV Exceedances - Northern Surface Water Feature Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Bis(2-Ethylhexyl) Phthalate	0	2	0 / 2	0.015	0.02			0.02	0	0.02	0
Caprolactam	0	2	0 / 2	0.027	0.038						
Carbazole	0	2	0 / 2	0.0094	0.013			80	0	80	0
Dibenzofuran	0	2	0 / 2	0.011	0.016			6.1	0	6.1	0
Diethyl Phthalate	0	2	0 / 2	0.011	0.015			100	0	100	0
Dimethyl Phthalate	0	2	0 / 2	0.011	0.015			10	0	10	0
Di-N-Butyl Phthalate	0	2	0 / 2	0.011	0.016			0.011	0	0.011	0
Di-N-Octylphthalate	0	2	0 / 2	0.019	0.027			0.91	0	0.91	0
Hexachlorobenzene	0	2	0 / 2	0.015	0.021			0.079	0	0.079	0
Hexachlorobutadiene	0	2	0 / 2	0.011	0.015			0.0398	0	0.0398	0
Hexachlorocyclopentadiene	0	2	0 / 2	0.024	0.033			0.755	0	0.755	0
Hexachloroethane	0	2	0 / 2	0.014	0.019			0.596	0	0.596	0
Isophorone	1	2	1 / 2	0.0081	0.011	0.015	0.015	139	0	139	0
Nitrobenzene	0	2	0 / 2	0.012	0.016			1.31	0	1.31	0
N-Nitrosodi-N-Propylamine	0	2	0 / 2	0.013	0.018			0.544	0	0.544	0
N-Nitrosodiphenylamine	0	2	0 / 2	0.034	0.048			0.545	0	0.545	0
Pentachlorophenol	0	2	0 / 2	0.046	0.063			0.119	0	0.119	0
Phenol	0	2	0 / 2	0.012	0.017			0.79	0	0.79	0

Notes:

All sediment samples from the 0-0.5' depth interval within the Northern Surface Water Feature exposure area included in screening assessment.

Quantitation limit used as the detection limit.

Concentration results evaluated against SLERA and BERA soil ESVs.

Total high molecular weight PAHs = sum of PAHs with four or more benzene rings.

Total low molecular weight PAHs = sum of PAHs with less than four benzene rings.

Table A-8
Summary of Soil ESV Exceedances - Northern Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
METALS mg/kg											
Aluminum	20	20	20 / 20	6.5	59.2	8860	121000	50	20		
Antimony	4	20	4 / 20	0.36	0.8	0.68	2.6	0.142	4	0.27	4
Arsenic	20	20	20 / 20	0.39	0.87	3.7	26.4	0.25	20	11.4	7
Barium	20	20	20 / 20	0.58	3.9	48.9	539	1.04	20	195	8
Beryllium	20	20	20 / 20	0.11	0.24	0.36	17.2	1.06	13	2.5	6
Cadmium	18	20	18 / 20	0.27	0.61	0.29	8.3	0.00222	18	0.36	17
Calcium	20	20	20 / 20	31.5	69.5	1370	106000				
Chromium, Total	20	20	20 / 20	0.68	1.5	9.5	53	0.34	20	26	5
Cobalt	20	20	20 / 20	0.68	1.5	2.6	27.4	0.14	20	13	2
Copper	20	20	20 / 20	0.59	3.3	6.7	83.6	5.4	20	28	9
Iron	20	20	20 / 20	22.8	50.2	2920	23600				
Lead	21	21	21 / 21	0.19	1.2	7.5	238	0.0537	21	15.3	15
Magnesium	20	20	20 / 20	31.6	69.7	1090	21800				
Manganese	20	20	20 / 20	1.4	3.1	15.8	762	220	9	508	1
Mercury	13	20	13 / 20	0.012	0.028	0.016	0.1	0.005	13	0.05	1
Nickel	20	20	20 / 20	0.69	2.7	16	1250	9.7	20	38	17
Potassium	20	20	20 / 20	29.9	66	266	1900				
Selenium	13	20	13 / 20	0.34	0.75	0.64	3.4	0.0276	13	0.52	13
Silver	2	20	2 / 20	0.66	1.5	0.7	1	2	0	2	0
Sodium	19	20	19 / 20	33.8	74.5	38.1	2140				
Thallium	19	20	19 / 20	0.14	0.83	0.14	4.6	0.027	19	0.25	15
Vanadium	20	20	20 / 20	0.68	1.5	12.5	348	0.714	20	30.9	12
Zinc	20	20	20 / 20	2.1	4.7	40.9	871	6.62	20	60.5	18
GENERAL CHEMISTRY mg/kg											
Cyanide	20	20	20 / 20	0.017	0.8	0.078	137	0.1	17	0.183148	17
Fluoride	20	20	20 / 20	0.2	2.77	7.98	258	6.5	20	30	18
PESTICIDES mg/kg											
Aldrin	0	9	0 / 9	0.00092	0.0021			0.00332	0	0.00332	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	9	0 / 9	0.00069	0.0016			0.0994	0	0.0994	0
Alpha Endosulfan	0	9	0 / 9	0.0011	0.0024			0.119	0	0.119	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	9	0 / 9	0.00074	0.0017			0.00398	0	0.00398	0
Beta Endosulfan	0	9	0 / 9	0.0012	0.0027			0.119	0	0.119	0
cis-Chlordane	0	9	0 / 9	0.0012	0.0028			0.27	0	0.27	0
Delta BHC (Delta Hexachlorocyclohexane)	0	9	0 / 9	0.00083	0.0019			0.1	0	0.1	0
Dieldrin	0	9	0 / 9	0.00099	0.0022			0.00238	0	0.00238	0
Endosulfan Sulfate	0	9	0 / 9	0.00088	0.002			0.0358	0	0.0358	0
Endrin	0	9	0 / 9	0.00096	0.0022			0.0014	0	0.0014	0
Endrin Aldehyde	0	9	0 / 9	0.00094	0.0021			0.0105	0	0.0105	0
Endrin Ketone	0	9	0 / 9	0.0011	0.0024						

Table A-8
Summary of Soil ESV Exceedances - Northern Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Gamma Bhc (Lindane)	0	9	0 / 9	0.00068	0.0015			0.005	0	0.005	0
Heptachlor	0	9	0 / 9	0.00098	0.0022			0.059	0	0.059	0
Heptachlor Epoxide	0	9	0 / 9	0.0015	0.0034			0.152	0	0.152	0
Methoxychlor	0	9	0 / 9	0.0016	0.0036			5	0	5	0
P,P'-DDD	0	9	0 / 9	0.001	0.0023			0.00488	0	0.00488	0
P,P'-DDE	0	9	0 / 9	0.0011	0.0025			0.021	0	0.021	0
P,P'-DDT	0	9	0 / 9	0.00078	0.0018			0.0035	0	0.0035	0
Toxaphene	0	9	0 / 9	0.022	0.05			0.119	0	0.119	0
trans-Chlordane	0	9	0 / 9	0.0016	0.0037			2.2	0	2.2	0
POLYCHLORINATED BIPHENYLS mg/kg											
PCB-1016 (Aroclor 1016)	0	20	0 / 20	0.0095	0.023			1	0	1	0
PCB-1221 (Aroclor 1221)	0	20	0 / 20	0.0095	0.023						
PCB-1232 (Aroclor 1232)	0	20	0 / 20	0.0095	0.023						
PCB-1242 (Aroclor 1242)	0	20	0 / 20	0.0095	0.023			0.041	0	0.041	0
PCB-1248 (Aroclor 1248)	0	20	0 / 20	0.0095	0.023			0.0072	0	0.0072	0
PCB-1254 (Aroclor 1254)	0	20	0 / 20	0.0099	0.024			0.041	0	0.041	0
PCB-1260 (Aroclor 1260)	0	20	0 / 20	0.0099	0.024			0.88	0	0.88	0
PCB-1262 (Aroclor 1262)	0	20	0 / 20	0.0099	0.024						
PCB-1268 (Aroclor 1268)	0	20	0 / 20	0.0099	0.024						
Polychlorinated Biphenyl (PCBs)	0	20	0 / 20	0.0099	0.024			40	0	40	0
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg											
Benzo(A)Anthracene	18	20	18 / 20	0.03	5.9	1.7	280	0.8	18		
Benzo(A)Pyrene	18	20	18 / 20	0.011	2.1	2	320	1.52	18		
Benzo(B)Fluoranthene	18	20	18 / 20	0.014	2.8	6.8	460	18	13		
Benzo(G,H,I)Perylene	18	20	18 / 20	0.021	4.1	2.2	250	24	9		
Benzo(K)Fluoranthene	18	20	18 / 20	0.016	3.1	2.4	150	62	5		
Chrysene	19	20	19 / 20	0.0097	1.9	0.011	500	2.4	17		
Dibenz(A,H)Anthracene	18	20	18 / 20	0.019	3.7	0.61	70	12	7		
Indeno(1,2,3-C,D)Pyrene	18	20	18 / 20	0.024	4.7	2.7	260	62	5		
Pyrene	19	20	19 / 20	0.016	3.2	0.058	1200	10	14		
Total High Molecular Weight PAHs	20	20	20 / 20			0.011	2892			1.1	18
2-Methylnaphthalene	18	20	18 / 20	0.0079	1.6	0.017	4.2	3.24	2		
Acenaphthene	19	20	19 / 20	0.0087	1.7	0.031	40	0.25	16		
Acenaphthylene	3	20	3 / 20	0.0092	1.8	0.033	1.2	120	0		
Anthracene	19	20	19 / 20	0.034	6.7	0.049	110	6.8	8		
Fluoranthene	19	20	19 / 20	0.011	2.1	0.029	1400	10	15		
Fluorene	19	20	19 / 20	0.0078	1.5	0.012	22	3.7	5		
Naphthalene	19	20	19 / 20	0.0091	1.8	0.042	6.5	0.0994	15		
Phenanthrene	19	20	19 / 20	0.0095	1.9	0.51	440	5.5	14		
Total Low Molecular Weight PAHs	19	20	19 / 20			1.963	1982.9			29	12

Table A-8
Summary of Soil ESV Exceedances - Northern Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg											
1,2,4,5-Tetrachlorobenzene	0	20	0 / 20	0.027	5.3			2.02	0	2.02	0
1,4-Dioxane (P-Dioxane)	0	20	0 / 20	0.096	19			1.83	0	1.83	0
2,3,4,6-Tetrachlorophenol	0	20	0 / 20	0.034	6.7						
2,4,5-Trichlorophenol	0	20	0 / 20	0.036	7.1			4	0	4	0
2,4,6-Trichlorophenol	0	20	0 / 20	0.01	2			9.94	0	9.94	0
2,4-Dichlorophenol	0	20	0 / 20	0.0084	1.7			87.5	0	87.5	0
2,4-Dimethylphenol	0	20	0 / 20	0.079	16			0.01	0	0.01	0
2,4-Dinitrophenol	0	20	0 / 20	0.27	54			0.0609	0	0.0609	0
2,4-Dinitrotoluene	0	20	0 / 20	0.014	2.8			1.28	0	1.28	0
2,6-Dinitrotoluene	0	20	0 / 20	0.019	3.8			0.0328	0	0.0328	0
2-Chloronaphthalene	0	20	0 / 20	0.0081	1.6			0.0122	0	0.0122	0
2-Chlorophenol	0	20	0 / 20	0.0091	1.8			0.243	0	0.243	0
2-Methylphenol (O-Cresol)	0	20	0 / 20	0.016	3.1			0.67	0	0.67	0
2-Nitroaniline	0	20	0 / 20	0.012	2.3			5.4	0	5.4	0
2-Nitrophenol	0	20	0 / 20	0.012	2.4			1.6	0	1.6	0
3- And 4- Methylphenol (Total)	0	20	0 / 20	0.0095	1.9						
3,3'-Dichlorobenzidine	0	20	0 / 20	0.04	7.9			0.646	0	0.646	0
3-Nitroaniline	0	20	0 / 20	0.011	2.1			3.16	0	3.16	0
4,6-Dinitro-2-Methylphenol	0	20	0 / 20	0.096	19			0.144	0	0.144	0
4-Bromophenyl Phenyl Ether	0	20	0 / 20	0.011	2.2						
4-Chloro-3-Methylphenol	0	20	0 / 20	0.015	3						
4-Chloroaniline	1	20	1 / 20	0.0092	1.8	0.13	0.13	1	0	1	0
4-Chlorophenyl Phenyl Ether	0	20	0 / 20	0.011	2.1						
4-Nitroaniline	0	20	0 / 20	0.014	2.7			21.9	0	21.9	0
4-Nitrophenol	0	20	0 / 20	0.17	34			7	0	7	0
Acetophenone	1	20	1 / 20	0.0078	1.5	0.011	0.011	300	0	300	0
Atrazine	0	20	0 / 20	0.016	3.2						
Benzaldehyde	0	20	0 / 20	0.027	5.4						
Benzyl Butyl Phthalate	1	20	1 / 20	0.011	2.2	0.55	0.55	0.239	1	0.239	1
Biphenyl (Diphenyl)	1	20	1 / 20	0.031	6.1	0.072	0.072	60	0	60	0
Bis(2-Chloroethoxy) Methane	0	20	0 / 20	0.011	2.2			0.302	0	0.302	0
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	20	0 / 20	0.0084	1.7			23.7	0	23.7	0
Bis(2-Chloroisopropyl) Ether	0	20	0 / 20	0.015	2.9			19.9	0	19.9	0
Bis(2-Ethylhexyl) Phthalate	4	20	4 / 20	0.014	2.8	0.17	5.9	0.02	4	0.02	4
Caprolactam	0	20	0 / 20	0.026	5.1						
Carbazole	18	20	18 / 20	0.0089	1.8	0.11	33	80	0	80	0
Dibenzofuran	19	20	19 / 20	0.011	2.1	0.041	8.8	6.1	2	6.1	2
Diethyl Phthalate	1	20	1 / 20	0.01	2	2.3	2.3	100	0	100	0
Dimethyl Phthalate	0	20	0 / 20	0.01	2.1			10	0	10	0

Table A-8
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Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Di-N-Butyl Phthalate	0	20	0 / 20	0.011	2.1			0.011	0	0.011	0
Di-N-Octylphthalate	0	20	0 / 20	0.018	3.6			0.91	0	0.91	0
Hexachlorobenzene	0	20	0 / 20	0.015	2.9			0.079	0	0.079	0
Hexachlorobutadiene	0	20	0 / 20	0.01	2			0.0398	0	0.0398	0
Hexachlorocyclopentadiene	0	20	0 / 20	0.022	4.4			0.755	0	0.755	0
Hexachloroethane	0	20	0 / 20	0.013	2.6			0.596	0	0.596	0
Isophorone	0	20	0 / 20	0.0077	1.5			139	0	139	0
Nitrobenzene	0	20	0 / 20	0.011	2.2			1.31	0	1.31	0
N-Nitrosodi-N-Propylamine	0	20	0 / 20	0.012	2.4			0.544	0	0.544	0
N-Nitrosodiphenylamine	0	20	0 / 20	0.032	6.4			0.545	0	0.545	0
Pentachlorophenol	0	20	0 / 20	0.043	8.6			0.119	0	0.119	0
Phenol	1	20	1 / 20	0.012	2.3	0.26	0.26	0.79	0	0.79	0
VOLATILE ORGANIC COMPOUNDS mg/kg											
1,1,1-Trichloroethane	0	9	0 / 9	0.00038	0.001			29.8	0	29.8	0
1,1,2,2-Tetrachloroethane	0	9	0 / 9	0.00017	0.00045			225	0	225	0
1,1,2-Trichloro-1,2,2-Trifluoroethane	0	9	0 / 9	0.00044	0.0012						
1,1,2-Trichloroethane	0	9	0 / 9	0.00028	0.00075			28.6	0	28.6	0
1,1-Dichloroethane	0	9	0 / 9	0.00034	0.00091			20.1	0	20.1	0
1,1-Dichloroethene	0	9	0 / 9	0.00041	0.0011			8.28	0	8.28	0
1,2,3-Trichlorobenzene	0	9	0 / 9	0.00011	0.00029			11.1	0	11.1	0
1,2,4-Trichlorobenzene	0	9	0 / 9	0.00032	0.00086			0.27	0	0.27	0
1,2-Dibromo-3-Chloropropane	0	9	0 / 9	0.00047	0.0013			0.0352	0	0.0352	0
1,2-Dibromoethane (Ethylene Dibromide)	0	9	0 / 9	0.00012	0.00032			1.23	0	1.23	0
1,2-Dichlorobenzene	0	9	0 / 9	0.00014	0.00037			0.92	0	0.92	0
1,2-Dichloroethane	0	9	0 / 9	0.00011	0.00029			0.85	0	0.85	0
1,2-Dichloropropane	0	9	0 / 9	0.00017	0.00045			32.7	0	32.7	0
1,3-Dichlorobenzene	0	9	0 / 9	0.00012	0.00032			0.73	0	0.73	0
1,4-Dichlorobenzene	0	9	0 / 9	0.00013	0.00035			0.88	0	0.88	0
2-Hexanone	2	9	2 / 9	0.00095	0.0025	0.0024	0.0036	0.36	0	0.36	0
Acetone	9	9	9 / 9	0.0011	0.0028	0.0096	0.31	1.2	0	1.2	0
Benzene	4	9	4 / 9	0.0002	0.00054	0.00043	0.0031	0.255	0	0.255	0
Bromochloromethane	0	9	0 / 9	0.00017	0.00045						
Bromodichloromethane	0	9	0 / 9	0.00038	0.001			0.54	0	0.54	0
Bromoform	0	9	0 / 9	0.00013	0.00035			15.9	0	15.9	0
Bromomethane	0	9	0 / 9	0.00032	0.00086						
Carbon Disulfide	6	9	6 / 9	0.00043	0.0012	0.00092	0.0059	0.0941	0	0.0941	0
Carbon Tetrachloride	0	9	0 / 9	0.00043	0.0012			2.98	0	2.98	0
Chlorobenzene	0	9	0 / 9	0.00014	0.00037			2.4	0	2.4	0
Chloroethane	0	9	0 / 9	0.00035	0.00094						
Chloroform	0	9	0 / 9	0.00021	0.00056			1.19	0	1.19	0

Table A-8
Summary of Soil ESV Exceedances - Northern Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Chloromethane	0	9	0 / 9	0.00038	0.001						
Cis-1,2-Dichloroethylene	0	9	0 / 9	0.00022	0.00059			23	0	23	0
Cis-1,3-Dichloropropene	0	9	0 / 9	0.00015	0.0004			0.398	0	0.398	0
Cyclohexane	3	9	3 / 9	0.00046	0.0012	0.0027	0.0086				
Dibromochloromethane	0	9	0 / 9	0.00015	0.0004			2.05	0	2.05	0
Dichlorodifluoromethane	0	9	0 / 9	0.00032	0.00086			39.5	0	39.5	0
Ethylbenzene	3	9	3 / 9	0.00018	0.00048	0.0015	0.0038	5.16	0	5.16	0
Isopropylbenzene (Cumene)	2	9	2 / 9	0.00017	0.00045	0.0002	0.00052				
M,P-Xylene	5	9	5 / 9	0.00011	0.00029	0.00016	0.0091				
Methyl Acetate	5	9	5 / 9	0.00091	0.0024	0.0022	0.0065				
Methyl Ethyl Ketone (2-Butanone)	7	9	7 / 9	0.00077	0.0021	0.002	0.041	360	0	360	0
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	0	9	0 / 9	0.0022	0.0059			9.8	0	9.8	0
Methylcyclohexane	3	9	3 / 9	0.0005	0.0013	0.0052	0.015				
Methylene Chloride	1	9	1 / 9	0.00032	0.00086	0.002	0.002	2.6	0	2.6	0
O-Xylene (1,2-Dimethylbenzene)	3	9	3 / 9	0.00016	0.00043	0.00094	0.0032				
Styrene	0	9	0 / 9	0.00015	0.0004			1.2	0	1.2	0
Tert-Butyl Methyl Ether	0	9	0 / 9	0.00017	0.00045						
Tetrachloroethylene (PCE)	0	9	0 / 9	0.00028	0.00075			0.18	0	0.18	0
Toluene	8	9	8 / 9	0.00019	0.00051	0.00033	0.013	5.45	0	5.45	0
Trans-1,2-Dichloroethene	0	9	0 / 9	0.00039	0.001			23	0	23	0
Trans-1,3-Dichloropropene	0	9	0 / 9	0.0001	0.00027			0.398	0	0.398	0
Trichloroethylene (TCE)	0	9	0 / 9	0.00026	0.0007			1.387	0	1.387	0
Trichlorofluoromethane	0	9	0 / 9	0.00034	0.00091			16.4	0	16.4	0
Vinyl Chloride	0	9	0 / 9	0.00039	0.001			0.12	0	0.12	0

Notes:

All soil samples from the 0-2' depth interval and sediment samples from the 0-0.5' depth interval within the North Percolation Pond exposure area included in screening assessment.
Quantitation limit used as the detection limit.
Concentration results evaluated against SLERA and BERA soil ESVs.
Total high molecular weight PAHs = sum of PAHs with four or more benzene rings.
Total low molecular weight PAHs = sum of PAHs with less than four benzene rings.

Table A-9
Summary of Soil ESV Exceedances - Central Landfill Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
METALS mg/kg											
Aluminum	118	118	118 / 118	0.79	16.9	7000	44900	50	118		
Antimony	36	118	36 / 118	0.018	0.49	0.092	1.9	0.142	27	0.27	8
Arsenic	118	118	118 / 118	0.033	0.53	2.8	12.3	0.25	118	11.4	3
Barium	118	118	118 / 118	0.28	0.79	40.7	293	1.04	118	195	9
Beryllium	118	118	118 / 118	0.014	0.15	0.24	3.7	1.06	8	2.5	2
Cadmium	38	118	38 / 118	0.0047	0.37	0.054	1.2	0.00222	38	0.36	6
Calcium	118	118	118 / 118	27.7	42.7	1770	95300				
Chromium, Total	118	118	118 / 118	0.077	0.93	6.5	84.8	0.34	118	26	8
Cobalt	118	118	118 / 118	0.0022	0.92	3.5	11.7	0.14	118	13	0
Copper	118	118	118 / 118	0.12	6.1	8	7260	5.4	118	28	16
Iron	118	118	118 / 118	4.1	30.9	9060	37100				
Lead	131	131	131 / 131	0.058	0.93	5.8	406	0.0537	131	15.3	42
Magnesium	118	118	118 / 118	5.1	42.8	7430	18800				
Manganese	118	118	118 / 118	0.15	1.9	156	886	220	115	508	25
Mercury	96	118	96 / 118	0.011	0.017	0.012	0.076	0.005	96	0.05	2
Nickel	118	118	118 / 118	0.05	0.93	7.4	142	9.7	109	38	14
Potassium	118	118	118 / 118	6.3	40.6	541	3080				
Selenium	47	118	47 / 118	0.051	0.46	0.34	13.3	0.0276	47	0.52	40
Silver	34	118	34 / 118	0.0018	0.9	0.03	0.19	2	0	2	0
Sodium	90	118	90 / 118	11.1	45.8	33	10500				
Thallium	42	118	42 / 118	0.024	0.18	0.06	0.4	0.027	42	0.25	1
Vanadium	118	118	118 / 118	0.047	0.92	5	54.5	0.714	118	30.9	5
Zinc	118	118	118 / 118	0.64	2.9	28.9	306	6.62	118	60.5	31
GENERAL CHEMISTRY mg/kg											
Cyanide	111	118	111 / 118	0.015	0.33	0.016	29	0.1	68	0.183148	53
Fluoride	118	118	118 / 118	0.19	9.02	5.6	976	6.5	117	30	88
PESTICIDES mg/kg											
Aldrin	0	42	0 / 42	0.00078	0.00095			0.00332	0	0.00332	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	42	0 / 42	0.00059	0.00072			0.0994	0	0.0994	0
Alpha Endosulfan	0	42	0 / 42	0.00089	0.0011			0.119	0	0.119	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	42	0 / 42	0.00063	0.00077			0.00398	0	0.00398	0
Beta Endosulfan	0	42	0 / 42	0.001	0.0012			0.119	0	0.119	0
cis-Chlordane	0	42	0 / 42	0.001	0.0013			0.27	0	0.27	0
Delta BHC (Delta Hexachlorocyclohexane)	0	42	0 / 42	0.0007	0.00086			0.1	0	0.1	0
Dieldrin	0	41	0 / 41	0.00084	0.001			0.00238	0	0.00238	0
Endosulfan Sulfate	0	42	0 / 42	0.00075	0.00092			0.0358	0	0.0358	0
Endrin	0	42	0 / 42	0.00082	0.001			0.0014	0	0.0014	0
Endrin Aldehyde	0	42	0 / 42	0.0008	0.00098			0.0105	0	0.0105	0
Endrin Ketone	0	42	0 / 42	0.00089	0.0011						

Table A-9
Summary of Soil ESV Exceedances - Central Landfill Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Gamma Bhc (Lindane)	0	42	0 / 42	0.00058	0.00071			0.005	0	0.005	0
Heptachlor	0	42	0 / 42	0.00083	0.001			0.059	0	0.059	0
Heptachlor Epoxide	0	42	0 / 42	0.0013	0.0015			0.152	0	0.152	0
Methoxychlor	0	42	0 / 42	0.0014	0.0017			5	0	5	0
P,P'-DDD	0	42	0 / 42	0.00085	0.001			0.00488	0	0.00488	0
P,P'-DDE	0	42	0 / 42	0.00093	0.0011			0.021	0	0.021	0
P,P'-DDT	0	42	0 / 42	0.00066	0.00081			0.0035	0	0.0035	0
Toxaphene	0	42	0 / 42	0.019	0.023			0.119	0	0.119	0
trans-Chlordane	0	42	0 / 42	0.0014	0.0017			2.2	0	2.2	0
POLYCHLORINATED BIPHENYLS mg/kg											
PCB-1016 (Aroclor 1016)	0	118	0 / 118	0.000089	0.012			1	0	1	0
PCB-1221 (Aroclor 1221)	0	118	0 / 118	0.000089	0.012						
PCB-1232 (Aroclor 1232)	0	118	0 / 118	0.000089	0.012						
PCB-1242 (Aroclor 1242)	0	118	0 / 118	0.000089	0.012			0.041	0	0.041	0
PCB-1248 (Aroclor 1248)	0	118	0 / 118	0.000089	0.012			0.0072	0	0.0072	0
PCB-1254 (Aroclor 1254)	6	118	6 / 118	0.000092	0.013	0.057	0.21	0.041	6	0.041	6
PCB-1260 (Aroclor 1260)	0	118	0 / 118	0.000092	0.013			0.88	0	0.88	0
PCB-1262 (Aroclor 1262)	0	118	0 / 118	0.000092	0.013						
PCB-1268 (Aroclor 1268)	0	118	0 / 118	0.000092	0.013						
Polychlorinated Biphenyl (PCBs)	6	118	6 / 118	0.000092	0.013	0.057	0.21	40	0	40	0
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg											
Benzo(A)Anthracene	107	118	107 / 118	0.026	1.6	0.036	100	0.8	44		
Benzo(A)Pyrene	111	118	111 / 118	0.0095	0.58	0.014	100	1.52	34		
Benzo(B)Fluoranthene	115	118	115 / 118	0.012	0.75	0.015	120	18	9		
Benzo(G,H,I)Perylene	108	118	108 / 118	0.018	1.1	0.021	62	24	4		
Benzo(K)Fluoranthene	104	118	104 / 118	0.014	0.83	0.015	50	62	0		
Chrysene	117	118	117 / 118	0.0086	0.52	0.011	110	2.4	29		
Dibenz(A,H)Anthracene	94	118	94 / 118	0.016	1	0.019	21	12	3		
Indeno(1,2,3-C,D)Pyrene	106	118	106 / 118	0.021	1.3	0.03	76	62	1		
Pyrene	112	118	112 / 118	0.014	0.87	0.017	150	10	12		
Total High Molecular Weight PAHs	117	118	117 / 118			0.011	789			1.1	90
2-Methylnaphthalene	68	118	68 / 118	0.0069	0.42	0.0074	3.9	3.24	2		
Acenaphthene	88	118	88 / 118	0.0076	0.46	0.008	28	0.25	24		
Acenaphthylene	9	118	9 / 118	0.0081	0.49	0.013	1	120	0		
Anthracene	77	118	77 / 118	0.03	1.8	0.033	48	6.8	7		
Fluoranthene	116	118	116 / 118	0.0093	0.57	0.014	240	10	11		
Fluorene	81	118	81 / 118	0.0069	0.42	0.01	25	3.7	6		
Naphthalene	71	118	71 / 118	0.008	0.49	0.0097	10	0.0994	22		
Phenanthrene	113	118	113 / 118	0.0084	0.51	0.011	240	5.5	13		
Total Low Molecular Weight PAHs	116	118	116 / 118			0.014	595.9			29	9

Table A-9
Summary of Soil ESV Exceedances - Central Landfill Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg											
1,2,4,5-Tetrachlorobenzene	0	118	0 / 118	0.023	1.4			2.02	0	2.02	0
1,4-Dioxane (P-Dioxane)	0	118	0 / 118	0.084	5.1			1.83	0	1.83	0
2,3,4,6-Tetrachlorophenol	0	118	0 / 118	0.03	1.8						
2,4,5-Trichlorophenol	0	118	0 / 118	0.031	1.9			4	0	4	0
2,4,6-Trichlorophenol	0	118	0 / 118	0.0089	0.54			9.94	0	9.94	0
2,4-Dichlorophenol	0	118	0 / 118	0.0074	0.45			87.5	0	87.5	0
2,4-Dimethylphenol	0	118	0 / 118	0.069	4.2			0.01	0	0.01	0
2,4-Dinitrophenol	0	118	0 / 118	0.24	14			0.0609	0	0.0609	0
2,4-Dinitrotoluene	0	118	0 / 118	0.012	0.76			1.28	0	1.28	0
2,6-Dinitrotoluene	0	118	0 / 118	0.017	1			0.0328	0	0.0328	0
2-Chloronaphthalene	0	118	0 / 118	0.0071	0.43			0.0122	0	0.0122	0
2-Chlorophenol	0	118	0 / 118	0.008	0.49			0.243	0	0.243	0
2-Methylphenol (O-Cresol)	0	118	0 / 118	0.014	0.83			0.67	0	0.67	0
2-Nitroaniline	0	118	0 / 118	0.01	0.63			5.4	0	5.4	0
2-Nitrophenol	0	118	0 / 118	0.011	0.64			1.6	0	1.6	0
3- And 4- Methylphenol (Total)	5	118	5 / 118	0.0084	0.51	0.011	1				
3,3'-Dichlorobenzidine	0	118	0 / 118	0.035	2.1			0.646	0	0.646	0
3-Nitroaniline	0	118	0 / 118	0.0093	0.57			3.16	0	3.16	0
4,6-Dinitro-2-Methylphenol	0	118	0 / 118	0.084	5.1			0.144	0	0.144	0
4-Bromophenyl Phenyl Ether	0	118	0 / 118	0.0099	0.6						
4-Chloro-3-Methylphenol	0	118	0 / 118	0.014	0.82						
4-Chloroaniline	0	118	0 / 118	0.0081	0.49			1	0	1	0
4-Chlorophenyl Phenyl Ether	0	118	0 / 118	0.0094	0.57						
4-Nitroaniline	0	118	0 / 118	0.012	0.72			21.9	0	21.9	0
4-Nitrophenol	0	118	0 / 118	0.15	9.2			7	0	7	0
Acetophenone	15	118	15 / 118	0.0069	0.42	0.0071	0.03	300	0	300	0
Atrazine	0	118	0 / 118	0.014	0.85						
Benzaldehyde	6	118	6 / 118	0.024	1.5	0.026	0.051				
Benzyl Butyl Phthalate	12	118	12 / 118	0.0097	0.59	0.0099	0.98	0.239	2	0.239	2
Biphenyl (Diphenyl)	4	118	4 / 118	0.027	1.6	0.035	0.31	60	0	60	0
Bis(2-Chloroethoxy) Methane	0	118	0 / 118	0.0098	0.6			0.302	0	0.302	0
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	118	0 / 118	0.0074	0.45			23.7	0	23.7	0
Bis(2-Chloroisopropyl) Ether	0	118	0 / 118	0.013	0.79			19.9	0	19.9	0
Bis(2-Ethylhexyl) Phthalate	25	118	25 / 118	0.012	0.75	0.014	0.81	0.02	23	0.02	23
Caprolactam	2	118	2 / 118	0.023	1.4	0.039	0.066				
Carbazole	98	118	98 / 118	0.0078	0.47	0.0097	32	80	0	80	0
Dibenzofuran	73	118	73 / 118	0.0095	0.58	0.011	15	6.1	3	6.1	3
Diethyl Phthalate	0	118	0 / 118	0.0089	0.54			100	0	100	0
Dimethyl Phthalate	0	118	0 / 118	0.0091	0.56			10	0	10	0

Table A-9
Summary of Soil ESV Exceedances - Central Landfill Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Di-N-Butyl Phthalate	27	118	27 / 118	0.0094	0.57	0.011	0.095	0.011	26	0.011	26
Di-N-Octylphthalate	2	118	2 / 118	0.016	0.97	0.096	0.61	0.91	0	0.91	0
Hexachlorobenzene	0	118	0 / 118	0.013	0.78			0.079	0	0.079	0
Hexachlorobutadiene	0	118	0 / 118	0.0088	0.54			0.0398	0	0.0398	0
Hexachlorocyclopentadiene	0	118	0 / 118	0.02	1.2			0.755	0	0.755	0
Hexachloroethane	0	118	0 / 118	0.012	0.7			0.596	0	0.596	0
Isophorone	27	118	27 / 118	0.0068	0.41	0.0072	1.5	139	0	139	0
Nitrobenzene	0	118	0 / 118	0.0099	0.6			1.31	0	1.31	0
N-Nitrosodi-N-Propylamine	0	118	0 / 118	0.011	0.64			0.544	0	0.544	0
N-Nitrosodiphenylamine	0	118	0 / 118	0.029	1.7			0.545	0	0.545	0
Pentachlorophenol	0	118	0 / 118	0.038	2.3			0.119	0	0.119	0
Phenol	7	118	7 / 118	0.01	0.63	0.012	1.2	0.79	1	0.79	1
VOLATILE ORGANIC COMPOUNDS mg/kg											
1,1,1-Trichloroethane	0	27	0 / 27	0.00028	0.00055			29.8	0	29.8	0
1,1,2,2-Tetrachloroethane	0	27	0 / 27	0.00013	0.00025			225	0	225	0
1,1,2-Trichloro-1,2,2-Trifluoroethane	0	27	0 / 27	0.00033	0.00064						
1,1,2-Trichloroethane	0	27	0 / 27	0.00021	0.00041			28.6	0	28.6	0
1,1-Dichloroethane	0	27	0 / 27	0.00025	0.0005			20.1	0	20.1	0
1,1-Dichloroethene	0	27	0 / 27	0.0003	0.0006			8.28	0	8.28	0
1,2,3-Trichlorobenzene	0	27	0 / 27	0.000082	0.00016			11.1	0	11.1	0
1,2,4-Trichlorobenzene	0	27	0 / 27	0.00024	0.00047			0.27	0	0.27	0
1,2-Dibromo-3-Chloropropane	0	27	0 / 27	0.00035	0.00069			0.0352	0	0.0352	0
1,2-Dibromoethane (Ethylene Dibromide)	0	27	0 / 27	0.000089	0.00018			1.23	0	1.23	0
1,2-Dichlorobenzene	0	27	0 / 27	0.0001	0.0002			0.92	0	0.92	0
1,2-Dichloroethane	0	27	0 / 27	0.000082	0.00016			0.85	0	0.85	0
1,2-Dichloropropane	0	27	0 / 27	0.00013	0.00025			32.7	0	32.7	0
1,3-Dichlorobenzene	0	27	0 / 27	0.000089	0.00018			0.73	0	0.73	0
1,4-Dichlorobenzene	0	27	0 / 27	0.000097	0.00019			0.88	0	0.88	0
2-Hexanone	0	27	0 / 27	0.0007	0.0014			0.36	0	0.36	0
Acetone	25	27	25 / 27	0.00079	0.0015	0.0079	0.13	1.2	0	1.2	0
Benzene	12	27	12 / 27	0.00015	0.00029	0.00017	0.0097	0.255	0	0.255	0
Bromochloromethane	0	27	0 / 27	0.00013	0.00025						
Bromodichloromethane	0	27	0 / 27	0.00028	0.00055			0.54	0	0.54	0
Bromoform	0	27	0 / 27	0.000097	0.00019			15.9	0	15.9	0
Bromomethane	1	27	1 / 27	0.00024	0.00047	0.00045	0.00045				
Carbon Disulfide	13	27	13 / 27	0.00032	0.00063	0.00039	0.0041	0.0941	0	0.0941	0
Carbon Tetrachloride	0	27	0 / 27	0.00032	0.00063			2.98	0	2.98	0
Chlorobenzene	0	27	0 / 27	0.0001	0.0002			2.4	0	2.4	0
Chloroethane	0	27	0 / 27	0.00026	0.00051						
Chloroform	0	27	0 / 27	0.00016	0.00031			1.19	0	1.19	0

Table A-9
Summary of Soil ESV Exceedances - Central Landfill Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Chloromethane	0	27	0 / 27	0.00028	0.00055						
Cis-1,2-Dichloroethylene	0	27	0 / 27	0.00016	0.00032			23	0	23	0
Cis-1,3-Dichloropropene	0	27	0 / 27	0.00011	0.00022			0.398	0	0.398	0
Cyclohexane	1	27	1 / 27	0.00034	0.00067	0.00052	0.00052				
Dibromochloromethane	0	27	0 / 27	0.00011	0.00022			2.05	0	2.05	0
Dichlorodifluoromethane	0	27	0 / 27	0.00024	0.00047			39.5	0	39.5	0
Ethylbenzene	1	27	1 / 27	0.00013	0.00026	0.0024	0.0024	5.16	0	5.16	0
Isopropylbenzene (Cumene)	1	27	1 / 27	0.00013	0.00025	0.00034	0.00034				
M,P-Xylene	10	27	10 / 27	0.000082	0.00016	0.00012	0.0038				
Methyl Acetate	7	27	7 / 27	0.00067	0.0013	0.0028	0.017				
Methyl Ethyl Ketone (2-Butanone)	6	27	6 / 27	0.00057	0.0011	0.0009	0.012	360	0	360	0
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	0	27	0 / 27	0.0017	0.0032			9.8	0	9.8	0
Methylcyclohexane	5	27	5 / 27	0.00037	0.00073	0.00042	0.001				
Methylene Chloride	2	27	2 / 27	0.00024	0.00047	0.00056	0.0015	2.6	0	2.6	0
O-Xylene (1,2-Dimethylbenzene)	2	27	2 / 27	0.00012	0.00023	0.00022	0.0016				
Styrene	0	27	0 / 27	0.00011	0.00022			1.2	0	1.2	0
Tert-Butyl Methyl Ether	0	27	0 / 27	0.00013	0.00025						
Tetrachloroethylene (PCE)	1	27	1 / 27	0.00021	0.00041	0.00034	0.00034	0.18	0	0.18	0
Toluene	22	27	22 / 27	0.00014	0.00028	0.00015	0.012	5.45	0	5.45	0
Trans-1,2-Dichloroethene	0	27	0 / 27	0.00029	0.00057			23	0	23	0
Trans-1,3-Dichloropropene	0	27	0 / 27	0.000074	0.00015			0.398	0	0.398	0
Trichloroethylene (TCE)	0	27	0 / 27	0.00019	0.00038			1.387	0	1.387	0
Trichlorofluoromethane	0	27	0 / 27	0.00025	0.0005			16.4	0	16.4	0
Vinyl Chloride	0	27	0 / 27	0.00029	0.00057			0.12	0	0.12	0

Notes:

All soil samples from the 0-2' depth interval within the Central Landfill exposure area included in screening assessment.

Quantitation limit used as the detection limit.

Concentration results evaluated against SLERA and BERA soil ESVs.

Total high molecular weight PAHs = sum of PAHs with four or more benzene rings.

Total low molecular weight PAHs = sum of PAHs with less than four benzene rings.

Table A-10
Summary of Soil ESV Exceedances - Eastern Undeveloped Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
METALS mg/kg											
Aluminum	7	7	7 / 7	8	12.7	12000	21300	50	7		
Antimony	0	7	0 / 7	0.28	0.45			0.142	0	0.27	0
Arsenic	7	7	7 / 7	0.29	0.46	3	6	0.25	7	11.4	0
Barium	7	7	7 / 7	0.57	0.9	152	267	1.04	7	195	4
Beryllium	7	7	7 / 7	0.087	0.14	0.25	0.65	1.06	0	2.5	0
Cadmium	0	7	0 / 7	0.3	0.48			0.00222	0	0.36	0
Calcium	7	7	7 / 7	39	62.2	1730	2930				
Chromium, Total	7	7	7 / 7	0.54	0.86	8.4	15.8	0.34	7	26	0
Cobalt	7	7	7 / 7	0.54	0.86	4.4	6.2	0.14	7	13	0
Copper	7	7	7 / 7	0.54	0.87	6	25.5	5.4	7	28	0
Iron	7	7	7 / 7	16.9	27	11200	21800				
Lead	7	7	7 / 7	0.16	0.26	7.9	13.9	0.0537	7	15.3	0
Magnesium	7	7	7 / 7	27	43.1	5940	12500				
Manganese	7	7	7 / 7	1.1	1.7	260	877	220	7	508	5
Mercury	6	7	6 / 7	0.011	0.02	0.013	0.068	0.005	6	0.05	1
Nickel	7	7	7 / 7	0.55	0.87	10.2	17	9.7	7	38	0
Potassium	7	7	7 / 7	26.5	42.3	846	1500				
Selenium	0	7	0 / 7	0.26	0.42			0.0276	0	0.52	0
Silver	0	7	0 / 7	0.55	0.89			2	0	2	0
Sodium	5	7	5 / 7	38.5	61.4	44.8	90.6				
Thallium	0	7	0 / 7	0.11	0.18			0.027	0	0.25	0
Vanadium	7	7	7 / 7	0.79	1.3	9.9	16.7	0.714	7	30.9	0
Zinc	7	7	7 / 7	2.8	4.5	47.5	65.1	6.62	7	60.5	2
GENERAL CHEMISTRY mg/kg											
Cyanide	6	7	6 / 7	0.029	0.048	0.06	0.45	0.1	4	0.183148	2
Fluoride	7	7	7 / 7	0.39	0.67	17.3	61.4	6.5	7	30	2
PESTICIDES mg/kg											
Aldrin	0	7	0 / 7	0.00088	0.0015			0.00332	0	0.00332	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	7	0 / 7	0.00066	0.0011			0.0994	0	0.0994	0
Alpha Endosulfan	0	7	0 / 7	0.001	0.0017			0.119	0	0.119	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	7	0 / 7	0.0007	0.0012			0.00398	0	0.00398	0
Beta Endosulfan	0	7	0 / 7	0.0011	0.0019			0.119	0	0.119	0
cis-Chlordane	0	7	0 / 7	0.0012	0.002			0.27	0	0.27	0
Delta BHC (Delta Hexachlorocyclohexane)	0	7	0 / 7	0.00079	0.0013			0.1	0	0.1	0
Dieldrin	0	7	0 / 7	0.00094	0.0016			0.00238	0	0.00238	0
Endosulfan Sulfate	0	7	0 / 7	0.00084	0.0014			0.0358	0	0.0358	0
Endrin	0	7	0 / 7	0.00092	0.0016			0.0014	0	0.0014	0

Table A-10
Summary of Soil ESV Exceedances - Eastern Undeveloped Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Endrin Aldehyde	0	7	0 / 7	0.0009	0.0015			0.0105	0	0.0105	0
Endrin Ketone	0	7	0 / 7	0.001	0.0017						
Gamma Bhc (Lindane)	0	7	0 / 7	0.00065	0.0011			0.005	0	0.005	0
Heptachlor	0	7	0 / 7	0.00093	0.0016			0.059	0	0.059	0
Heptachlor Epoxide	0	7	0 / 7	0.0014	0.0024			0.152	0	0.152	0
Methoxychlor	0	7	0 / 7	0.0015	0.0026			5	0	5	0
P,P'-DDD	0	7	0 / 7	0.00095	0.0016			0.00488	0	0.00488	0
P,P'-DDE	0	7	0 / 7	0.001	0.0018			0.021	0	0.021	0
P,P'-DDT	0	7	0 / 7	0.00075	0.0013			0.0035	0	0.0035	0
Toxaphene	0	7	0 / 7	0.021	0.036			0.119	0	0.119	0
trans-Chlordane	0	7	0 / 7	0.0016	0.0027			2.2	0	2.2	0
POLYCHLORINATED BIPHENYLS mg/kg											
PCB-1016 (Aroclor 1016)	0	7	0 / 7	0.0096	0.016			1	0	1	0
PCB-1221 (Aroclor 1221)	0	7	0 / 7	0.0096	0.016						
PCB-1232 (Aroclor 1232)	0	7	0 / 7	0.0096	0.016						
PCB-1242 (Aroclor 1242)	0	7	0 / 7	0.0096	0.016			0.041	0	0.041	0
PCB-1248 (Aroclor 1248)	0	7	0 / 7	0.0096	0.016			0.0072	0	0.0072	0
PCB-1254 (Aroclor 1254)	0	7	0 / 7	0.0099	0.017			0.041	0	0.041	0
PCB-1260 (Aroclor 1260)	0	7	0 / 7	0.0099	0.017			0.88	0	0.88	0
PCB-1262 (Aroclor 1262)	0	7	0 / 7	0.0099	0.017						
PCB-1268 (Aroclor 1268)	0	7	0 / 7	0.0099	0.017						
Polychlorinated Biphenyl (PCBs)	0	7	0 / 7	0.0099	0.017			40	0	40	0
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg											
Benzo(A)Anthracene	5	7	5 / 7	0.03	0.051	0.046	0.55	0.8	0		
Benzo(A)Pyrene	7	7	7 / 7	0.011	0.018	0.027	0.85	1.52	0		
Benzo(B)Fluoranthene	7	7	7 / 7	0.014	0.024	0.075	2.7	18	0		
Benzo(G,H,I)Perylene	7	7	7 / 7	0.02	0.035	0.033	1.3	24	0		
Benzo(K)Fluoranthene	7	7	7 / 7	0.016	0.027	0.028	0.74	62	0		
Chrysene	7	7	7 / 7	0.0097	0.017	0.045	1.5	2.4	0		
Dibenz(A,H)Anthracene	3	7	3 / 7	0.019	0.032	0.11	0.27	12	0		
Indeno(1,2,3-C,D)Pyrene	7	7	7 / 7	0.024	0.041	0.032	1.4	62	0		
Pyrene	7	7	7 / 7	0.016	0.028	0.028	1	10	0		
Total High Molecular Weight PAHs	7	7	7 / 7			0.278	10.31			1.1	3
2-Methylnaphthalene	1	7	1 / 7	0.0079	0.013	0.014	0.014	3.24	0		
Acenaphthene	3	7	3 / 7	0.0086	0.015	0.016	0.042	0.25	0		
Acenaphthylene	0	7	0 / 7	0.0092	0.016			120	0		
Anthracene	1	7	1 / 7	0.034	0.058	0.089	0.089	6.8	0		
Fluoranthene	7	7	7 / 7	0.011	0.018	0.026	1	10	0		

Table A-10
Summary of Soil ESV Exceedances - Eastern Undeveloped Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Fluorene	3	7	3 / 7	0.0078	0.013	0.011	0.038	3.7	0		
Naphthalene	1	7	1 / 7	0.0091	0.016	0.025	0.025	0.0994	0		
Phenanthrene	7	7	7 / 7	0.0095	0.016	0.017	0.49	5.5	0		
Total Low Molecular Weight PAHs	7	7	7 / 7			0.043	1.698			29	0
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg											
1,2,4,5-Tetrachlorobenzene	0	7	0 / 7	0.027	0.045			2.02	0	2.02	0
1,4-Dioxane (P-Dioxane)	0	7	0 / 7	0.095	0.16			1.83	0	1.83	0
2,3,4,6-Tetrachlorophenol	0	7	0 / 7	0.034	0.057						
2,4,5-Trichlorophenol	0	7	0 / 7	0.035	0.061			4	0	4	0
2,4,6-Trichlorophenol	0	7	0 / 7	0.01	0.017			9.94	0	9.94	0
2,4-Dichlorophenol	0	7	0 / 7	0.0084	0.014			87.5	0	87.5	0
2,4-Dimethylphenol	0	7	0 / 7	0.078	0.13			0.01	0	0.01	0
2,4-Dinitrophenol	0	7	0 / 7	0.27	0.46			0.0609	0	0.0609	0
2,4-Dinitrotoluene	0	7	0 / 7	0.014	0.024			1.28	0	1.28	0
2,6-Dinitrotoluene	0	7	0 / 7	0.019	0.032			0.0328	0	0.0328	0
2-Chloronaphthalene	0	7	0 / 7	0.0081	0.014			0.0122	0	0.0122	0
2-Chlorophenol	0	7	0 / 7	0.0091	0.016			0.243	0	0.243	0
2-Methylphenol (O-Cresol)	0	7	0 / 7	0.016	0.027			0.67	0	0.67	0
2-Nitroaniline	0	7	0 / 7	0.012	0.02			5.4	0	5.4	0
2-Nitrophenol	0	7	0 / 7	0.012	0.02			1.6	0	1.6	0
3- And 4- Methylphenol (Total)	2	7	2 / 7	0.0095	0.016	0.01	0.068				
3,3'-Dichlorobenzidine	0	7	0 / 7	0.04	0.068			0.646	0	0.646	0
3-Nitroaniline	0	7	0 / 7	0.011	0.018			3.16	0	3.16	0
4,6-Dinitro-2-Methylphenol	0	7	0 / 7	0.095	0.16			0.144	0	0.144	0
4-Bromophenyl Phenyl Ether	0	7	0 / 7	0.011	0.019						
4-Chloro-3-Methylphenol	0	7	0 / 7	0.015	0.026						
4-Chloroaniline	0	7	0 / 7	0.0092	0.016			1	0	1	0
4-Chlorophenyl Phenyl Ether	0	7	0 / 7	0.011	0.018						
4-Nitroaniline	0	7	0 / 7	0.013	0.023			21.9	0	21.9	0
4-Nitrophenol	0	7	0 / 7	0.17	0.29			7	0	7	0
Acetophenone	2	7	2 / 7	0.0078	0.013	0.019	0.024	300	0	300	0
Atrazine	0	7	0 / 7	0.016	0.027						
Benzaldehyde	1	7	1 / 7	0.027	0.047	0.06	0.06				
Benzyl Butyl Phthalate	0	7	0 / 7	0.011	0.019			0.239	0	0.239	0
Biphenyl (Diphenyl)	0	7	0 / 7	0.03	0.052			60	0	60	0
Bis(2-Chloroethoxy) Methane	0	7	0 / 7	0.011	0.019			0.302	0	0.302	0
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	7	0 / 7	0.0084	0.014			23.7	0	23.7	0
Bis(2-Chloroisopropyl) Ether	0	7	0 / 7	0.015	0.025			19.9	0	19.9	0

Table A-10
Summary of Soil ESV Exceedances - Eastern Undeveloped Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Bis(2-Ethylhexyl) Phthalate	1	7	1 / 7	0.014	0.024	0.016	0.016	0.02	0	0.02	0
Caprolactam	0	7	0 / 7	0.026	0.044						
Carbazole	4	7	4 / 7	0.0088	0.015	0.014	0.13	80	0	80	0
Dibenzofuran	1	7	1 / 7	0.011	0.018	0.023	0.023	6.1	0	6.1	0
Diethyl Phthalate	0	7	0 / 7	0.01	0.017			100	0	100	0
Dimethyl Phthalate	0	7	0 / 7	0.01	0.018			10	0	10	0
Di-N-Butyl Phthalate	1	7	1 / 7	0.011	0.018	0.22	0.22	0.011	1	0.011	1
Di-N-Octylphthalate	0	7	0 / 7	0.018	0.031			0.91	0	0.91	0
Hexachlorobenzene	0	7	0 / 7	0.014	0.025			0.079	0	0.079	0
Hexachlorobutadiene	0	7	0 / 7	0.01	0.017			0.0398	0	0.0398	0
Hexachlorocyclopentadiene	0	7	0 / 7	0.022	0.038			0.755	0	0.755	0
Hexachloroethane	0	7	0 / 7	0.013	0.022			0.596	0	0.596	0
Isophorone	0	7	0 / 7	0.0077	0.013			139	0	139	0
Nitrobenzene	0	7	0 / 7	0.011	0.019			1.31	0	1.31	0
N-Nitrosodi-N-Propylamine	0	7	0 / 7	0.012	0.02			0.544	0	0.544	0
N-Nitrosodiphenylamine	0	7	0 / 7	0.032	0.055			0.545	0	0.545	0
Pentachlorophenol	0	7	0 / 7	0.043	0.074			0.119	0	0.119	0
Phenol	0	7	0 / 7	0.012	0.02			0.79	0	0.79	0

Notes:

All soil samples from the 0-2' depth interval within the Eastern Undeveloped exposure area included in screening assessment.

Quantitation limit used as the detection limit.

Concentration results evaluated against SLERA and BERA soil ESVs.

Total high molecular weight PAHs = sum of PAHs with four or more benzene rings.

Total low molecular weight PAHs = sum of PAHs with less than four benzene rings.

Table A-11
Summary of Soil ESV Exceedances - North Central Undeveloped Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
METALS mg/kg											
Aluminum	8	8	8 / 8	5.9	8.9	6230	16900	50	8		
Antimony	0	8	0 / 8	0.33	0.5			0.142	0	0.27	0
Arsenic	8	8	8 / 8	0.36	0.54	4.1	6.1	0.25	8	11.4	0
Barium	8	8	8 / 8	0.53	0.8	61.8	267	1.04	8	195	3
Beryllium	8	8	8 / 8	0.1	0.15	0.29	0.59	1.06	0	2.5	0
Cadmium	0	8	0 / 8	0.25	0.38			0.00222	0	0.36	0
Calcium	8	8	8 / 8	28.9	43.3	1660	75000				
Chromium, Total	8	8	8 / 8	0.63	0.94	6.5	13.5	0.34	8	26	0
Cobalt	8	8	8 / 8	0.62	0.93	3.6	8.1	0.14	8	13	0
Copper	8	8	8 / 8	0.54	0.81	10.8	20.6	5.4	8	28	0
Iron	8	8	8 / 8	20.9	31.3	9890	17100				
Lead	9	9	9 / 9	0.18	0.87	7.9	12.9	0.0537	9	15.3	0
Magnesium	8	8	8 / 8	29	43.4	5750	14100				
Manganese	8	8	8 / 8	1.3	1.9	284	554	220	8	508	2
Mercury	6	8	6 / 8	0.012	0.015	0.014	0.055	0.005	6	0.05	1
Nickel	8	8	8 / 8	0.63	0.94	7.8	12.4	9.7	6	38	0
Potassium	8	8	8 / 8	27.5	41.1	464	1140				
Selenium	4	8	4 / 8	0.31	0.47	0.41	0.5	0.0276	4	0.52	0
Silver	0	8	0 / 8	0.61	0.91			2	0	2	0
Sodium	6	8	6 / 8	31	46.4	36.1	168				
Thallium	0	8	0 / 8	0.13	0.19			0.027	0	0.25	0
Vanadium	8	8	8 / 8	0.63	0.94	4.6	12.8	0.714	8	30.9	0
Zinc	8	8	8 / 8	2	2.9	30.5	70.8	6.62	8	60.5	2
GENERAL CHEMISTRY mg/kg											
Cyanide	8	8	8 / 8	0.017	0.021	0.042	0.23	0.1	3	0.183148	1
Fluoride	8	8	8 / 8	0.2	0.45	4.17	37.8	6.5	7	30	1
PESTICIDES mg/kg											
Aldrin	0	2	0 / 2	0.00099	0.001			0.00332	0	0.00332	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	2	0 / 2	0.00074	0.00076			0.0994	0	0.0994	0
Alpha Endosulfan	0	2	0 / 2	0.0011	0.0012			0.119	0	0.119	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	2	0 / 2	0.00079	0.00081			0.00398	0	0.00398	0
Beta Endosulfan	0	2	0 / 2	0.0013	0.0013			0.119	0	0.119	0
cis-Chlordane	0	2	0 / 2	0.0013	0.0014			0.27	0	0.27	0
Delta BHC (Delta Hexachlorocyclohexane)	0	2	0 / 2	0.00089	0.00091			0.1	0	0.1	0
Dieldrin	0	2	0 / 2	0.0011	0.0011			0.00238	0	0.00238	0
Endosulfan Sulfate	0	2	0 / 2	0.00095	0.00097			0.0358	0	0.0358	0
Endrin	0	2	0 / 2	0.001	0.0011			0.0014	0	0.0014	0
Endrin Aldehyde	0	2	0 / 2	0.001	0.001			0.0105	0	0.0105	0
Endrin Ketone	0	2	0 / 2	0.0011	0.0012						

Table A-11
Summary of Soil ESV Exceedances - North Central Undeveloped Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Gamma Bhc (Lindane)	0	2	0 / 2	0.00073	0.00075			0.005	0	0.005	0
Heptachlor	0	2	0 / 2	0.001	0.0011			0.059	0	0.059	0
Heptachlor Epoxide	0	2	0 / 2	0.0016	0.0016			0.152	0	0.152	0
Methoxychlor	0	2	0 / 2	0.0017	0.0018			5	0	5	0
P,P'-DDD	0	2	0 / 2	0.0011	0.0011			0.00488	0	0.00488	0
P,P'-DDE	0	2	0 / 2	0.0012	0.0012			0.021	0	0.021	0
P,P'-DDT	0	2	0 / 2	0.00084	0.00086			0.0035	0	0.0035	0
Toxaphene	0	2	0 / 2	0.024	0.024			0.119	0	0.119	0
trans-Chlordane	0	2	0 / 2	0.0018	0.0018			2.2	0	2.2	0
POLYCHLORINATED BIPHENYLS mg/kg											
PCB-1016 (Aroclor 1016)	0	8	0 / 8	0.0099	0.011			1	0	1	0
PCB-1221 (Aroclor 1221)	0	8	0 / 8	0.0099	0.011						
PCB-1232 (Aroclor 1232)	0	8	0 / 8	0.0099	0.011						
PCB-1242 (Aroclor 1242)	0	8	0 / 8	0.0099	0.011			0.041	0	0.041	0
PCB-1248 (Aroclor 1248)	0	8	0 / 8	0.0099	0.011			0.0072	0	0.0072	0
PCB-1254 (Aroclor 1254)	0	8	0 / 8	0.01	0.012			0.041	0	0.041	0
PCB-1260 (Aroclor 1260)	0	8	0 / 8	0.01	0.012			0.88	0	0.88	0
PCB-1262 (Aroclor 1262)	0	8	0 / 8	0.01	0.012						
PCB-1268 (Aroclor 1268)	0	8	0 / 8	0.01	0.012						
Polychlorinated Biphenyl (PCBs)	0	8	0 / 8	0.01	0.012			40	0	40	0
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg											
Benzo(A)Anthracene	3	8	3 / 8	0.031	0.035	0.033	0.14	0.8	0		
Benzo(A)Pyrene	6	8	6 / 8	0.011	0.013	0.02	0.16	1.52	0		
Benzo(B)Fluoranthene	7	8	7 / 8	0.014	0.017	0.015	0.41	18	0		
Benzo(G,H,I)Perylene	6	8	6 / 8	0.021	0.024	0.023	0.19	24	0		
Benzo(K)Fluoranthene	4	8	4 / 8	0.016	0.018	0.023	0.13	62	0		
Chrysene	6	8	6 / 8	0.01	0.012	0.035	0.25	2.4	0		
Dibenz(A,H)Anthracene	1	8	1 / 8	0.019	0.022	0.056	0.056	12	0		
Indeno(1,2,3-C,D)Pyrene	4	8	4 / 8	0.024	0.028	0.024	0.2	62	0		
Pyrene	6	8	6 / 8	0.017	0.019	0.029	0.22	10	0		
Total High Molecular Weight PAHs	7	8	7 / 8			0.015	1.756			1.1	1
2-Methylnaphthalene	0	8	0 / 8	0.0081	0.0094			3.24	0		
Acenaphthene	0	8	0 / 8	0.0089	0.01			0.25	0		
Acenaphthylene	0	8	0 / 8	0.0094	0.011			120	0		
Anthracene	0	8	0 / 8	0.035	0.04			6.8	0		
Fluoranthene	6	8	6 / 8	0.011	0.013	0.028	0.21	10	0		
Fluorene	0	8	0 / 8	0.008	0.0092			3.7	0		
Naphthalene	0	8	0 / 8	0.0093	0.011			0.0994	0		
Phenanthrene	6	8	6 / 8	0.0097	0.011	0.018	0.098	5.5	0		
Total Low Molecular Weight PAHs	6	8	6 / 8			0.046	0.308			29	0

Table A-11
Summary of Soil ESV Exceedances - North Central Undeveloped Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg											
1,2,4,5-Tetrachlorobenzene	0	8	0 / 8	0.027	0.032			2.02	0	2.02	0
1,4-Dioxane (P-Dioxane)	0	8	0 / 8	0.098	0.11			1.83	0	1.83	0
2,3,4,6-Tetrachlorophenol	0	8	0 / 8	0.034	0.04						
2,4,5-Trichlorophenol	0	8	0 / 8	0.036	0.042			4	0	4	0
2,4,6-Trichlorophenol	0	8	0 / 8	0.01	0.012			9.94	0	9.94	0
2,4-Dichlorophenol	0	8	0 / 8	0.0086	0.01			87.5	0	87.5	0
2,4-Dimethylphenol	0	8	0 / 8	0.081	0.093			0.01	0	0.01	0
2,4-Dinitrophenol	0	8	0 / 8	0.28	0.32			0.0609	0	0.0609	0
2,4-Dinitrotoluene	0	8	0 / 8	0.015	0.017			1.28	0	1.28	0
2,6-Dinitrotoluene	0	8	0 / 8	0.019	0.023			0.0328	0	0.0328	0
2-Chloronaphthalene	0	8	0 / 8	0.0083	0.0096			0.0122	0	0.0122	0
2-Chlorophenol	0	8	0 / 8	0.0093	0.011			0.243	0	0.243	0
2-Methylphenol (O-Cresol)	0	8	0 / 8	0.016	0.018			0.67	0	0.67	0
2-Nitroaniline	0	8	0 / 8	0.012	0.014			5.4	0	5.4	0
2-Nitrophenol	0	8	0 / 8	0.012	0.014			1.6	0	1.6	0
3- And 4- Methylphenol (Total)	0	8	0 / 8	0.0097	0.011						
3,3'-Dichlorobenzidine	0	8	0 / 8	0.041	0.047			0.646	0	0.646	0
3-Nitroaniline	0	8	0 / 8	0.011	0.013			3.16	0	3.16	0
4,6-Dinitro-2-Methylphenol	0	8	0 / 8	0.098	0.11			0.144	0	0.144	0
4-Bromophenyl Phenyl Ether	0	8	0 / 8	0.012	0.013						
4-Chloro-3-Methylphenol	0	8	0 / 8	0.016	0.018						
4-Chloroaniline	0	8	0 / 8	0.0094	0.011			1	0	1	0
4-Chlorophenyl Phenyl Ether	0	8	0 / 8	0.011	0.013						
4-Nitroaniline	0	8	0 / 8	0.014	0.016			21.9	0	21.9	0
4-Nitrophenol	0	8	0 / 8	0.18	0.2			7	0	7	0
Acetophenone	0	8	0 / 8	0.008	0.0092			300	0	300	0
Atrazine	0	8	0 / 8	0.016	0.019						
Benzaldehyde	0	8	0 / 8	0.028	0.032						
Benzyl Butyl Phthalate	0	8	0 / 8	0.011	0.013			0.239	0	0.239	0
Biphenyl (Diphenyl)	0	8	0 / 8	0.031	0.036			60	0	60	0
Bis(2-Chloroethoxy) Methane	0	8	0 / 8	0.011	0.013			0.302	0	0.302	0
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	8	0 / 8	0.0086	0.01			23.7	0	23.7	0
Bis(2-Chloroisopropyl) Ether	0	8	0 / 8	0.015	0.017			19.9	0	19.9	0
Bis(2-Ethylhexyl) Phthalate	3	8	3 / 8	0.014	0.017	0.043	0.085	0.02	3	0.02	3
Caprolactam	0	8	0 / 8	0.026	0.031						
Carbazole	1	8	1 / 8	0.0091	0.011	0.017	0.017	80	0	80	0
Dibenzofuran	0	8	0 / 8	0.011	0.013			6.1	0	6.1	0
Diethyl Phthalate	0	8	0 / 8	0.01	0.012			100	0	100	0
Dimethyl Phthalate	0	8	0 / 8	0.011	0.012			10	0	10	0

Table A-11
Summary of Soil ESV Exceedances - North Central Undeveloped Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Di-N-Butyl Phthalate	0	8	0 / 8	0.011	0.013			0.011	0	0.011	0
Di-N-Octylphthalate	0	8	0 / 8	0.019	0.022			0.91	0	0.91	0
Hexachlorobenzene	0	8	0 / 8	0.015	0.017			0.079	0	0.079	0
Hexachlorobutadiene	0	8	0 / 8	0.01	0.012			0.0398	0	0.0398	0
Hexachlorocyclopentadiene	0	8	0 / 8	0.023	0.026			0.755	0	0.755	0
Hexachloroethane	0	8	0 / 8	0.013	0.016			0.596	0	0.596	0
Isophorone	2	8	2 / 8	0.0079	0.0091	0.0089	0.013	139	0	139	0
Nitrobenzene	0	8	0 / 8	0.012	0.013			1.31	0	1.31	0
N-Nitrosodi-N-Propylamine	0	8	0 / 8	0.012	0.014			0.544	0	0.544	0
N-Nitrosodiphenylamine	0	8	0 / 8	0.033	0.038			0.545	0	0.545	0
Pentachlorophenol	0	8	0 / 8	0.044	0.051			0.119	0	0.119	0
Phenol	0	8	0 / 8	0.012	0.014			0.79	0	0.79	0
VOLATILE ORGANIC COMPOUNDS mg/kg											
1,1,1-Trichloroethane	0	4	0 / 4	0.00029	0.00055			29.8	0	29.8	0
1,1,2,2-Tetrachloroethane	0	4	0 / 4	0.00013	0.00024			225	0	225	0
1,1,2-Trichloro-1,2,2-Trifluoroethane	0	4	0 / 4	0.00034	0.00063						
1,1,2-Trichloroethane	0	4	0 / 4	0.00022	0.0004			28.6	0	28.6	0
1,1-Dichloroethane	0	4	0 / 4	0.00026	0.00049			20.1	0	20.1	0
1,1-Dichloroethene	0	4	0 / 4	0.00032	0.00059			8.28	0	8.28	0
1,2,3-Trichlorobenzene	0	4	0 / 4	0.000085	0.00016			11.1	0	11.1	0
1,2,4-Trichlorobenzene	0	4	0 / 4	0.00025	0.00046			0.27	0	0.27	0
1,2-Dibromo-3-Chloropropane	0	4	0 / 4	0.00036	0.00067			0.0352	0	0.0352	0
1,2-Dibromoethane (Ethylene Dibromide)	0	4	0 / 4	0.000093	0.00017			1.23	0	1.23	0
1,2-Dichlorobenzene	0	4	0 / 4	0.00011	0.0002			0.92	0	0.92	0
1,2-Dichloroethane	0	4	0 / 4	0.000085	0.00016			0.85	0	0.85	0
1,2-Dichloropropane	0	4	0 / 4	0.00013	0.00024			32.7	0	32.7	0
1,3-Dichlorobenzene	0	4	0 / 4	0.000093	0.00017			0.73	0	0.73	0
1,4-Dichlorobenzene	0	4	0 / 4	0.0001	0.00019			0.88	0	0.88	0
2-Hexanone	0	4	0 / 4	0.00073	0.0013			0.36	0	0.36	0
Acetone	4	4	4 / 4	0.00082	0.0015	0.0091	0.071	1.2	0	1.2	0
Benzene	1	4	1 / 4	0.00015	0.00029	0.00041	0.00041	0.255	0	0.255	0
Bromochloromethane	0	4	0 / 4	0.00013	0.00024						
Bromodichloromethane	0	4	0 / 4	0.00029	0.00055			0.54	0	0.54	0
Bromoform	0	4	0 / 4	0.0001	0.00019			15.9	0	15.9	0
Bromomethane	0	4	0 / 4	0.00025	0.00046						
Carbon Disulfide	1	4	1 / 4	0.00033	0.00062	0.00035	0.00035	0.0941	0	0.0941	0
Carbon Tetrachloride	0	4	0 / 4	0.00033	0.00062			2.98	0	2.98	0
Chlorobenzene	0	4	0 / 4	0.00011	0.0002			2.4	0	2.4	0
Chloroethane	0	4	0 / 4	0.00027	0.0005						
Chloroform	0	4	0 / 4	0.00016	0.0003			1.19	0	1.19	0

Table A-11
Summary of Soil ESV Exceedances - North Central Undeveloped Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Chloromethane	0	4	0 / 4	0.00029	0.00055						
Cis-1,2-Dichloroethylene	0	4	0 / 4	0.00017	0.00032			23	0	23	0
Cis-1,3-Dichloropropene	0	4	0 / 4	0.00012	0.00022			0.398	0	0.398	0
Cyclohexane	0	4	0 / 4	0.00035	0.00066						
Dibromochloromethane	0	4	0 / 4	0.00012	0.00022			2.05	0	2.05	0
Dichlorodifluoromethane	0	4	0 / 4	0.00025	0.00046			39.5	0	39.5	0
Ethylbenzene	0	4	0 / 4	0.00014	0.00026			5.16	0	5.16	0
Isopropylbenzene (Cumene)	0	4	0 / 4	0.00013	0.00024						
M,P-Xylene	0	4	0 / 4	0.000085	0.00016						
Methyl Acetate	3	4	3 / 4	0.00069	0.0013	0.0019	0.27				
Methyl Ethyl Ketone (2-Butanone)	2	4	2 / 4	0.00059	0.0011	0.0018	0.0034	360	0	360	0
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	0	4	0 / 4	0.0017	0.0032			9.8	0	9.8	0
Methylcyclohexane	0	4	0 / 4	0.00039	0.00072						
Methylene Chloride	0	4	0 / 4	0.00025	0.00046			2.6	0	2.6	0
O-Xylene (1,2-Dimethylbenzene)	0	4	0 / 4	0.00012	0.00023						
Styrene	0	4	0 / 4	0.00012	0.00022			1.2	0	1.2	0
Tert-Butyl Methyl Ether	0	4	0 / 4	0.00013	0.00024						
Tetrachloroethylene (PCE)	0	4	0 / 4	0.00022	0.0004			0.18	0	0.18	0
Toluene	1	4	1 / 4	0.00015	0.00027	0.00064	0.00064	5.45	0	5.45	0
Trans-1,2-Dichloroethene	0	4	0 / 4	0.0003	0.00056			23	0	23	0
Trans-1,3-Dichloropropene	0	4	0 / 4	0.000077	0.00014			0.398	0	0.398	0
Trichloroethylene (TCE)	0	4	0 / 4	0.0002	0.00037			1.387	0	1.387	0
Trichlorofluoromethane	0	4	0 / 4	0.00026	0.00049			16.4	0	16.4	0
Vinyl Chloride	0	4	0 / 4	0.0003	0.00056			0.12	0	0.12	0

Notes:

All soil samples from the 0-2' depth interval within the North Central Undeveloped exposure area included in screening assessment.

Quantitation limit used as the detection limit.

Concentration results evaluated against SLERA and BERA soil ESVs.

Total high molecular weight PAHs = sum of PAHs with four or more benzene rings.

Total low molecular weight PAHs = sum of PAHs with less than four benzene rings.

Table A-12
Summary of Soil ESV Exceedances - Western Undeveloped Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
METALS mg/kg											
Aluminum	38	38	38 / 38	6.2	9.5	8330	30900	50	38		
Antimony	0	38	0 / 38	0.35	0.53			0.142	0	0.27	0
Arsenic	38	38	38 / 38	0.37	0.57	2.1	7.9	0.25	38	11.4	0
Barium	38	38	38 / 38	0.55	0.85	73.1	440	1.04	38	195	25
Beryllium	38	38	38 / 38	0.11	0.16	0.32	1.2	1.06	2	2.5	0
Cadmium	2	38	2 / 38	0.26	0.4	0.66	0.9	0.00222	2	0.36	2
Calcium	38	38	38 / 38	30.1	46.1	1470	18900				
Chromium, Total	38	38	38 / 38	0.65	1	4.9	20.9	0.34	38	26	0
Cobalt	38	38	38 / 38	0.65	0.99	2.8	8.7	0.14	38	13	0
Copper	38	38	38 / 38	0.57	0.87	9.1	52.6	5.4	38	28	1
Iron	38	38	38 / 38	21.8	33.4	7710	19900				
Lead	43	43	43 / 43	0.19	0.85	5.1	44.8	0.0537	43	15.3	9
Magnesium	38	38	38 / 38	30.2	46.3	2940	12500				
Manganese	38	38	38 / 38	1.3	2	44.4	778	220	33	508	12
Mercury	29	38	29 / 38	0.011	0.019	0.012	0.27	0.005	29	0.05	2
Nickel	38	38	38 / 38	0.66	1	5.8	98.1	9.7	32	38	1
Potassium	38	38	38 / 38	28.6	43.8	519	1530				
Selenium	13	38	13 / 38	0.32	0.5	0.39	1.1	0.0276	13	0.52	8
Silver	1	38	1 / 38	0.63	0.97	0.99	0.99	2	0	2	0
Sodium	35	38	35 / 38	32.3	49.5	34.6	555				
Thallium	0	38	0 / 38	0.13	0.2			0.027	0	0.25	0
Vanadium	38	38	38 / 38	0.65	1	6.3	31.8	0.714	38	30.9	1
Zinc	38	38	38 / 38	2.1	3.1	12.6	244	6.62	38	60.5	11
GENERAL CHEMISTRY mg/kg											
Cyanide	36	38	36 / 38	0.017	0.026	0.02	0.68	0.1	14	0.183148	6
Fluoride	38	38	38 / 38	0.19	2.27	0.31	71.2	6.5	21	30	6
PESTICIDES mg/kg											
Aldrin	0	14	0 / 14	0.0009	0.0013			0.00332	0	0.00332	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	14	0 / 14	0.00068	0.00097			0.0994	0	0.0994	0
Alpha Endosulfan	0	14	0 / 14	0.001	0.0015			0.119	0	0.119	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	14	0 / 14	0.00072	0.001			0.00398	0	0.00398	0
Beta Endosulfan	0	14	0 / 14	0.0012	0.0017			0.119	0	0.119	0
cis-Chlordane	0	14	0 / 14	0.0012	0.0017			0.27	0	0.27	0
Delta BHC (Delta Hexachlorocyclohexane)	0	14	0 / 14	0.00081	0.0012			0.1	0	0.1	0
Dieldrin	0	14	0 / 14	0.00097	0.0014			0.00238	0	0.00238	0
Endosulfan Sulfate	0	14	0 / 14	0.00087	0.0012			0.0358	0	0.0358	0
Endrin	0	14	0 / 14	0.00095	0.0014			0.0014	0	0.0014	0
Endrin Aldehyde	0	14	0 / 14	0.00092	0.0013			0.0105	0	0.0105	0
Endrin Ketone	0	14	0 / 14	0.001	0.0015						

Table A-12
Summary of Soil ESV Exceedances - Western Undeveloped Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Gamma Bhc (Lindane)	0	14	0 / 14	0.00067	0.00095			0.005	0	0.005	0
Heptachlor	0	14	0 / 14	0.00096	0.0014			0.059	0	0.059	0
Heptachlor Epoxide	0	14	0 / 14	0.0015	0.0021			0.152	0	0.152	0
Methoxychlor	0	14	0 / 14	0.0016	0.0023			5	0	5	0
P,P'-DDD	0	14	0 / 14	0.00098	0.0014			0.00488	0	0.00488	0
P,P'-DDE	0	14	0 / 14	0.0011	0.0015			0.021	0	0.021	0
P,P'-DDT	0	14	0 / 14	0.00077	0.0011			0.0035	0	0.0035	0
Toxaphene	0	14	0 / 14	0.022	0.031			0.119	0	0.119	0
trans-Chlordane	0	14	0 / 14	0.0016	0.0023			2.2	0	2.2	0
POLYCHLORINATED BIPHENYLS mg/kg											
PCB-1016 (Aroclor 1016)	0	38	0 / 38	0.0095	0.014			1	0	1	0
PCB-1221 (Aroclor 1221)	0	38	0 / 38	0.0095	0.014						
PCB-1232 (Aroclor 1232)	0	38	0 / 38	0.0095	0.014						
PCB-1242 (Aroclor 1242)	0	38	0 / 38	0.0095	0.014			0.041	0	0.041	0
PCB-1248 (Aroclor 1248)	0	38	0 / 38	0.0095	0.014			0.0072	0	0.0072	0
PCB-1254 (Aroclor 1254)	0	38	0 / 38	0.0098	0.015			0.041	0	0.041	0
PCB-1260 (Aroclor 1260)	0	38	0 / 38	0.0098	0.015			0.88	0	0.88	0
PCB-1262 (Aroclor 1262)	0	38	0 / 38	0.0098	0.015						
PCB-1268 (Aroclor 1268)	0	38	0 / 38	0.0098	0.015						
Polychlorinated Biphenyl (PCBs)	0	38	0 / 38	0.0098	0.015			40	0	40	0
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg											
Benzo(A)Anthracene	12	38	12 / 38	0.029	0.17	0.037	4.1	0.8	1		
Benzo(A)Pyrene	19	38	19 / 38	0.011	0.063	0.013	5.4	1.52	1		
Benzo(B)Fluoranthene	21	38	21 / 38	0.014	0.081	0.02	12	18	0		
Benzo(G,H,I)Perylene	14	38	14 / 38	0.02	0.12	0.022	9.7	24	0		
Benzo(K)Fluoranthene	14	38	14 / 38	0.015	0.091	0.016	3.8	62	0		
Chrysene	22	38	22 / 38	0.0096	0.057	0.013	10	2.4	1		
Dibenz(A,H)Anthracene	9	38	9 / 38	0.018	0.11	0.023	1.6	12	0		
Indeno(1,2,3-C,D)Pyrene	13	38	13 / 38	0.023	0.14	0.028	9.6	62	0		
Pyrene	19	38	19 / 38	0.016	0.094	0.02	9.8	10	0		
Total High Molecular Weight PAHs	22	38	22 / 38			0.014	66			1.1	7
2-Methylnaphthalene	7	38	7 / 38	0.0078	0.046	0.0086	0.025	3.24	0		
Acenaphthene	7	38	7 / 38	0.0085	0.05	0.012	0.23	0.25	0		
Acenaphthylene	0	38	0 / 38	0.0091	0.053			120	0		
Anthracene	6	38	6 / 38	0.033	0.2	0.047	0.51	6.8	0		
Fluoranthene	21	38	21 / 38	0.01	0.062	0.013	9.2	10	0		
Fluorene	6	38	6 / 38	0.0077	0.045	0.029	0.17	3.7	0		
Naphthalene	7	38	7 / 38	0.009	0.053	0.01	0.09	0.0994	0		
Phenanthrene	20	38	20 / 38	0.0094	0.055	0.01	3.2	5.5	0		
Total Low Molecular Weight PAHs	25	38	25 / 38			0.01	13.4			29	0

Table A-12
Summary of Soil ESV Exceedances - Western Undeveloped Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg											
1,2,4,5-Tetrachlorobenzene	0	38	0 / 38	0.026	0.15			2.02	0	2.02	0
1,4-Dioxane (P-Dioxane)	0	38	0 / 38	0.094	0.56			1.83	0	1.83	0
2,3,4,6-Tetrachlorophenol	0	38	0 / 38	0.033	0.2						
2,4,5-Trichlorophenol	0	38	0 / 38	0.035	0.21			4	0	4	0
2,4,6-Trichlorophenol	0	38	0 / 38	0.01	0.059			9.94	0	9.94	0
2,4-Dichlorophenol	0	38	0 / 38	0.0083	0.049			87.5	0	87.5	0
2,4-Dimethylphenol	0	38	0 / 38	0.077	0.46			0.01	0	0.01	0
2,4-Dinitrophenol	0	38	0 / 38	0.27	1.6			0.0609	0	0.0609	0
2,4-Dinitrotoluene	0	38	0 / 38	0.014	0.082			1.28	0	1.28	0
2,6-Dinitrotoluene	0	38	0 / 38	0.019	0.11			0.0328	0	0.0328	0
2-Chloronaphthalene	0	38	0 / 38	0.008	0.047			0.0122	0	0.0122	0
2-Chlorophenol	0	38	0 / 38	0.009	0.053			0.243	0	0.243	0
2-Methylphenol (O-Cresol)	0	38	0 / 38	0.015	0.091			0.67	0	0.67	0
2-Nitroaniline	0	38	0 / 38	0.012	0.069			5.4	0	5.4	0
2-Nitrophenol	0	38	0 / 38	0.012	0.07			1.6	0	1.6	0
3- And 4- Methylphenol (Total)	0	38	0 / 38	0.0094	0.055						
3,3'-Dichlorobenzidine	0	38	0 / 38	0.039	0.23			0.646	0	0.646	0
3-Nitroaniline	0	38	0 / 38	0.01	0.062			3.16	0	3.16	0
4,6-Dinitro-2-Methylphenol	0	38	0 / 38	0.094	0.55			0.144	0	0.144	0
4-Bromophenyl Phenyl Ether	0	38	0 / 38	0.011	0.065						
4-Chloro-3-Methylphenol	0	38	0 / 38	0.015	0.089						
4-Chloroaniline	0	38	0 / 38	0.0091	0.053			1	0	1	0
4-Chlorophenyl Phenyl Ether	0	38	0 / 38	0.011	0.062						
4-Nitroaniline	0	38	0 / 38	0.013	0.079			21.9	0	21.9	0
4-Nitrophenol	0	38	0 / 38	0.17	1			7	0	7	0
Acetophenone	1	38	1 / 38	0.0077	0.045	0.0083	0.0083	300	0	300	0
Atrazine	0	38	0 / 38	0.016	0.092						
Benzaldehyde	2	38	2 / 38	0.027	0.16	0.031	0.093				
Benzyl Butyl Phthalate	2	38	2 / 38	0.011	0.064	0.017	0.045	0.239	0	0.239	0
Biphenyl (Diphenyl)	1	38	1 / 38	0.03	0.18	0.046	0.046	60	0	60	0
Bis(2-Chloroethoxy) Methane	0	38	0 / 38	0.011	0.065			0.302	0	0.302	0
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	38	0 / 38	0.0083	0.049			23.7	0	23.7	0
Bis(2-Chloroisopropyl) Ether	0	38	0 / 38	0.014	0.086			19.9	0	19.9	0
Bis(2-Ethylhexyl) Phthalate	5	38	5 / 38	0.014	0.081	0.016	0.52	0.02	4	0.02	4
Caprolactam	0	38	0 / 38	0.025	0.15						
Carbazole	10	38	10 / 38	0.0087	0.052	0.014	1.1	80	0	80	0
Dibenzofuran	6	38	6 / 38	0.011	0.063	0.017	0.094	6.1	0	6.1	0
Diethyl Phthalate	1	38	1 / 38	0.01	0.059	0.032	0.032	100	0	100	0
Dimethyl Phthalate	0	38	0 / 38	0.01	0.06			10	0	10	0

Table A-12
Summary of Soil ESV Exceedances - Western Undeveloped Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Di-N-Butyl Phthalate	4	38	4 / 38	0.011	0.062	0.011	0.48	0.011	3	0.011	3
Di-N-Octylphthalate	0	38	0 / 38	0.018	0.11			0.91	0	0.91	0
Hexachlorobenzene	0	38	0 / 38	0.014	0.084			0.079	0	0.079	0
Hexachlorobutadiene	0	38	0 / 38	0.0099	0.058			0.0398	0	0.0398	0
Hexachlorocyclopentadiene	0	38	0 / 38	0.022	0.13			0.755	0	0.755	0
Hexachloroethane	0	38	0 / 38	0.013	0.076			0.596	0	0.596	0
Isophorone	0	38	0 / 38	0.0076	0.045			139	0	139	0
Nitrobenzene	0	38	0 / 38	0.011	0.065			1.31	0	1.31	0
N-Nitrosodi-N-Propylamine	0	38	0 / 38	0.012	0.07			0.544	0	0.544	0
N-Nitrosodiphenylamine	0	38	0 / 38	0.032	0.19			0.545	0	0.545	0
Pentachlorophenol	0	38	0 / 38	0.043	0.25			0.119	0	0.119	0
Phenol	0	38	0 / 38	0.012	0.068			0.79	0	0.79	0
VOLATILE ORGANIC COMPOUNDS mg/kg											
1,1,1-Trichloroethane	0	19	0 / 19	0.00031	0.0006			29.8	0	29.8	0
1,1,2,2-Tetrachloroethane	0	19	0 / 19	0.00014	0.00027			225	0	225	0
1,1,2-Trichloro-1,2,2-Trifluoroethane	0	19	0 / 19	0.00036	0.0007						
1,1,2-Trichloroethane	0	19	0 / 19	0.00023	0.00044			28.6	0	28.6	0
1,1-Dichloroethane	0	19	0 / 19	0.00028	0.00054			20.1	0	20.1	0
1,1-Dichloroethene	0	19	0 / 19	0.00033	0.00065			8.28	0	8.28	0
1,2,3-Trichlorobenzene	0	19	0 / 19	0.000089	0.00017			11.1	0	11.1	0
1,2,4-Trichlorobenzene	0	19	0 / 19	0.00026	0.00051			0.27	0	0.27	0
1,2-Dibromo-3-Chloropropane	0	19	0 / 19	0.00038	0.00074			0.0352	0	0.0352	0
1,2-Dibromoethane (Ethylene Dibromide)	0	19	0 / 19	0.000097	0.00019			1.23	0	1.23	0
1,2-Dichlorobenzene	0	19	0 / 19	0.00011	0.00022			0.92	0	0.92	0
1,2-Dichloroethane	0	19	0 / 19	0.000089	0.00017			0.85	0	0.85	0
1,2-Dichloropropane	0	19	0 / 19	0.00014	0.00027			32.7	0	32.7	0
1,3-Dichlorobenzene	0	19	0 / 19	0.000097	0.00019			0.73	0	0.73	0
1,4-Dichlorobenzene	0	19	0 / 19	0.00011	0.00021			0.88	0	0.88	0
2-Hexanone	0	19	0 / 19	0.00076	0.0015			0.36	0	0.36	0
Acetone	19	19	19 / 19	0.00086	0.0017	0.0094	0.11	1.2	0	1.2	0
Benzene	12	19	12 / 19	0.00016	0.00032	0.0002	0.0015	0.255	0	0.255	0
Bromochloromethane	0	19	0 / 19	0.00014	0.00027						
Bromodichloromethane	0	19	0 / 19	0.00031	0.0006			0.54	0	0.54	0
Bromoform	0	19	0 / 19	0.00011	0.00021			15.9	0	15.9	0
Bromomethane	0	19	0 / 19	0.00026	0.00051						
Carbon Disulfide	1	19	1 / 19	0.00035	0.00068	0.00063	0.00063	0.0941	0	0.0941	0
Carbon Tetrachloride	0	19	0 / 19	0.00035	0.00068			2.98	0	2.98	0
Chlorobenzene	0	19	0 / 19	0.00011	0.00022			2.4	0	2.4	0
Chloroethane	0	19	0 / 19	0.00028	0.00055						
Chloroform	0	19	0 / 19	0.00017	0.00033			1.19	0	1.19	0

Table A-12
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Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Chloromethane	0	19	0 / 19	0.00031	0.0006						
Cis-1,2-Dichloroethylene	0	19	0 / 19	0.00018	0.00035			23	0	23	0
Cis-1,3-Dichloropropene	0	19	0 / 19	0.00012	0.00024			0.398	0	0.398	0
Cyclohexane	1	19	1 / 19	0.00037	0.00073	0.001	0.001				
Dibromochloromethane	0	19	0 / 19	0.00012	0.00024			2.05	0	2.05	0
Dichlorodifluoromethane	0	19	0 / 19	0.00026	0.00051			39.5	0	39.5	0
Ethylbenzene	0	19	0 / 19	0.00015	0.00028			5.16	0	5.16	0
Isopropylbenzene (Cumene)	0	19	0 / 19	0.00014	0.00027						
M,P-Xylene	2	19	2 / 19	0.000089	0.00017	0.00012	0.00051				
Methyl Acetate	10	19	10 / 19	0.00073	0.0014	0.002	0.035				
Methyl Ethyl Ketone (2-Butanone)	5	19	5 / 19	0.00062	0.0012	0.0022	0.0057	360	0	360	0
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	0	19	0 / 19	0.0018	0.0035			9.8	0	9.8	0
Methylcyclohexane	2	19	2 / 19	0.00041	0.00079	0.00045	0.0015				
Methylene Chloride	0	19	0 / 19	0.00026	0.00051			2.6	0	2.6	0
O-Xylene (1,2-Dimethylbenzene)	0	19	0 / 19	0.00013	0.00025						
Styrene	0	19	0 / 19	0.00012	0.00024			1.2	0	1.2	0
Tert-Butyl Methyl Ether	0	19	0 / 19	0.00014	0.00027						
Tetrachloroethylene (PCE)	0	19	0 / 19	0.00023	0.00044			0.18	0	0.18	0
Toluene	6	19	6 / 19	0.00015	0.0003	0.00018	0.0014	5.45	0	5.45	0
Trans-1,2-Dichloroethene	0	19	0 / 19	0.00032	0.00062			23	0	23	0
Trans-1,3-Dichloropropene	0	19	0 / 19	0.000081	0.00016			0.398	0	0.398	0
Trichloroethylene (TCE)	0	19	0 / 19	0.00021	0.00041			1.387	0	1.387	0
Trichlorofluoromethane	0	19	0 / 19	0.00028	0.00054			16.4	0	16.4	0
Vinyl Chloride	0	19	0 / 19	0.00032	0.00062			0.12	0	0.12	0

Notes:

All soil samples from the 0-2' depth interval within the Western Undeveloped exposure area included in screening assessment.
Quantitation limit used as the detection limit.
Concentration results evaluated against SLERA and BERA soil ESVs.
Total high molecular weight PAHs = sum of PAHs with four or more benzene rings.
Total low molecular weight PAHs = sum of PAHs with less than four benzene rings.

Table A-13
Summary of Soil ESV Exceedances - Flathead River Riparian Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
METALS mg/kg											
Aluminum	8	8	8 / 8	7.2	8.7	6070	10500	50	8		
Antimony	0	8	0 / 8	0.4	0.48			0.142	0	0.27	0
Arsenic	8	8	8 / 8	0.44	0.52	3.4	5	0.25	8	11.4	0
Barium	8	8	8 / 8	0.65	0.78	74	125	1.04	8	195	0
Beryllium	8	8	8 / 8	0.12	0.15	0.35	0.48	1.06	0	2.5	0
Cadmium	0	8	0 / 8	0.31	0.37			0.00222	0	0.36	0
Calcium	8	8	8 / 8	35	42.1	7410	33900				
Chromium, Total	8	8	8 / 8	0.76	0.91	6.4	10.2	0.34	8	26	0
Cobalt	8	8	8 / 8	0.75	0.9	4.2	6.1	0.14	8	13	0
Copper	8	8	8 / 8	0.66	0.79	8.9	19.2	5.4	8	28	0
Iron	8	8	8 / 8	25.3	30.5	9640	15800				
Lead	10	10	10 / 10	0.22	0.73	6.3	15.2	0.0537	10	15.3	0
Magnesium	8	8	8 / 8	35.1	42.2	7060	11600				
Manganese	8	8	8 / 8	1.5	1.9	261	359	220	8	508	0
Mercury	8	8	8 / 8	0.012	0.014	0.02	0.049	0.005	8	0.05	0
Nickel	8	8	8 / 8	0.77	0.92	9.6	18.1	9.7	7	38	0
Potassium	8	8	8 / 8	33.3	40	619	1050				
Selenium	0	8	0 / 8	0.38	0.45			0.0276	0	0.52	0
Silver	0	8	0 / 8	0.74	0.88			2	0	2	0
Sodium	0	8	0 / 8	37.6	45.2						
Thallium	0	8	0 / 8	0.15	0.18			0.027	0	0.25	0
Vanadium	8	8	8 / 8	0.76	0.91	8	16.2	0.714	8	30.9	0
Zinc	8	8	8 / 8	2.4	2.9	27.7	49.8	6.62	8	60.5	0
GENERAL CHEMISTRY mg/kg											
Cyanide	7	8	7 / 8	0.016	0.021	0.03	0.17	0.1	2	0.183148	0
Fluoride	8	8	8 / 8	0.38	0.47	3.06	15.2	6.5	4	30	0
PESTICIDES mg/kg											
Aldrin	0	1	0 / 1	0.001	0.001			0.00332	0	0.00332	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	1	0 / 1	0.00079	0.00079			0.0994	0	0.0994	0
Alpha Endosulfan	0	1	0 / 1	0.0012	0.0012			0.119	0	0.119	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	1	0 / 1	0.00084	0.00084			0.00398	0	0.00398	0
Beta Endosulfan	0	1	0 / 1	0.0014	0.0014			0.119	0	0.119	0
cis-Chlordane	0	1	0 / 1	0.0014	0.0014			0.27	0	0.27	0
Delta BHC (Delta Hexachlorocyclohexane)	0	1	0 / 1	0.00094	0.00094			0.1	0	0.1	0
Dieldrin	0	1	0 / 1	0.0011	0.0011			0.00238	0	0.00238	0
Endosulfan Sulfate	0	1	0 / 1	0.001	0.001			0.0358	0	0.0358	0
Endrin	0	1	0 / 1	0.0011	0.0011			0.0014	0	0.0014	0
Endrin Aldehyde	0	1	0 / 1	0.0011	0.0011			0.0105	0	0.0105	0
Endrin Ketone	0	1	0 / 1	0.0012	0.0012						

Table A-13
Summary of Soil ESV Exceedances - Flathead River Riparian Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Gamma Bhc (Lindane)	0	1	0 / 1	0.00078	0.00078			0.005	0	0.005	0
Heptachlor	0	1	0 / 1	0.0011	0.0011			0.059	0	0.059	0
Heptachlor Epoxide	0	1	0 / 1	0.0017	0.0017			0.152	0	0.152	0
Methoxychlor	0	1	0 / 1	0.0018	0.0018			5	0	5	0
P,P'-DDD	0	1	0 / 1	0.0011	0.0011			0.00488	0	0.00488	0
P,P'-DDE	0	1	0 / 1	0.0013	0.0013			0.021	0	0.021	0
P,P'-DDT	0	1	0 / 1	0.00089	0.00089			0.0035	0	0.0035	0
Toxaphene	0	1	0 / 1	0.025	0.025			0.119	0	0.119	0
trans-Chlordane	0	1	0 / 1	0.0019	0.0019			2.2	0	2.2	0
POLYCHLORINATED BIPHENYLS mg/kg											
PCB-1016 (Aroclor 1016)	0	8	0 / 8	0.0093	0.012			1	0	1	0
PCB-1221 (Aroclor 1221)	0	8	0 / 8	0.0093	0.012						
PCB-1232 (Aroclor 1232)	0	8	0 / 8	0.0093	0.012						
PCB-1242 (Aroclor 1242)	0	8	0 / 8	0.0093	0.012			0.041	0	0.041	0
PCB-1248 (Aroclor 1248)	0	8	0 / 8	0.0093	0.012			0.0072	0	0.0072	0
PCB-1254 (Aroclor 1254)	0	8	0 / 8	0.0096	0.012			0.041	0	0.041	0
PCB-1260 (Aroclor 1260)	0	8	0 / 8	0.0096	0.012			0.88	0	0.88	0
PCB-1262 (Aroclor 1262)	0	8	0 / 8	0.0096	0.012						
PCB-1268 (Aroclor 1268)	0	8	0 / 8	0.0096	0.012						
Polychlorinated Biphenyl (PCBs)	0	8	0 / 8	0.0096	0.012			40	0	40	0
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg											
Benzo(A)Anthracene	5	8	5 / 8	0.029	0.036	0.05	0.26	0.8	0		
Benzo(A)Pyrene	7	8	7 / 8	0.01	0.013	0.024	0.36	1.52	0		
Benzo(B)Fluoranthene	7	8	7 / 8	0.013	0.017	0.036	0.62	18	0		
Benzo(G,H,I)Perylene	6	8	6 / 8	0.02	0.025	0.061	0.46	24	0		
Benzo(K)Fluoranthene	6	8	6 / 8	0.015	0.019	0.02	0.21	62	0		
Chrysene	7	8	7 / 8	0.0094	0.012	0.026	0.42	2.4	0		
Dibenz(A,H)Anthracene	3	8	3 / 8	0.018	0.022	0.019	0.079	12	0		
Indeno(1,2,3-C,D)Pyrene	6	8	6 / 8	0.023	0.028	0.053	0.43	62	0		
Pyrene	7	8	7 / 8	0.016	0.019	0.033	0.56	10	0		
Total High Molecular Weight PAHs	7	8	7 / 8			0.119	3.399			1.1	2
2-Methylnaphthalene	0	8	0 / 8	0.0076	0.0094			3.24	0		
Acenaphthene	1	8	1 / 8	0.0084	0.01	0.024	0.024	0.25	0		
Acenaphthylene	0	8	0 / 8	0.0089	0.011			120	0		
Anthracene	0	8	0 / 8	0.033	0.041			6.8	0		
Fluoranthene	7	8	7 / 8	0.01	0.013	0.026	0.42	10	0		
Fluorene	1	8	1 / 8	0.0075	0.0093	0.015	0.015	3.7	0		
Naphthalene	0	8	0 / 8	0.0088	0.011			0.0994	0		
Phenanthrene	7	8	7 / 8	0.0092	0.011	0.019	0.21	5.5	0		
Total Low Molecular Weight PAHs	7	8	7 / 8			0.047	0.669			29	0

Table A-13
Summary of Soil ESV Exceedances - Flathead River Riparian Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg											
1,2,4,5-Tetrachlorobenzene	0	8	0 / 8	0.026	0.032			2.02	0	2.02	0
1,4-Dioxane (P-Dioxane)	0	8	0 / 8	0.092	0.11			1.83	0	1.83	0
2,3,4,6-Tetrachlorophenol	0	8	0 / 8	0.032	0.04						
2,4,5-Trichlorophenol	0	8	0 / 8	0.034	0.042			4	0	4	0
2,4,6-Trichlorophenol	0	8	0 / 8	0.0098	0.012			9.94	0	9.94	0
2,4-Dichlorophenol	0	8	0 / 8	0.0081	0.01			87.5	0	87.5	0
2,4-Dimethylphenol	0	8	0 / 8	0.076	0.094			0.01	0	0.01	0
2,4-Dinitrophenol	0	8	0 / 8	0.26	0.32			0.0609	0	0.0609	0
2,4-Dinitrotoluene	0	8	0 / 8	0.014	0.017			1.28	0	1.28	0
2,6-Dinitrotoluene	0	8	0 / 8	0.018	0.023			0.0328	0	0.0328	0
2-Chloronaphthalene	0	8	0 / 8	0.0078	0.0097			0.0122	0	0.0122	0
2-Chlorophenol	0	8	0 / 8	0.0088	0.011			0.243	0	0.243	0
2-Methylphenol (O-Cresol)	0	8	0 / 8	0.015	0.019			0.67	0	0.67	0
2-Nitroaniline	0	8	0 / 8	0.011	0.014			5.4	0	5.4	0
2-Nitrophenol	0	8	0 / 8	0.012	0.014			1.6	0	1.6	0
3- And 4- Methylphenol (Total)	0	8	0 / 8	0.0092	0.011						
3,3'-Dichlorobenzidine	0	8	0 / 8	0.039	0.048			0.646	0	0.646	0
3-Nitroaniline	0	8	0 / 8	0.01	0.013			3.16	0	3.16	0
4,6-Dinitro-2-Methylphenol	0	8	0 / 8	0.092	0.11			0.144	0	0.144	0
4-Bromophenyl Phenyl Ether	0	8	0 / 8	0.011	0.013						
4-Chloro-3-Methylphenol	0	8	0 / 8	0.015	0.018						
4-Chloroaniline	0	8	0 / 8	0.0089	0.011			1	0	1	0
4-Chlorophenyl Phenyl Ether	0	8	0 / 8	0.01	0.013						
4-Nitroaniline	0	8	0 / 8	0.013	0.016			21.9	0	21.9	0
4-Nitrophenol	0	8	0 / 8	0.17	0.21			7	0	7	0
Acetophenone	1	8	1 / 8	0.0075	0.0093	0.011	0.011	300	0	300	0
Atrazine	0	8	0 / 8	0.015	0.019						
Benzaldehyde	3	8	3 / 8	0.026	0.033	0.031	0.088				
Benzyl Butyl Phthalate	0	8	0 / 8	0.011	0.013			0.239	0	0.239	0
Biphenyl (Diphenyl)	0	8	0 / 8	0.029	0.036			60	0	60	0
Bis(2-Chloroethoxy) Methane	0	8	0 / 8	0.011	0.013			0.302	0	0.302	0
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	8	0 / 8	0.0081	0.01			23.7	0	23.7	0
Bis(2-Chloroisopropyl) Ether	0	8	0 / 8	0.014	0.018			19.9	0	19.9	0
Bis(2-Ethylhexyl) Phthalate	0	8	0 / 8	0.013	0.017			0.02	0	0.02	0
Caprolactam	2	8	2 / 8	0.025	0.031	0.042	0.046				
Carbazole	4	8	4 / 8	0.0086	0.011	0.0089	0.051	80	0	80	0
Dibenzofuran	0	8	0 / 8	0.01	0.013			6.1	0	6.1	0
Diethyl Phthalate	0	8	0 / 8	0.0098	0.012			100	0	100	0
Dimethyl Phthalate	0	8	0 / 8	0.01	0.012			10	0	10	0

Table A-13
Summary of Soil ESV Exceedances - Flathead River Riparian Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Di-N-Butyl Phthalate	4	8	4 / 8	0.01	0.013	0.014	0.034	0.011	4	0.011	4
Di-N-Octylphthalate	0	8	0 / 8	0.018	0.022			0.91	0	0.91	0
Hexachlorobenzene	0	8	0 / 8	0.014	0.017			0.079	0	0.079	0
Hexachlorobutadiene	0	8	0 / 8	0.0097	0.012			0.0398	0	0.0398	0
Hexachlorocyclopentadiene	0	8	0 / 8	0.022	0.027			0.755	0	0.755	0
Hexachloroethane	0	8	0 / 8	0.013	0.016			0.596	0	0.596	0
Isophorone	0	8	0 / 8	0.0074	0.0092			139	0	139	0
Nitrobenzene	0	8	0 / 8	0.011	0.013			1.31	0	1.31	0
N-Nitrosodi-N-Propylamine	0	8	0 / 8	0.012	0.014			0.544	0	0.544	0
N-Nitrosodiphenylamine	0	8	0 / 8	0.031	0.039			0.545	0	0.545	0
Pentachlorophenol	0	8	0 / 8	0.042	0.052			0.119	0	0.119	0
Phenol	0	8	0 / 8	0.011	0.014			0.79	0	0.79	0
VOLATILE ORGANIC COMPOUNDS mg/kg											
1,1,1-Trichloroethane	0	4	0 / 4	0.00032	0.00046			29.8	0	29.8	0
1,1,2,2-Tetrachloroethane	0	4	0 / 4	0.00014	0.0002			225	0	225	0
1,1,2-Trichloro-1,2,2-Trifluoroethane	0	4	0 / 4	0.00037	0.00053						
1,1,2-Trichloroethane	0	4	0 / 4	0.00024	0.00034			28.6	0	28.6	0
1,1-Dichloroethane	0	4	0 / 4	0.00029	0.00041			20.1	0	20.1	0
1,1-Dichloroethene	0	4	0 / 4	0.00034	0.00049			8.28	0	8.28	0
1,2,3-Trichlorobenzene	0	4	0 / 4	0.000092	0.00013			11.1	0	11.1	0
1,2,4-Trichlorobenzene	0	4	0 / 4	0.00027	0.00038			0.27	0	0.27	0
1,2-Dibromo-3-Chloropropane	0	4	0 / 4	0.00039	0.00056			0.0352	0	0.0352	0
1,2-Dibromoethane (Ethylene Dibromide)	0	4	0 / 4	0.0001	0.00014			1.23	0	1.23	0
1,2-Dichlorobenzene	0	4	0 / 4	0.00012	0.00017			0.92	0	0.92	0
1,2-Dichloroethane	0	4	0 / 4	0.000092	0.00013			0.85	0	0.85	0
1,2-Dichloropropane	0	4	0 / 4	0.00014	0.0002			32.7	0	32.7	0
1,3-Dichlorobenzene	0	4	0 / 4	0.0001	0.00014			0.73	0	0.73	0
1,4-Dichlorobenzene	0	4	0 / 4	0.00011	0.00016			0.88	0	0.88	0
2-Hexanone	0	4	0 / 4	0.00079	0.0011			0.36	0	0.36	0
Acetone	4	4	4 / 4	0.00089	0.0013	0.017	0.18	1.2	0	1.2	0
Benzene	4	4	4 / 4	0.00017	0.00024	0.00031	0.0022	0.255	0	0.255	0
Bromochloromethane	0	4	0 / 4	0.00014	0.0002						
Bromodichloromethane	0	4	0 / 4	0.00032	0.00046			0.54	0	0.54	0
Bromoform	0	4	0 / 4	0.00011	0.00016			15.9	0	15.9	0
Bromomethane	0	4	0 / 4	0.00027	0.00038						
Carbon Disulfide	3	4	3 / 4	0.00036	0.00052	0.00052	0.0015	0.0941	0	0.0941	0
Carbon Tetrachloride	0	4	0 / 4	0.00036	0.00052			2.98	0	2.98	0
Chlorobenzene	0	4	0 / 4	0.00012	0.00017			2.4	0	2.4	0
Chloroethane	0	4	0 / 4	0.00029	0.00042						
Chloroform	0	4	0 / 4	0.00018	0.00025			1.19	0	1.19	0

Table A-13
Summary of Soil ESV Exceedances - Flathead River Riparian Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Chloromethane	0	4	0 / 4	0.00032	0.00046						
Cis-1,2-Dichloroethylene	0	4	0 / 4	0.00018	0.00026			23	0	23	0
Cis-1,3-Dichloropropene	0	4	0 / 4	0.00013	0.00018			0.398	0	0.398	0
Cyclohexane	3	4	3 / 4	0.00039	0.00055	0.00092	0.0032				
Dibromochloromethane	0	4	0 / 4	0.00013	0.00018			2.05	0	2.05	0
Dichlorodifluoromethane	0	4	0 / 4	0.00027	0.00038			39.5	0	39.5	0
Ethylbenzene	3	4	3 / 4	0.00015	0.00022	0.0004	0.0012	5.16	0	5.16	0
Isopropylbenzene (Cumene)	0	4	0 / 4	0.00014	0.0002						
M,P-Xylene	4	4	4 / 4	0.000092	0.00013	0.00034	0.0033				
Methyl Acetate	1	4	1 / 4	0.00076	0.0011	0.36	0.36				
Methyl Ethyl Ketone (2-Butanone)	3	4	3 / 4	0.00065	0.00092	0.0076	0.011	360	0	360	0
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	0	4	0 / 4	0.0019	0.0027			9.8	0	9.8	0
Methylcyclohexane	4	4	4 / 4	0.00042	0.0006	0.00058	0.0056				
Methylene Chloride	1	4	1 / 4	0.00027	0.00038	0.001	0.001	2.6	0	2.6	0
O-Xylene (1,2-Dimethylbenzene)	3	4	3 / 4	0.00013	0.00019	0.00044	0.0011				
Styrene	0	4	0 / 4	0.00013	0.00018			1.2	0	1.2	0
Tert-Butyl Methyl Ether	0	4	0 / 4	0.00014	0.0002						
Tetrachloroethylene (PCE)	0	4	0 / 4	0.00024	0.00034			0.18	0	0.18	0
Toluene	4	4	4 / 4	0.00016	0.00023	0.0011	0.0069	5.45	0	5.45	0
Trans-1,2-Dichloroethene	0	4	0 / 4	0.00033	0.00047			23	0	23	0
Trans-1,3-Dichloropropene	0	4	0 / 4	0.000084	0.00012			0.398	0	0.398	0
Trichloroethylene (TCE)	0	4	0 / 4	0.00022	0.00031			1.387	0	1.387	0
Trichlorofluoromethane	0	4	0 / 4	0.00029	0.00041			16.4	0	16.4	0
Vinyl Chloride	0	4	0 / 4	0.00033	0.00047			0.12	0	0.12	0

Notes:

All soil samples from the 0-2' depth interval within the Flathead River Riparian exposure area included in screening assessment.
Quantitation limit used as the detection limit.
Concentration results evaluated against SLERA and BERA soil ESVs.
Total high molecular weight PAHs = sum of PAHs with four or more benzene rings.
Total low molecular weight PAHs = sum of PAHs with less than four benzene rings.

Table A-14
Summary of Sediment ESV Exceedances - Cedar Creek Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
METALS mg/kg											
Aluminum	3	3	3 / 3	23.6	26.2	8250	10300	26000	0	26000	0
Antimony	0	3	0 / 3	0.84	0.93			2	0	2	0
Arsenic	3	3	3 / 3	0.85	0.94	2.1	2.3	9.79	0	9.79	0
Barium	3	3	3 / 3	1.7	1.9	151	173				
Beryllium	3	3	3 / 3	0.26	0.28	0.34	0.43				
Cadmium	0	3	0 / 3	0.89	0.99			0.583	0	0.583	0
Calcium	3	3	3 / 3	115	128	13800	16400				
Chromium, Total	3	3	3 / 3	1.6	1.8	7.7	9.7	36.2	0	36.2	0
Cobalt	3	3	3 / 3	1.6	1.8	3.2	4.2	50	0	50	0
Copper	3	3	3 / 3	1.6	1.8	12.2	13.6	28	0	28	0
Iron	3	3	3 / 3	50.2	55.5	7770	10100	20000	0	20000	0
Lead	3	3	3 / 3	0.47	0.52	6.1	7.6	35.8	0	35.8	0
Magnesium	3	3	3 / 3	79.9	88.5	5410	7710				
Manganese	3	3	3 / 3	3.2	3.6	272	302	460	0	460	0
Mercury	3	3	3 / 3	0.031	0.035	0.032	0.044	0.174	0	0.174	0
Nickel	3	3	3 / 3	1.6	1.8	6.9	8.6	19.5	0	19.5	0
Potassium	3	3	3 / 3	78.4	86.8	613	789				
Selenium	0	3	0 / 3	0.78	0.87			2	0	2	0
Silver	0	3	0 / 3	1.6	1.8			0.5	0	0.5	0
Sodium	2	3	2 / 3	114	126	128	148				
Thallium	0	3	0 / 3	0.33	0.37						
Vanadium	3	3	3 / 3	2.3	2.6	5.4	7.2				
Zinc	3	3	3 / 3	8.4	9.3	37.3	48.9	98	0	98	0
GENERAL CHEMISTRY mg/kg											
Cyanide	3	3	3 / 3	0.079	0.087	0.15	0.24	0.0001	3	0.1	3
Fluoride	3	3	3 / 3	0.54	0.6	1.41	1.71	0	0	290	0
PESTICIDES mg/kg											
Aldrin	0	3	0 / 3	0.0024	0.0027			0.002	0	0.002	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	3	0 / 3	0.0018	0.002			0.006	0	0.006	0
Alpha Endosulfan	0	3	0 / 3	0.0028	0.0031			6.42E-06	0	6.42E-06	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	3	0 / 3	0.002	0.0022			0.005	0	0.005	0
Beta Endosulfan	0	3	0 / 3	0.0032	0.0035			6.42E-06	0	6.42E-06	0
cis-Chlordane	0	3	0 / 3	0.0033	0.0036						
Delta BHC (Delta Hexachlorocyclohexane)	0	3	0 / 3	0.0022	0.0024			0.138811	0	0.138811	0
Dieldrin	0	3	0 / 3	0.0026	0.0029			0.0019	0	0.0019	0
Endosulfan Sulfate	0	3	0 / 3	0.0024	0.0026			6.42E-06	0	6.42E-06	0
Endrin	0	3	0 / 3	0.0026	0.0028			0.00222	0	0.00222	0
Endrin Aldehyde	0	3	0 / 3	0.0025	0.0028			0.004428	0	0.004428	0
Endrin Ketone	0	3	0 / 3	0.0028	0.0031						

Table A-14
Summary of Sediment ESV Exceedances - Cedar Creek Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Gamma Bhc (Lindane)	0	3	0 / 3	0.0018	0.002			0.00237	0	0.00237	0
Heptachlor	0	3	0 / 3	0.0026	0.0029			0.0006	0	0.0006	0
Heptachlor Epoxide	0	3	0 / 3	0.004	0.0044			0.00247	0	0.00247	0
Methoxychlor	0	3	0 / 3	0.0043	0.0048						
P,P'-DDD	0	3	0 / 3	0.0027	0.0029			0.00488	0	0.00488	0
P,P'-DDE	0	3	0 / 3	0.0029	0.0032			0.00316	0	0.00316	0
P,P'-DDT	0	3	0 / 3	0.0021	0.0023			0.00416	0	0.00416	0
Toxaphene	0	3	0 / 3	0.059	0.065			0.000077	0	0.000077	0
trans-Chlordane	0	3	0 / 3	0.0044	0.0049						
POLYCHLORINATED BIPHENYLS mg/kg											
PCB-1016 (Aroclor 1016)	0	3	0 / 3	0.027	0.03						
PCB-1221 (Aroclor 1221)	0	3	0 / 3	0.027	0.03						
PCB-1232 (Aroclor 1232)	0	3	0 / 3	0.027	0.03						
PCB-1242 (Aroclor 1242)	0	3	0 / 3	0.027	0.03						
PCB-1248 (Aroclor 1248)	0	3	0 / 3	0.027	0.03						
PCB-1254 (Aroclor 1254)	0	3	0 / 3	0.028	0.031						
PCB-1260 (Aroclor 1260)	0	3	0 / 3	0.028	0.031						
PCB-1262 (Aroclor 1262)	0	3	0 / 3	0.028	0.031						
PCB-1268 (Aroclor 1268)	0	3	0 / 3	0.028	0.031						
Polychlorinated Biphenyl (PCBs)	0	3	0 / 3	0.028	0.031			0.032	0	0.032	0
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg											
2-Methylnaphthalene	0	3	0 / 3	0.022	0.024			0.0202	0	See Tables A-17 and A-18 for ESBTUs	
Acenaphthene	0	3	0 / 3	0.024	0.027			0.00671	0		
Acenaphthylene	0	3	0 / 3	0.026	0.028			0.00587	0		
Anthracene	0	3	0 / 3	0.095	0.1			0.01	0		
Benzo(A)Anthracene	1	3	1 / 3	0.083	0.092	0.12	0.12	0.016	1		
Benzo(A)Pyrene	2	3	2 / 3	0.03	0.033	0.043	0.094	0.032	2		
Benzo(B)Fluoranthene	1	3	1 / 3	0.039	0.043	0.12	0.12	9.79	0		
Benzo(G,H,I)Perylene	1	3	1 / 3	0.057	0.064	0.081	0.081	0.016	1		
Benzo(K)Fluoranthene	0	3	0 / 3	0.043	0.048			0.24	0		
Chrysene	3	3	3 / 3	0.027	0.03	0.038	0.13	0.027	3		
Dibenz(A,H)Anthracene	0	3	0 / 3	0.052	0.058			0.01	0		
Fluoranthene	3	3	3 / 3	0.03	0.033	0.042	0.19	0.031	3		
Fluorene	0	3	0 / 3	0.022	0.024			0.01	0		
Indeno(1,2,3-C,D)Pyrene	1	3	1 / 3	0.066	0.074	0.087	0.087	0.017	1		
Naphthalene	0	3	0 / 3	0.025	0.028			0.015	0		
Phenanthrene	3	3	3 / 3	0.027	0.029	0.039	0.17	0.019	3		
Pyrene	2	3	2 / 3	0.045	0.05	0.069	0.16	0.044	2		

Table A-14
Summary of Sediment ESV Exceedances - Cedar Creek Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg											
1,2,4,5-Tetrachlorobenzene	0	3	0 / 3	0.074	0.082						
1,4-Dioxane (P-Dioxane)	0	3	0 / 3	0.27	0.3						
2,3,4,6-Tetrachlorophenol	0	3	0 / 3	0.094	0.1			0.129	0	0.129	0
2,4,5-Trichlorophenol	0	3	0 / 3	0.099	0.11			0.288	0	0.288	0
2,4,6-Trichlorophenol	0	3	0 / 3	0.028	0.031			0.208	0	0.208	0
2,4-Dichlorophenol	0	3	0 / 3	0.024	0.026			0.0817	0	0.0817	0
2,4-Dimethylphenol	0	3	0 / 3	0.22	0.24			0.029	0	0.029	0
2,4-Dinitrophenol	0	3	0 / 3	0.75	0.84			0.00621	0	0.00621	0
2,4-Dinitrotoluene	0	3	0 / 3	0.04	0.044			0.0144	0	0.0144	0
2,6-Dinitrotoluene	0	3	0 / 3	0.053	0.059			0.0398	0	0.0398	0
2-Chloronaphthalene	0	3	0 / 3	0.023	0.025			0.417	0	0.417	0
2-Chlorophenol	0	3	0 / 3	0.025	0.028			0.02716	0	0.02716	0
2-Methylphenol (O-Cresol)	0	3	0 / 3	0.043	0.048			0.011856	0	0.011856	0
2-Nitroaniline	0	3	0 / 3	0.033	0.036						
2-Nitrophenol	0	3	0 / 3	0.034	0.037						
3- And 4- Methylphenol (Total)	0	3	0 / 3	0.027	0.029						
3,3'-Dichlorobenzidine	0	3	0 / 3	0.11	0.12			0.127	0	0.127	0
3-Nitroaniline	0	3	0 / 3	0.03	0.033						
4,6-Dinitro-2-Methylphenol	0	3	0 / 3	0.27	0.29						
4-Bromophenyl Phenyl Ether	0	3	0 / 3	0.031	0.035			0.255	0	0.255	0
4-Chloro-3-Methylphenol	0	3	0 / 3	0.043	0.047			0.388	0	0.388	0
4-Chloroaniline	0	3	0 / 3	0.026	0.028			0.146	0	0.146	0
4-Chlorophenyl Phenyl Ether	0	3	0 / 3	0.03	0.033						
4-Nitroaniline	0	3	0 / 3	0.038	0.042						
4-Nitrophenol	0	3	0 / 3	0.48	0.53					0.013	0
Acetophenone	0	3	0 / 3	0.022	0.024						
Atrazine	0	3	0 / 3	0.044	0.049			0.00662	0	0.00662	0
Benzaldehyde	2	3	2 / 3	0.076	0.084	0.15	0.17				
Benzyl Butyl Phthalate	0	3	0 / 3	0.031	0.034			1.97	0	1.97	0
Biphenyl (Diphenyl)	0	3	0 / 3	0.085	0.094			1.22	0	1.22	0
Bis(2-Chloroethoxy) Methane	0	3	0 / 3	0.031	0.034						
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	3	0 / 3	0.024	0.026						
Bis(2-Chloroisopropyl) Ether	0	3	0 / 3	0.041	0.045						
Bis(2-Ethylhexyl) Phthalate	1	3	1 / 3	0.039	0.043	0.04	0.04	0.18	0	0.18	0
Caprolactam	0	3	0 / 3	0.072	0.08						
Carbazole	0	3	0 / 3	0.025	0.027						
Dibenzofuran	0	3	0 / 3	0.03	0.033			0.300736	0	0.300736	0
Diethyl Phthalate	0	3	0 / 3	0.028	0.031			0.603	0	0.603	0
Dimethyl Phthalate	0	3	0 / 3	0.029	0.032						

Table A-14
Summary of Sediment ESV Exceedances - Cedar Creek Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Di-N-Butyl Phthalate	0	3	0 / 3	0.03	0.033			1.1989	0	1.1989	0
Di-N-Octylphthalate	0	3	0 / 3	0.051	0.056			16.8858	0	16.8858	0
Hexachlorobenzene	0	3	0 / 3	0.04	0.045			0.02	0	0.02	0
Hexachlorobutadiene	0	3	0 / 3	0.028	0.031			0.0265	0	0.0265	0
Hexachlorocyclopentadiene	0	3	0 / 3	0.062	0.069			0.901	0	0.901	0
Hexachloroethane	0	3	0 / 3	0.037	0.04			0.2136	0	0.2136	0
Isophorone	2	3	2 / 3	0.021	0.024	0.06	0.078	0.432	0	0.432	0
Nitrobenzene	0	3	0 / 3	0.031	0.035			0.145	0	0.145	0
N-Nitrosodi-N-Propylamine	0	3	0 / 3	0.034	0.037						
N-Nitrosodiphenylamine	0	3	0 / 3	0.091	0.1			0.516	0	0.516	0
Pentachlorophenol	0	3	0 / 3	0.12	0.13			0.504	0	0.504	0
Phenol	0	3	0 / 3	0.033	0.036			0.001152	0	0.001152	0

Notes:

All sediment samples from the 0-0.5' depth interval within the Cedar Creek exposure area included in screening assessment.

Quantitation limit used as the detection limit.

Concentration results evaluated against SLERA and BERA sediment ESVs.

Table A-15
Summary of Sediment ESV Exceedances - Cedar Creek Overflow Ditch Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
METALS mg/kg											
Aluminum	5	5	5 / 5	8.9	12.9	14700	22700	26000	0	26000	0
Antimony	0	5	0 / 5	0.32	0.46			2	0	2	0
Arsenic	5	5	5 / 5	0.32	0.46	4.1	6.8	9.79	0	9.79	0
Barium	5	5	5 / 5	0.63	0.91	180	295				
Beryllium	5	5	5 / 5	0.097	0.14	0.64	1				
Cadmium	0	5	0 / 5	0.33	0.48			0.583	0	0.583	0
Calcium	5	5	5 / 5	43.4	62.8	11500	30100				
Chromium, Total	5	5	5 / 5	0.6	0.87	11.8	15	36.2	0	36.2	0
Cobalt	5	5	5 / 5	0.6	0.87	5.8	8.4	50	0	50	0
Copper	5	5	5 / 5	0.61	0.88	19.8	27.8	28	0	28	0
Iron	5	5	5 / 5	18.9	27.3	14100	19500	20000	0	20000	0
Lead	5	5	5 / 5	0.18	0.26	13	18.5	35.8	0	35.8	0
Magnesium	5	5	5 / 5	30	43.5	8750	12200				
Manganese	5	5	5 / 5	1.2	1.8	517	1250	460	5	460	5
Mercury	5	5	5 / 5	0.013	0.019	0.029	0.045	0.174	0	0.174	0
Nickel	5	5	5 / 5	0.61	0.88	16	43.8	19.5	3	19.5	3
Potassium	5	5	5 / 5	29.5	42.7	922	1700				
Selenium	4	5	4 / 5	0.29	0.43	0.34	1.4	2	0	2	0
Silver	0	5	0 / 5	0.62	0.89			0.5	0	0.5	0
Sodium	5	5	5 / 5	42.8	62	60	171				
Thallium	0	5	0 / 5	0.13	0.18						
Vanadium	5	5	5 / 5	0.88	1.3	11.5	18				
Zinc	5	5	5 / 5	3.2	4.6	59	129	98	2	98	2
GENERAL CHEMISTRY mg/kg											
Cyanide	5	5	5 / 5	0.03	0.052	0.3	1.5	0.0001	5	0.1	5
Fluoride	5	5	5 / 5	0.22	0.5	1.3	4.27			290	0
PESTICIDES mg/kg											
Aldrin	0	5	0 / 5	0.00097	0.0015			0.002	0	0.002	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	5	0 / 5	0.00073	0.0011			0.006	0	0.006	0
Alpha Endosulfan	0	5	0 / 5	0.0011	0.0017			6.42E-06	0	6.42E-06	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	5	0 / 5	0.00078	0.0012			0.005	0	0.005	0
Beta Endosulfan	0	5	0 / 5	0.0013	0.0019			6.42E-06	0	6.42E-06	0
cis-Chlordane	0	5	0 / 5	0.0013	0.002						
Delta BHC (Delta Hexachlorocyclohexane)	0	5	0 / 5	0.00087	0.0013			0.138811	0	0.138811	0
Dieldrin	0	5	0 / 5	0.001	0.0016			0.0019	0	0.0019	0
Endosulfan Sulfate	0	5	0 / 5	0.00093	0.0014			6.42E-06	0	6.42E-06	0
Endrin	0	5	0 / 5	0.001	0.0015			0.00222	0	0.00222	0
Endrin Aldehyde	0	5	0 / 5	0.00099	0.0015			0.004428	0	0.004428	0
Endrin Ketone	0	5	0 / 5	0.0011	0.0017						

Table A-15
Summary of Sediment ESV Exceedances - Cedar Creek Overflow Ditch Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Gamma Bhc (Lindane)	0	5	0 / 5	0.00072	0.0011			0.00237	0	0.00237	0
Heptachlor	0	5	0 / 5	0.001	0.0016			0.0006	0	0.0006	0
Heptachlor Epoxide	0	5	0 / 5	0.0016	0.0024			0.00247	0	0.00247	0
Methoxychlor	0	5	0 / 5	0.0017	0.0026						
P,P'-DDD	0	5	0 / 5	0.0011	0.0016			0.00488	0	0.00488	0
P,P'-DDE	0	5	0 / 5	0.0012	0.0018			0.00316	0	0.00316	0
P,P'-DDT	0	5	0 / 5	0.00083	0.0012			0.00416	0	0.00416	0
Toxaphene	0	5	0 / 5	0.023	0.035			0.000077	0	0.000077	0
trans-Chlordane	0	5	0 / 5	0.0017	0.0026						
POLYCHLORINATED BIPHENYLS mg/kg											
PCB-1016 (Aroclor 1016)	0	5	0 / 5	0.011	0.016						
PCB-1221 (Aroclor 1221)	0	5	0 / 5	0.011	0.016						
PCB-1232 (Aroclor 1232)	0	5	0 / 5	0.011	0.016						
PCB-1242 (Aroclor 1242)	0	5	0 / 5	0.011	0.016						
PCB-1248 (Aroclor 1248)	0	5	0 / 5	0.011	0.016						
PCB-1254 (Aroclor 1254)	0	5	0 / 5	0.011	0.017						
PCB-1260 (Aroclor 1260)	0	5	0 / 5	0.011	0.017						
PCB-1262 (Aroclor 1262)	0	5	0 / 5	0.011	0.017						
PCB-1268 (Aroclor 1268)	0	5	0 / 5	0.011	0.017						
Polychlorinated Biphenyl (PCBs)	0	5	0 / 5	0.011	0.017			0.032	0	0.032	0
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg											
2-Methylnaphthalene	1	5	1 / 5	0.0087	0.013	0.012	0.012	0.0202	0	See Tables A-17 and A-18 for ESBTUs	
Acenaphthene	3	5	3 / 5	0.0096	0.014	0.043	0.075	0.00671	3		
Acenaphthylene	0	5	0 / 5	0.01	0.015			0.00587	0		
Anthracene	3	5	3 / 5	0.038	0.057	0.082	0.14	0.01	3		
Benzo(A)Anthracene	5	5	5 / 5	0.033	0.05	0.093	0.82	0.016	5		
Benzo(A)Pyrene	5	5	5 / 5	0.012	0.018	0.11	1.1	0.032	5		
Benzo(B)Fluoranthene	5	5	5 / 5	0.015	0.023	0.19	1.8	9.79	0		
Benzo(G,H,I)Perylene	5	5	5 / 5	0.023	0.034	0.11	1.3	0.016	5		
Benzo(K)Fluoranthene	5	5	5 / 5	0.017	0.026	0.051	0.49	0.24	3		
Chrysene	5	5	5 / 5	0.011	0.016	0.13	1.1	0.027	5		
Dibenz(A,H)Anthracene	3	5	3 / 5	0.021	0.031	0.16	0.28	0.01	3		
Fluoranthene	5	5	5 / 5	0.012	0.018	0.13	1.1	0.031	5		
Fluorene	3	5	3 / 5	0.0086	0.013	0.028	0.053	0.01	3		
Indeno(1,2,3-C,D)Pyrene	5	5	5 / 5	0.026	0.04	0.11	1.3	0.017	5		
Naphthalene	3	5	3 / 5	0.01	0.015	0.013	0.02	0.015	1		
Phenanthrene	5	5	5 / 5	0.011	0.016	0.065	0.69	0.019	5		
Pyrene	5	5	5 / 5	0.018	0.027	0.13	1.5	0.044	5		

Table A-15
Summary of Sediment ESV Exceedances - Cedar Creek Overflow Ditch Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg											
1,2,4,5-Tetrachlorobenzene	0	5	0 / 5	0.029	0.044						
1,4-Dioxane (P-Dioxane)	0	5	0 / 5	0.11	0.16						
2,3,4,6-Tetrachlorophenol	0	5	0 / 5	0.037	0.056			0.129	0	0.129	0
2,4,5-Trichlorophenol	0	5	0 / 5	0.039	0.059			0.288	0	0.288	0
2,4,6-Trichlorophenol	0	5	0 / 5	0.011	0.017			0.208	0	0.208	0
2,4-Dichlorophenol	0	5	0 / 5	0.0093	0.014			0.0817	0	0.0817	0
2,4-Dimethylphenol	0	5	0 / 5	0.087	0.13			0.029	0	0.029	0
2,4-Dinitrophenol	0	5	0 / 5	0.3	0.45			0.00621	0	0.00621	0
2,4-Dinitrotoluene	0	5	0 / 5	0.016	0.024			0.0144	0	0.0144	0
2,6-Dinitrotoluene	0	5	0 / 5	0.021	0.032			0.0398	0	0.0398	0
2-Chloronaphthalene	0	5	0 / 5	0.009	0.014			0.417	0	0.417	0
2-Chlorophenol	0	5	0 / 5	0.01	0.015			0.02716	0	0.02716	0
2-Methylphenol (O-Cresol)	0	5	0 / 5	0.017	0.026			0.011856	0	0.011856	0
2-Nitroaniline	0	5	0 / 5	0.013	0.02						
2-Nitrophenol	0	5	0 / 5	0.013	0.02						
3- And 4- Methylphenol (Total)	0	5	0 / 5	0.011	0.016						
3,3'-Dichlorobenzidine	0	5	0 / 5	0.044	0.067			0.127	0	0.127	0
3-Nitroaniline	0	5	0 / 5	0.012	0.018						
4,6-Dinitro-2-Methylphenol	0	5	0 / 5	0.11	0.16						
4-Bromophenyl Phenyl Ether	0	5	0 / 5	0.012	0.019			0.255	0	0.255	0
4-Chloro-3-Methylphenol	0	5	0 / 5	0.017	0.026			0.388	0	0.388	0
4-Chloroaniline	0	5	0 / 5	0.01	0.015			0.146	0	0.146	0
4-Chlorophenyl Phenyl Ether	0	5	0 / 5	0.012	0.018						
4-Nitroaniline	0	5	0 / 5	0.015	0.023						
4-Nitrophenol	0	5	0 / 5	0.19	0.29					0.013	0
Acetophenone	1	5	1 / 5	0.0086	0.013	0.011	0.011				
Atrazine	0	5	0 / 5	0.018	0.027			0.00662	0	0.00662	0
Benzaldehyde	1	5	1 / 5	0.03	0.046	0.069	0.069				
Benzyl Butyl Phthalate	1	5	1 / 5	0.012	0.018	0.031	0.031	1.97	0	1.97	0
Biphenyl (Diphenyl)	0	5	0 / 5	0.034	0.051			1.22	0	1.22	0
Bis(2-Chloroethoxy) Methane	0	5	0 / 5	0.012	0.019						
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	5	0 / 5	0.0093	0.014						
Bis(2-Chloroisopropyl) Ether	0	5	0 / 5	0.016	0.025						
Bis(2-Ethylhexyl) Phthalate	1	5	1 / 5	0.015	0.023	0.045	0.045	0.18	0	0.18	0
Caprolactam	0	5	0 / 5	0.028	0.043						
Carbazole	5	5	5 / 5	0.0098	0.015	0.011	0.1				
Dibenzofuran	2	5	2 / 5	0.012	0.018	0.015	0.024	0.300736	0	0.300736	0
Diethyl Phthalate	0	5	0 / 5	0.011	0.017			0.603	0	0.603	0
Dimethyl Phthalate	0	5	0 / 5	0.011	0.017						

Table A-15
Summary of Sediment ESV Exceedances - Cedar Creek Overflow Ditch Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Di-N-Butyl Phthalate	1	5	1 / 5	0.012	0.018	0.039	0.039	1.1989	0	1.1989	0
Di-N-Octylphthalate	0	5	0 / 5	0.02	0.03			16.8858	0	16.8858	0
Hexachlorobenzene	0	5	0 / 5	0.016	0.024			0.02	0	0.02	0
Hexachlorobutadiene	0	5	0 / 5	0.011	0.017			0.0265	0	0.0265	0
Hexachlorocyclopentadiene	0	5	0 / 5	0.025	0.037			0.901	0	0.901	0
Hexachloroethane	0	5	0 / 5	0.014	0.022			0.2136	0	0.2136	0
Isophorone	4	5	4 / 5	0.0085	0.013	0.012	0.016	0.432	0	0.432	0
Nitrobenzene	0	5	0 / 5	0.012	0.019			0.145	0	0.145	0
N-Nitrosodi-N-Propylamine	0	5	0 / 5	0.013	0.02						
N-Nitrosodiphenylamine	0	5	0 / 5	0.036	0.054			0.516	0	0.516	0
Pentachlorophenol	0	5	0 / 5	0.048	0.072			0.504	0	0.504	0
Phenol	0	5	0 / 5	0.013	0.02			0.001152	0	0.001152	0

Notes:

All sediment samples from the 0-0.5' depth interval and soil samples from the 0-0.5' depth interval within the Cedar Creek exposure area included in screening assessment.

Quantitation limit used as the detection limit.

Concentration results evaluated against SLERA and BERA sediment ESVs.

Table A-16
Summary of Sediment ESV Exceedances - South Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
METALS mg/kg											
Aluminum	11	11	11 / 11	8	18.1	2360	11800	26000	0	26000	0
Antimony	0	11	0 / 11	0.35	0.91			2	0	2	0
Arsenic	9	11	9 / 11	0.36	0.99	0.46	2.5	9.79	0	9.79	0
Barium	11	11	11 / 11	0.71	6	52.3	972				
Beryllium	8	11	8 / 11	0.11	0.28	0.16	0.65				
Cadmium	0	11	0 / 11	0.34	0.69			0.583	0	0.583	0
Calcium	11	11	11 / 11	39.1	88.4	8540	313000				
Chromium, Total	11	11	11 / 11	0.67	1.7	2.6	10.5	36.2	0	36.2	0
Cobalt	10	11	10 / 11	0.67	1.7	1.2	5.5	50	0	50	0
Copper	11	11	11 / 11	0.68	1.5	9	204	28	7	28	7
Iron	11	11	11 / 11	21.1	57.2	1490	12600	20000	0	20000	0
Lead	12	12	12 / 12	0.2	0.97	3.4	22.3	35.8	0	35.8	0
Magnesium	11	11	11 / 11	33.7	79.3	2510	9630				
Manganese	11	11	11 / 11	1.4	3.5	14.8	215	460	0	460	0
Mercury	11	11	11 / 11	0.013	0.027	0.016	0.14	0.174	0	0.174	0
Nickel	11	11	11 / 11	0.68	1.7	4.4	17.5	19.5	0	19.5	0
Potassium	11	11	11 / 11	33	75.1	238	1080				
Selenium	2	11	2 / 11	0.33	0.85	0.4	0.57	2	0	2	0
Silver	0	11	0 / 11	0.69	1.7			0.5	0	0.5	0
Sodium	9	11	9 / 11	42	87.3	54.3	410				
Thallium	0	11	0 / 11	0.14	0.34						
Vanadium	11	11	11 / 11	0.85	1.8	2.3	15.3				
Zinc	11	11	11 / 11	2.7	6.4	16.3	131	98	2	98	2
GENERAL CHEMISTRY mg/kg											
Cyanide	10	11	10 / 11	0.02	0.066	0.12	1.3	0.0001	10	0.1	10
Fluoride	11	11	11 / 11	0.28	0.86	1.8	29.4			290	0
PESTICIDES mg/kg											
Aldrin	0	9	0 / 9	0.001	0.0019			0.002	0	0.002	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	9	0 / 9	0.00076	0.0015			0.006	0	0.006	0
Alpha Endosulfan	0	9	0 / 9	0.0012	0.0022			6.42E-06	0	6.42E-06	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	9	0 / 9	0.00081	0.0016			0.005	0	0.005	0
Beta Endosulfan	0	9	0 / 9	0.0013	0.0025			6.42E-06	0	6.42E-06	0
cis-Chlordane	0	9	0 / 9	0.0014	0.0026						
Delta BHC (Delta Hexachlorocyclohexane)	0	9	0 / 9	0.00091	0.0017			0.138811	0	0.138811	0
Dieldrin	0	9	0 / 9	0.0011	0.0021			0.0019	0	0.0019	0
Endosulfan Sulfate	0	9	0 / 9	0.00098	0.0019			6.42E-06	0	6.42E-06	0
Endrin	0	9	0 / 9	0.0011	0.002			0.00222	0	0.00222	0
Endrin Aldehyde	0	9	0 / 9	0.001	0.002			0.004428	0	0.004428	0
Endrin Ketone	0	9	0 / 9	0.0012	0.0022						

Table A-16
Summary of Sediment ESV Exceedances - South Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Gamma Bhc (Lindane)	0	9	0 / 9	0.00075	0.0014			0.00237	0	0.00237	0
Heptachlor	0	9	0 / 9	0.0011	0.0021			0.0006	0	0.0006	0
Heptachlor Epoxide	0	9	0 / 9	0.0016	0.0031			0.00247	0	0.00247	0
Methoxychlor	0	9	0 / 9	0.0018	0.0034						
P,P'-DDD	0	9	0 / 9	0.0011	0.0021			0.00488	0	0.00488	0
P,P'-DDE	0	9	0 / 9	0.0012	0.0023			0.00316	0	0.00316	0
P,P'-DDT	0	9	0 / 9	0.00086	0.0017			0.00416	0	0.00416	0
Toxaphene	0	9	0 / 9	0.024	0.047			0.000077	0	0.000077	0
trans-Chlordane	0	9	0 / 9	0.0018	0.0035						
POLYCHLORINATED BIPHENYLS mg/kg											
PCB-1016 (Aroclor 1016)	0	11	0 / 11	0.01	0.021						
PCB-1221 (Aroclor 1221)	0	11	0 / 11	0.01	0.021						
PCB-1232 (Aroclor 1232)	0	11	0 / 11	0.01	0.021						
PCB-1242 (Aroclor 1242)	0	11	0 / 11	0.01	0.021						
PCB-1248 (Aroclor 1248)	0	11	0 / 11	0.01	0.021						
PCB-1254 (Aroclor 1254)	0	11	0 / 11	0.011	0.022						
PCB-1260 (Aroclor 1260)	0	11	0 / 11	0.011	0.022						
PCB-1262 (Aroclor 1262)	0	11	0 / 11	0.011	0.022						
PCB-1268 (Aroclor 1268)	0	11	0 / 11	0.011	0.022						
Polychlorinated Biphenyl (PCBs)	0	11	0 / 11	0.011	0.022			0.032	0	0.032	0
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg											
2-Methylnaphthalene	1	11	1 / 11	0.0086	0.035	0.01	0.01	0.0202	0	See Tables A-17 and A-18 for ESBTUs	
Acenaphthene	2	11	2 / 11	0.0094	0.038	0.01	0.02	0.00671	2		
Acenaphthylene	0	11	0 / 11	0.01	0.041			0.00587	0		
Anthracene	0	11	0 / 11	0.037	0.15			0.01	0		
Benzo(A)Anthracene	10	11	10 / 11	0.033	0.13	0.042	0.36	0.016	10		
Benzo(A)Pyrene	9	11	9 / 11	0.012	0.048	0.084	0.48	0.032	9		
Benzo(B)Fluoranthene	10	11	10 / 11	0.015	0.062	0.084	0.62	9.79	0		
Benzo(G,H,I)Perylene	10	11	10 / 11	0.022	0.091	0.057	0.9	0.016	10		
Benzo(K)Fluoranthene	10	11	10 / 11	0.017	0.069	0.022	0.25	0.24	1		
Chrysene	10	11	10 / 11	0.011	0.043	0.067	0.55	0.027	10		
Dibenz(A,H)Anthracene	6	11	6 / 11	0.02	0.082	0.035	0.14	0.01	6		
Fluoranthene	10	11	10 / 11	0.012	0.047	0.053	0.56	0.031	10		
Fluorene	1	11	1 / 11	0.0085	0.034	0.02	0.02	0.01	1		
Indeno(1,2,3-C,D)Pyrene	10	11	10 / 11	0.026	0.11	0.061	0.66	0.017	10		
Naphthalene	1	11	1 / 11	0.0099	0.04	0.015	0.015	0.015	0		
Phenanthrene	10	11	10 / 11	0.01	0.042	0.037	0.27	0.019	10		
Pyrene	10	11	10 / 11	0.018	0.072	0.058	0.57	0.044	10		

Table A-16
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Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg											
1,2,4,5-Tetrachlorobenzene	0	11	0 / 11	0.029	0.12						
1,4-Dioxane (P-Dioxane)	0	11	0 / 11	0.1	0.42						
2,3,4,6-Tetrachlorophenol	0	11	0 / 11	0.037	0.15			0.129	0	0.129	0
2,4,5-Trichlorophenol	0	11	0 / 11	0.039	0.16			0.288	0	0.288	0
2,4,6-Trichlorophenol	0	11	0 / 11	0.011	0.045			0.208	0	0.208	0
2,4-Dichlorophenol	0	11	0 / 11	0.0092	0.037			0.0817	0	0.0817	0
2,4-Dimethylphenol	0	11	0 / 11	0.086	0.35			0.029	0	0.029	0
2,4-Dinitrophenol	0	11	0 / 11	0.29	1.2			0.00621	0	0.00621	0
2,4-Dinitrotoluene	0	11	0 / 11	0.015	0.063			0.0144	0	0.0144	0
2,6-Dinitrotoluene	0	11	0 / 11	0.021	0.084			0.0398	0	0.0398	0
2-Chloronaphthalene	0	11	0 / 11	0.0088	0.036			0.417	0	0.417	0
2-Chlorophenol	0	11	0 / 11	0.0099	0.04			0.02716	0	0.02716	0
2-Methylphenol (O-Cresol)	0	11	0 / 11	0.017	0.069			0.011856	0	0.011856	0
2-Nitroaniline	0	11	0 / 11	0.013	0.052						
2-Nitrophenol	0	11	0 / 11	0.013	0.053						
3- And 4- Methylphenol (Total)	0	11	0 / 11	0.01	0.042						
3,3'-Dichlorobenzidine	0	11	0 / 11	0.043	0.18			0.127	0	0.127	0
3-Nitroaniline	0	11	0 / 11	0.012	0.047						
4,6-Dinitro-2-Methylphenol	0	11	0 / 11	0.1	0.42						
4-Bromophenyl Phenyl Ether	0	11	0 / 11	0.012	0.05			0.255	0	0.255	0
4-Chloro-3-Methylphenol	0	11	0 / 11	0.017	0.068			0.388	0	0.388	0
4-Chloroaniline	0	11	0 / 11	0.01	0.041			0.146	0	0.146	0
4-Chlorophenyl Phenyl Ether	0	11	0 / 11	0.012	0.047						
4-Nitroaniline	0	11	0 / 11	0.015	0.06						
4-Nitrophenol	0	11	0 / 11	0.19	0.76					0.013	0
Acetophenone	0	11	0 / 11	0.0085	0.034						
Atrazine	0	11	0 / 11	0.017	0.07			0.00662	0	0.00662	0
Benzaldehyde	1	11	1 / 11	0.03	0.12	0.038	0.038				
Benzyl Butyl Phthalate	0	11	0 / 11	0.012	0.049			1.97	0	1.97	0
Biphenyl (Diphenyl)	0	11	0 / 11	0.033	0.13			1.22	0	1.22	0
Bis(2-Chloroethoxy) Methane	0	11	0 / 11	0.012	0.049						
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	1	11	1 / 11	0.0092	0.037	0.017	0.017				
Bis(2-Chloroisopropyl) Ether	0	11	0 / 11	0.016	0.065						
Bis(2-Ethylhexyl) Phthalate	0	11	0 / 11	0.015	0.062			0.18	0	0.18	0
Caprolactam	0	11	0 / 11	0.028	0.11						
Carbazole	7	11	7 / 11	0.0097	0.039	0.016	0.073				
Dibenzofuran	0	11	0 / 11	0.012	0.048			0.300736	0	0.300736	0
Diethyl Phthalate	0	11	0 / 11	0.011	0.045			0.603	0	0.603	0
Dimethyl Phthalate	0	11	0 / 11	0.011	0.046						

Table A-16
Summary of Sediment ESV Exceedances - South Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Di-N-Butyl Phthalate	2	11	2 / 11	0.012	0.047	0.019	0.058	1.1989	0	1.1989	0
Di-N-Octylphthalate	0	11	0 / 11	0.02	0.08			16.8858	0	16.8858	0
Hexachlorobenzene	0	11	0 / 11	0.016	0.064			0.02	0	0.02	0
Hexachlorobutadiene	0	11	0 / 11	0.011	0.044			0.0265	0	0.0265	0
Hexachlorocyclopentadiene	0	11	0 / 11	0.024	0.098			0.901	0	0.901	0
Hexachloroethane	0	11	0 / 11	0.014	0.058			0.2136	0	0.2136	0
Isophorone	2	11	2 / 11	0.0084	0.034	0.02	0.024	0.432	0	0.432	0
Nitrobenzene	0	11	0 / 11	0.012	0.05			0.145	0	0.145	0
N-Nitrosodi-N-Propylamine	0	11	0 / 11	0.013	0.053						
N-Nitrosodiphenylamine	0	11	0 / 11	0.035	0.14			0.516	0	0.516	0
Pentachlorophenol	0	11	0 / 11	0.047	0.19			0.504	0	0.504	0
Phenol	0	11	0 / 11	0.013	0.052			0.001152	0	0.001152	0

Notes:

All sediment samples from the 0-0.5' depth interval and soil samples from the 0-0.5' depth interval within the South Percolation Pond exposure area included in screening assessment.

Quantitation limit used as the detection limit.

Concentration results evaluated against SLERA and BERA sediment ESVs.

Table A-17
Summary of Sediment ESV Exceedances - Northern Surface Water Feature Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
METALS mg/kg											
Aluminum	2	2	2 / 2	8.8	12.4	15500	34700	26000	1	26000	1
Antimony	0	2	0 / 2	0.31	0.44			2	0	2	0
Arsenic	2	2	2 / 2	0.32	0.45	6.2	7.6	9.79	0	9.79	0
Barium	2	2	2 / 2	0.63	4.4	191	905				
Beryllium	2	2	2 / 2	0.096	0.13	0.62	1.1				
Cadmium	0	2	0 / 2	0.33	0.47			0.583	0	0.583	0
Calcium	2	2	2 / 2	43.2	60.6	10900	11000				
Chromium, Total	2	2	2 / 2	0.6	0.84	9.1	11.3	36.2	0	36.2	0
Cobalt	2	2	2 / 2	0.6	0.84	4	5.6	50	0	50	0
Copper	2	2	2 / 2	0.6	0.85	12.3	32.1	28	1	28	1
Iron	2	2	2 / 2	18.8	26.3	12700	14000	20000	0	20000	0
Lead	2	2	2 / 2	0.18	0.25	10.6	14.6	35.8	0	35.8	0
Magnesium	2	2	2 / 2	29.9	41.9	5590	5690				
Manganese	2	2	2 / 2	1.2	1.7	175	234	460	0	460	0
Mercury	2	2	2 / 2	0.012	0.017	0.012	0.025	0.174	0	0.174	0
Nickel	2	2	2 / 2	0.61	0.85	9.8	13.3	19.5	0	19.5	0
Potassium	2	2	2 / 2	29.3	41.2	1040	1180				
Selenium	1	2	1 / 2	0.29	0.41	0.81	0.81	2	0	2	0
Silver	0	2	0 / 2	0.61	0.86			0.5	0	0.5	0
Sodium	2	2	2 / 2	42.6	59.8	152	477				
Thallium	0	2	0 / 2	0.12	0.17						
Vanadium	2	2	2 / 2	0.87	1.2	11	13.3				
Zinc	2	2	2 / 2	3.1	4.4	41	41.6	98	0	98	0
GENERAL CHEMISTRY mg/kg											
Cyanide	2	2	2 / 2	0.033	0.039	0.24	0.84	0.0001	2	0.1	2
Fluoride	2	2	2 / 2	0.41	0.57	2.6	3.79	0	0	290	0
PESTICIDES mg/kg											
Aldrin	0	2	0 / 2	0.00093	0.0013			0.002	0	0.002	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	2	0 / 2	0.0007	0.00097			0.006	0	0.006	0
Alpha Endosulfan	0	2	0 / 2	0.0011	0.0015			6.42E-06	0	6.42E-06	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	2	0 / 2	0.00075	0.001			0.005	0	0.005	0
Beta Endosulfan	0	2	0 / 2	0.0012	0.0017			6.42E-06	0	6.42E-06	0
cis-Chlordane	0	2	0 / 2	0.0013	0.0017						
Delta BHC (Delta Hexachlorocyclohexane)	0	2	0 / 2	0.00084	0.0012			0.138811	0	0.138811	0
Dieldrin	0	2	0 / 2	0.001	0.0014			0.0019	0	0.0019	0
Endosulfan Sulfate	0	2	0 / 2	0.0009	0.0012			6.42E-06	0	6.42E-06	0
Endrin	0	2	0 / 2	0.00098	0.0013			0.00222	0	0.00222	0
Endrin Aldehyde	0	2	0 / 2	0.00095	0.0013			0.004428	0	0.004428	0
Endrin Ketone	0	2	0 / 2	0.0011	0.0015						

Table A-17
Summary of Sediment ESV Exceedances - Northern Surface Water Feature Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Gamma Bhc (Lindane)	0	2	0 / 2	0.00069	0.00095			0.00237	0	0.00237	0
Heptachlor	0	2	0 / 2	0.00099	0.0014			0.0006	0	0.0006	0
Heptachlor Epoxide	0	2	0 / 2	0.0015	0.0021			0.00247	0	0.00247	0
Methoxychlor	0	2	0 / 2	0.0016	0.0022						
P,P'-DDD	0	2	0 / 2	0.001	0.0014			0.00488	0	0.00488	0
P,P'-DDE	0	2	0 / 2	0.0011	0.0015			0.00316	0	0.00316	0
P,P'-DDT	0	2	0 / 2	0.00079	0.0011			0.00416	0	0.00416	0
Toxaphene	0	2	0 / 2	0.022	0.031			0.000077	0	0.000077	0
trans-Chlordane	0	2	0 / 2	0.0017	0.0023						
POLYCHLORINATED BIPHENYLS mg/kg											
PCB-1016 (Aroclor 1016)	0	2	0 / 2	0.01	0.014						
PCB-1221 (Aroclor 1221)	0	2	0 / 2	0.01	0.014						
PCB-1232 (Aroclor 1232)	0	2	0 / 2	0.01	0.014						
PCB-1242 (Aroclor 1242)	0	2	0 / 2	0.01	0.014						
PCB-1248 (Aroclor 1248)	0	2	0 / 2	0.01	0.014						
PCB-1254 (Aroclor 1254)	0	2	0 / 2	0.011	0.015						
PCB-1260 (Aroclor 1260)	0	2	0 / 2	0.011	0.015						
PCB-1262 (Aroclor 1262)	0	2	0 / 2	0.011	0.015						
PCB-1268 (Aroclor 1268)	0	2	0 / 2	0.011	0.015						
Polychlorinated Biphenyl (PCBs)	0	2	0 / 2	0.011	0.015			0.032	0	0.032	0
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg											
2-Methylnaphthalene	0	2	0 / 2	0.0084	0.012			0.0202	0	See Tables A-17 and A-18 for ESBTUs	
Acenaphthene	0	2	0 / 2	0.0092	0.013			0.00671	0		
Acenaphthylene	0	2	0 / 2	0.0098	0.013			0.00587	0		
Anthracene	0	2	0 / 2	0.036	0.05			0.01	0		
Benzo(A)Anthracene	1	2	1 / 2	0.032	0.044	0.074	0.074	0.016	1		
Benzo(A)Pyrene	2	2	2 / 2	0.011	0.016	0.021	0.091	0.032	1		
Benzo(B)Fluoranthene	2	2	2 / 2	0.015	0.02	0.036	0.15	9.79	0		
Benzo(G,H,I)Perylene	2	2	2 / 2	0.022	0.03	0.027	0.1	0.016	2		
Benzo(K)Fluoranthene	1	2	1 / 2	0.017	0.023	0.053	0.053	0.24	0		
Chrysene	2	2	2 / 2	0.01	0.014	0.019	0.13	0.027	1		
Dibenz(A,H)Anthracene	0	2	0 / 2	0.02	0.027			0.01	0		
Fluoranthene	2	2	2 / 2	0.011	0.016	0.018	0.12	0.031	1		
Fluorene	0	2	0 / 2	0.0083	0.011			0.01	0		
Indeno(1,2,3-C,D)Pyrene	2	2	2 / 2	0.025	0.035	0.025	0.093	0.017	2		
Naphthalene	0	2	0 / 2	0.0096	0.013			0.015	0		
Phenanthrene	2	2	2 / 2	0.01	0.014	0.011	0.058	0.019	1		
Pyrene	2	2	2 / 2	0.017	0.024	0.027	0.11	0.044	1		

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Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg											
1,2,4,5-Tetrachlorobenzene	0	2	0 / 2	0.028	0.039						
1,4-Dioxane (P-Dioxane)	0	2	0 / 2	0.1	0.14						
2,3,4,6-Tetrachlorophenol	0	2	0 / 2	0.036	0.049			0.129	0	0.129	0
2,4,5-Trichlorophenol	0	2	0 / 2	0.038	0.052			0.288	0	0.288	0
2,4,6-Trichlorophenol	0	2	0 / 2	0.011	0.015			0.208	0	0.208	0
2,4-Dichlorophenol	0	2	0 / 2	0.009	0.012			0.0817	0	0.0817	0
2,4-Dimethylphenol	0	2	0 / 2	0.083	0.12			0.029	0	0.029	0
2,4-Dinitrophenol	0	2	0 / 2	0.29	0.4			0.00621	0	0.00621	0
2,4-Dinitrotoluene	0	2	0 / 2	0.015	0.021			0.0144	0	0.0144	0
2,6-Dinitrotoluene	0	2	0 / 2	0.02	0.028			0.0398	0	0.0398	0
2-Chloronaphthalene	0	2	0 / 2	0.0086	0.012			0.417	0	0.417	0
2-Chlorophenol	0	2	0 / 2	0.0096	0.013			0.02716	0	0.02716	0
2-Methylphenol (O-Cresol)	0	2	0 / 2	0.017	0.023			0.011856	0	0.011856	0
2-Nitroaniline	0	2	0 / 2	0.013	0.017						
2-Nitrophenol	0	2	0 / 2	0.013	0.018						
3- And 4- Methylphenol (Total)	0	2	0 / 2	0.01	0.014						
3,3'-Dichlorobenzidine	0	2	0 / 2	0.042	0.058			0.127	0	0.127	0
3-Nitroaniline	0	2	0 / 2	0.011	0.016						
4,6-Dinitro-2-Methylphenol	0	2	0 / 2	0.1	0.14						
4-Bromophenyl Phenyl Ether	0	2	0 / 2	0.012	0.016			0.255	0	0.255	0
4-Chloro-3-Methylphenol	0	2	0 / 2	0.016	0.023			0.388	0	0.388	0
4-Chloroaniline	0	2	0 / 2	0.0098	0.013			0.146	0	0.146	0
4-Chlorophenyl Phenyl Ether	0	2	0 / 2	0.011	0.016						
4-Nitroaniline	0	2	0 / 2	0.014	0.02						
4-Nitrophenol	0	2	0 / 2	0.18	0.25					0.013	0
Acetophenone	0	2	0 / 2	0.0083	0.011						
Atrazine	0	2	0 / 2	0.017	0.023			0.00662	0	0.00662	0
Benzaldehyde	0	2	0 / 2	0.029	0.04						
Benzyl Butyl Phthalate	0	2	0 / 2	0.012	0.016			1.97	0	1.97	0
Biphenyl (Diphenyl)	0	2	0 / 2	0.032	0.045			1.22	0	1.22	0
Bis(2-Chloroethoxy) Methane	0	2	0 / 2	0.012	0.016						
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	2	0 / 2	0.009	0.012						
Bis(2-Chloroisopropyl) Ether	0	2	0 / 2	0.016	0.022						
Bis(2-Ethylhexyl) Phthalate	0	2	0 / 2	0.015	0.02			0.18	0	0.18	0
Caprolactam	0	2	0 / 2	0.027	0.038						
Carbazole	0	2	0 / 2	0.0094	0.013						
Dibenzofuran	0	2	0 / 2	0.011	0.016			0.300736	0	0.300736	0
Diethyl Phthalate	0	2	0 / 2	0.011	0.015			0.603	0	0.603	0
Dimethyl Phthalate	0	2	0 / 2	0.011	0.015						

Table A-17
Summary of Sediment ESV Exceedances - Northern Surface Water Feature Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Di-N-Butyl Phthalate	0	2	0 / 2	0.011	0.016			1.1989	0	1.1989	0
Di-N-Octylphthalate	0	2	0 / 2	0.019	0.027			16.8858	0	16.8858	0
Hexachlorobenzene	0	2	0 / 2	0.015	0.021			0.02	0	0.02	0
Hexachlorobutadiene	0	2	0 / 2	0.011	0.015			0.0265	0	0.0265	0
Hexachlorocyclopentadiene	0	2	0 / 2	0.024	0.033			0.901	0	0.901	0
Hexachloroethane	0	2	0 / 2	0.014	0.019			0.2136	0	0.2136	0
Isophorone	1	2	1 / 2	0.0081	0.011	0.015	0.015	0.432	0	0.432	0
Nitrobenzene	0	2	0 / 2	0.012	0.016			0.145	0	0.145	0
N-Nitrosodi-N-Propylamine	0	2	0 / 2	0.013	0.018						
N-Nitrosodiphenylamine	0	2	0 / 2	0.034	0.048			0.516	0	0.516	0
Pentachlorophenol	0	2	0 / 2	0.046	0.063			0.504	0	0.504	0
Phenol	0	2	0 / 2	0.012	0.017			0.001152	0	0.001152	0

Notes:

All sediment samples from the 0-0.5' depth interval within the Northern Surface Water Feature exposure area included in screening assessment.

Quantitation limit used as the detection limit.

Concentration results evaluated against SLERA and BERA sediment ESVs.

Table A-18
Summary of Sediment ESV Exceedances - North Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
METALS mg/kg											
Aluminum	11	11	11 / 11	6.5	59.2	10300	112000	26000	6	26000	6
Antimony	3	11	3 / 11	0.36	0.75	1.1	2.6	2	2	2	2
Arsenic	11	11	11 / 11	0.39	0.82	3.7	26.4	9.79	4	9.79	4
Barium	11	11	11 / 11	0.58	3.9	48.9	539				
Beryllium	11	11	11 / 11	0.11	0.23	0.36	17.2				
Cadmium	10	11	10 / 11	0.27	0.57	0.68	8.3	0.583	10	0.583	10
Calcium	11	11	11 / 11	31.5	65.6	1370	106000				
Chromium, Total	11	11	11 / 11	0.68	1.4	11.4	53	36.2	3	36.2	3
Cobalt	11	11	11 / 11	0.68	1.4	2.6	27.4	50	0	50	0
Copper	11	11	11 / 11	0.59	3.1	6.7	83.6	28	6	28	6
Iron	11	11	11 / 11	22.8	47.4	2920	15400	20000	0	20000	0
Lead	12	12	12 / 12	0.19	1.2	8.3	238	35.8	4	35.8	4
Magnesium	11	11	11 / 11	31.6	65.7	1090	11800				
Manganese	11	11	11 / 11	1.4	2.9	15.8	479	460	1	460	1
Mercury	8	11	8 / 11	0.013	0.028	0.016	0.1	0.174	0	0.174	0
Nickel	11	11	11 / 11	0.69	2.7	17.9	1250	19.5	10	19.5	10
Potassium	11	11	11 / 11	29.9	62.3	266	1900				
Selenium	8	11	8 / 11	0.34	0.71	0.71	3.4	2	2	2	2
Silver	1	11	1 / 11	0.66	1.4	1	1	0.5	1	0.5	1
Sodium	10	11	10 / 11	33.8	70.3	67.6	2140				
Thallium	10	11	10 / 11	0.14	0.83	0.25	4.6				
Vanadium	11	11	11 / 11	0.68	1.4	13.3	348				
Zinc	11	11	11 / 11	2.1	4.5	42.2	871	98	10	98	10
GENERAL CHEMISTRY mg/kg											
Cyanide	11	11	11 / 11	0.017	0.8	0.096	137	0.0001	11	0.1	10
Fluoride	11	11	11 / 11	0.22	2.77	33.6	241			290	0
PESTICIDES mg/kg											
Aldrin	0	9	0 / 9	0.00092	0.0021			0.002	0	0.002	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	9	0 / 9	0.00069	0.0016			0.006	0	0.006	0
Alpha Endosulfan	0	9	0 / 9	0.0011	0.0024			6.42E-06	0	6.42E-06	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	9	0 / 9	0.00074	0.0017			0.005	0	0.005	0
Beta Endosulfan	0	9	0 / 9	0.0012	0.0027			6.42E-06	0	6.42E-06	0
cis-Chlordane	0	9	0 / 9	0.0012	0.0028						
Delta BHC (Delta Hexachlorocyclohexane)	0	9	0 / 9	0.00083	0.0019			0.138811	0	0.138811	0
Dieldrin	0	9	0 / 9	0.00099	0.0022			0.0019	0	0.0019	0
Endosulfan Sulfate	0	9	0 / 9	0.00088	0.002			6.42E-06	0	6.42E-06	0
Endrin	0	9	0 / 9	0.00096	0.0022			0.00222	0	0.00222	0
Endrin Aldehyde	0	9	0 / 9	0.00094	0.0021			0.004428	0	0.004428	0
Endrin Ketone	0	9	0 / 9	0.0011	0.0024						

Table A-18
Summary of Sediment ESV Exceedances - North Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Gamma Bhc (Lindane)	0	9	0 / 9	0.00068	0.0015			0.00237	0	0.00237	0
Heptachlor	0	9	0 / 9	0.00098	0.0022			0.0006	0	0.0006	0
Heptachlor Epoxide	0	9	0 / 9	0.0015	0.0034			0.00247	0	0.00247	0
Methoxychlor	0	9	0 / 9	0.0016	0.0036						
P,P'-DDD	0	9	0 / 9	0.001	0.0023			0.00488	0	0.00488	0
P,P'-DDE	0	9	0 / 9	0.0011	0.0025			0.00316	0	0.00316	0
P,P'-DDT	0	9	0 / 9	0.00078	0.0018			0.00416	0	0.00416	0
Toxaphene	0	9	0 / 9	0.022	0.05			0.000077	0	0.000077	0
trans-Chlordane	0	9	0 / 9	0.0016	0.0037						
POLYCHLORINATED BIPHENYLS mg/kg											
PCB-1016 (Aroclor 1016)	0	11	0 / 11	0.0095	0.023						
PCB-1221 (Aroclor 1221)	0	11	0 / 11	0.0095	0.023						
PCB-1232 (Aroclor 1232)	0	11	0 / 11	0.0095	0.023						
PCB-1242 (Aroclor 1242)	0	11	0 / 11	0.0095	0.023						
PCB-1248 (Aroclor 1248)	0	11	0 / 11	0.0095	0.023						
PCB-1254 (Aroclor 1254)	0	11	0 / 11	0.0099	0.024						
PCB-1260 (Aroclor 1260)	0	11	0 / 11	0.0099	0.024						
PCB-1262 (Aroclor 1262)	0	11	0 / 11	0.0099	0.024						
PCB-1268 (Aroclor 1268)	0	11	0 / 11	0.0099	0.024						
Polychlorinated Biphenyl (PCBs)	0	11	0 / 11	0.0099	0.024			0.032	0	0.032	0
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg											
2-Methylnaphthalene	11	11	11 / 11	0.0086	1.1	0.017	3.6	0.0202	10	See Tables A-17 and A-18 for ESBTUs	
Acenaphthene	11	11	11 / 11	0.0094	1.2	0.031	40	0.00671	11		
Acenaphthylene	3	11	3 / 11	0.01	1.2	0.033	1.2	0.00587	3		
Anthracene	11	11	11 / 11	0.037	4.6	0.049	41	0.01	11		
Benzo(A)Anthracene	10	11	10 / 11	0.032	4	1.7	280	0.016	10		
Benzo(A)Pyrene	10	11	10 / 11	0.012	1.5	2	320	0.032	10		
Benzo(B)Fluoranthene	10	11	10 / 11	0.015	1.9	6.8	460	9.79	8		
Benzo(G,H,I)Perylene	10	11	10 / 11	0.022	2.8	2.2	250	0.016	10		
Benzo(K)Fluoranthene	10	11	10 / 11	0.017	2.1	2.4	150	0.24	10		
Chrysene	10	11	10 / 11	0.011	1.3	2.3	350	0.027	10		
Dibenz(A,H)Anthracene	10	11	10 / 11	0.02	2.5	0.61	70	0.01	10		
Fluoranthene	11	11	11 / 11	0.012	1.4	0.029	430	0.031	10		
Fluorene	11	11	11 / 11	0.0085	1.1	0.012	16	0.01	11		
Indeno(1,2,3-C,D)Pyrene	10	11	10 / 11	0.026	3.2	2.7	260	0.017	10		
Naphthalene	11	11	11 / 11	0.0099	1.2	0.042	6.5	0.015	11		
Phenanthrene	11	11	11 / 11	0.01	1.3	0.51	200	0.019	11		
Pyrene	11	11	11 / 11	0.018	2.2	0.058	440	0.044	11		

Table A-18
Summary of Sediment ESV Exceedances - North Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg											
1,2,4,5-Tetrachlorobenzene	0	11	0 / 11	0.029	3.6						
1,4-Dioxane (P-Dioxane)	0	11	0 / 11	0.1	13						
2,3,4,6-Tetrachlorophenol	0	11	0 / 11	0.037	4.5			0.129	0	0.129	0
2,4,5-Trichlorophenol	0	11	0 / 11	0.039	4.8			0.288	0	0.288	0
2,4,6-Trichlorophenol	0	11	0 / 11	0.011	1.4			0.208	0	0.208	0
2,4-Dichlorophenol	0	11	0 / 11	0.0092	1.1			0.0817	0	0.0817	0
2,4-Dimethylphenol	0	11	0 / 11	0.085	11			0.029	0	0.029	0
2,4-Dinitrophenol	0	11	0 / 11	0.29	37			0.00621	0	0.00621	0
2,4-Dinitrotoluene	0	11	0 / 11	0.015	1.9			0.0144	0	0.0144	0
2,6-Dinitrotoluene	0	11	0 / 11	0.021	2.6			0.0398	0	0.0398	0
2-Chloronaphthalene	0	11	0 / 11	0.0088	1.1			0.417	0	0.417	0
2-Chlorophenol	0	11	0 / 11	0.0099	1.2			0.02716	0	0.02716	0
2-Methylphenol (O-Cresol)	0	11	0 / 11	0.017	2.1			0.011856	0	0.011856	0
2-Nitroaniline	0	11	0 / 11	0.013	1.6						
2-Nitrophenol	0	11	0 / 11	0.013	1.6						
3- And 4- Methylphenol (Total)	0	11	0 / 11	0.01	1.3						
3,3'-Dichlorobenzidine	0	11	0 / 11	0.043	5.4			0.127	0	0.127	0
3-Nitroaniline	0	11	0 / 11	0.012	1.4						
4,6-Dinitro-2-Methylphenol	0	11	0 / 11	0.1	13						
4-Bromophenyl Phenyl Ether	0	11	0 / 11	0.012	1.5			0.255	0	0.255	0
4-Chloro-3-Methylphenol	0	11	0 / 11	0.017	2.1			0.388	0	0.388	0
4-Chloroaniline	1	11	1 / 11	0.01	1.2	0.13	0.13	0.146	0	0.146	0
4-Chlorophenyl Phenyl Ether	0	11	0 / 11	0.012	1.4						
4-Nitroaniline	0	11	0 / 11	0.015	1.8						
4-Nitrophenol	0	11	0 / 11	0.19	23					0.013	0
Acetophenone	1	11	1 / 11	0.0085	1.1	0.011	0.011				
Atrazine	0	11	0 / 11	0.017	2.2			0.00662	0	0.00662	0
Benzaldehyde	0	11	0 / 11	0.03	3.7						
Benzyl Butyl Phthalate	1	11	1 / 11	0.012	1.5	0.55	0.55	1.97	0	1.97	0
Biphenyl (Diphenyl)	1	11	1 / 11	0.033	4.1	0.072	0.072	1.22	0	1.22	0
Bis(2-Chloroethoxy) Methane	0	11	0 / 11	0.012	1.5						
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	11	0 / 11	0.0092	1.1						
Bis(2-Chloroisopropyl) Ether	0	11	0 / 11	0.016	2						
Bis(2-Ethylhexyl) Phthalate	2	11	2 / 11	0.015	1.9	0.17	0.18	0.18	0	0.18	0
Caprolactam	0	11	0 / 11	0.028	3.5						
Carbazole	10	11	10 / 11	0.0096	1.2	0.11	33				
Dibenzofuran	11	11	11 / 11	0.012	1.5	0.041	7.3	0.300736	6	0.300736	6
Diethyl Phthalate	0	11	0 / 11	0.011	1.4			0.603	0	0.603	0
Dimethyl Phthalate	0	11	0 / 11	0.011	1.4						

Table A-18
Summary of Sediment ESV Exceedances - North Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Di-N-Butyl Phthalate	0	11	0 / 11	0.012	1.4			1.1989	0	1.1989	0
Di-N-Octylphthalate	0	11	0 / 11	0.02	2.5			16.8858	0	16.8858	0
Hexachlorobenzene	0	11	0 / 11	0.016	2			0.02	0	0.02	0
Hexachlorobutadiene	0	11	0 / 11	0.011	1.4			0.0265	0	0.0265	0
Hexachlorocyclopentadiene	0	11	0 / 11	0.024	3			0.901	0	0.901	0
Hexachloroethane	0	11	0 / 11	0.014	1.8			0.2136	0	0.2136	0
Isophorone	0	11	0 / 11	0.0083	1			0.432	0	0.432	0
Nitrobenzene	0	11	0 / 11	0.012	1.5			0.145	0	0.145	0
N-Nitrosodi-N-Propylamine	0	11	0 / 11	0.013	1.6						
N-Nitrosodiphenylamine	0	11	0 / 11	0.035	4.4			0.516	0	0.516	0
Pentachlorophenol	0	11	0 / 11	0.047	5.9			0.504	0	0.504	0
Phenol	0	11	0 / 11	0.013	1.6			0.001152	0	0.001152	0

Notes:

All sediment samples from the 0-0.5' depth interval and soil samples from the 0-0.5' depth interval within the North Percolation Pond exposure area included in screening assessment.

Quantitation limit used as the detection limit.

Concentration results evaluated against SLERA and BERA sediment ESVs.

Table A-19
Summary of Sediment ESV Exceedances - Flathead River Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
METALS mg/kg											
Aluminum	8	8	8 / 8	8.5	16.1	6570	8460	26000	0	26000	0
Antimony	0	8	0 / 8	0.3	0.57			2	0	2	0
Arsenic	8	8	8 / 8	0.3	0.58	3.5	6.2	9.79	0	9.79	0
Barium	8	8	8 / 8	0.6	1.1	38	151				
Beryllium	8	8	8 / 8	0.092	0.18	0.28	0.54				
Cadmium	0	8	0 / 8	0.32	0.61			0.583	0	0.583	0
Calcium	8	8	8 / 8	41.3	78.7	11700	28000				
Chromium, Total	8	8	8 / 8	0.57	1.1	7.7	10.5	36.2	0	36.2	0
Cobalt	8	8	8 / 8	0.57	1.1	4.8	6	50	0	50	0
Copper	8	8	8 / 8	0.58	1.1	9.4	13.8	28	0	28	0
Iron	8	8	8 / 8	18	34.2	10800	15200	20000	0	20000	0
Lead	8	8	8 / 8	0.17	0.32	5.6	9	35.8	0	35.8	0
Magnesium	8	8	8 / 8	28.6	54.5	9590	11200				
Manganese	8	8	8 / 8	1.2	2.2	139	297	460	0	460	0
Mercury	3	8	3 / 8	0.013	0.021	0.019	0.042	0.174	0	0.174	0
Nickel	8	8	8 / 8	0.58	1.1	9.8	13	19.5	0	19.5	0
Potassium	8	8	8 / 8	28.1	53.4	390	1080				
Selenium	0	8	0 / 8	0.28	0.53			2	0	2	0
Silver	0	8	0 / 8	0.59	1.1			0.5	0	0.5	0
Sodium	4	8	4 / 8	40.8	77.6	45.1	148				
Thallium	0	8	0 / 8	0.12	0.23						
Vanadium	8	8	8 / 8	0.83	1.6	7.5	25.5				
Zinc	8	8	8 / 8	3	5.7	35	48.8	98	0	98	0
GENERAL CHEMISTRY mg/kg											
Cyanide	4	8	4 / 8	0.032	0.06	0.067	3.2	0.0001	4	0.1	3
Fluoride	8	8	8 / 8	0.22	0.38	0.36	13.7			290	0
PESTICIDES mg/kg											
Aldrin	0	8	0 / 8	0.00098	0.0017			0.002	0	0.002	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	8	0 / 8	0.00074	0.0013			0.006	0	0.006	0
Alpha Endosulfan	0	8	0 / 8	0.0011	0.002			6.42E-06	0	6.42E-06	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	8	0 / 8	0.00078	0.0014			0.005	0	0.005	0
Beta Endosulfan	0	8	0 / 8	0.0013	0.0022			6.42E-06	0	6.42E-06	0
cis-Chlordane	0	8	0 / 8	0.0013	0.0023						
Delta BHC (Delta Hexachlorocyclohexane)	0	8	0 / 8	0.00088	0.0016			0.138811	0	0.138811	0
Dieldrin	0	8	0 / 8	0.0011	0.0019			0.0019	0	0.0019	0
Endosulfan Sulfate	0	8	0 / 8	0.00094	0.0017			6.42E-06	0	6.42E-06	0
Endrin	0	8	0 / 8	0.001	0.0018			0.00222	0	0.00222	0
Endrin Aldehyde	0	8	0 / 8	0.001	0.0018			0.004428	0	0.004428	0
Endrin Ketone	0	8	0 / 8	0.0011	0.002						

Table A-19
Summary of Sediment ESV Exceedances - Flathead River Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Gamma Bhc (Lindane)	0	8	0 / 8	0.00072	0.0013			0.00237	0	0.00237	0
Heptachlor	0	8	0 / 8	0.001	0.0018			0.0006	0	0.0006	0
Heptachlor Epoxide	0	8	0 / 8	0.0016	0.0028			0.00247	0	0.00247	0
Methoxychlor	0	8	0 / 8	0.0017	0.003						
P,P'-DDD	0	8	0 / 8	0.0011	0.0019			0.00488	0	0.00488	0
P,P'-DDE	0	8	0 / 8	0.0012	0.0021			0.00316	0	0.00316	0
P,P'-DDT	0	8	0 / 8	0.00083	0.0015			0.00416	0	0.00416	0
Toxaphene	0	8	0 / 8	0.024	0.042			0.000077	0	0.000077	0
trans-Chlordane	0	8	0 / 8	0.0018	0.0031						
POLYCHLORINATED BIPHENYLS mg/kg											
PCB-1016 (Aroclor 1016)	0	8	0 / 8	0.011	0.019						
PCB-1221 (Aroclor 1221)	0	8	0 / 8	0.011	0.019						
PCB-1232 (Aroclor 1232)	0	8	0 / 8	0.011	0.019						
PCB-1242 (Aroclor 1242)	0	8	0 / 8	0.011	0.019						
PCB-1248 (Aroclor 1248)	0	8	0 / 8	0.011	0.019						
PCB-1254 (Aroclor 1254)	0	8	0 / 8	0.011	0.02						
PCB-1260 (Aroclor 1260)	0	8	0 / 8	0.011	0.02						
PCB-1262 (Aroclor 1262)	0	8	0 / 8	0.011	0.02						
PCB-1268 (Aroclor 1268)	0	8	0 / 8	0.011	0.02						
Polychlorinated Biphenyl (PCBs)	0	8	0 / 8	0.011	0.02			0.032	0	0.032	0
POLYCYCLIC AROMATIC HYDROCARBONS mg/kg											
2-Methylnaphthalene	0	8	0 / 8	0.0088	0.031			0.0202	0	See Tables A-17 and A-18 for ESBTUs	
Acenaphthene	0	8	0 / 8	0.0096	0.034			0.00671	0		
Acenaphthylene	0	8	0 / 8	0.01	0.036			0.00587	0		
Anthracene	0	8	0 / 8	0.038	0.13			0.01	0		
Benzo(A)Anthracene	0	8	0 / 8	0.033	0.12			0.016	0		
Benzo(A)Pyrene	1	8	1 / 8	0.012	0.043	0.1	0.1	0.032	1		
Benzo(B)Fluoranthene	1	8	1 / 8	0.016	0.055	0.3	0.3	9.79	0		
Benzo(G,H,I)Perylene	1	8	1 / 8	0.023	0.081	0.14	0.14	0.016	1		
Benzo(K)Fluoranthene	1	8	1 / 8	0.017	0.061	0.11	0.11	0.24	0		
Chrysene	1	8	1 / 8	0.011	0.038	0.48	0.48	0.027	1		
Dibenz(A,H)Anthracene	0	8	0 / 8	0.021	0.073			0.01	0		
Fluoranthene	1	8	1 / 8	0.012	0.042	0.48	0.48	0.031	1		
Fluorene	0	8	0 / 8	0.0087	0.031			0.01	0		
Indeno(1,2,3-C,D)Pyrene	1	8	1 / 8	0.027	0.094	0.2	0.2	0.017	1		
Naphthalene	0	8	0 / 8	0.01	0.036			0.015	0		
Phenanthrene	0	8	0 / 8	0.011	0.037			0.019	0		
Pyrene	1	8	1 / 8	0.018	0.064	0.31	0.31	0.044	1		

Table A-19
Summary of Sediment ESV Exceedances - Flathead River Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
OTHER SEMIVOLATILE ORGANIC COMPOUNDS mg/kg											
1,2,4,5-Tetrachlorobenzene	0	8	0 / 8	0.03	0.1						
1,4-Dioxane (P-Dioxane)	0	8	0 / 8	0.11	0.38						
2,3,4,6-Tetrachlorophenol	0	8	0 / 8	0.037	0.13			0.129	0	0.129	0
2,4,5-Trichlorophenol	0	8	0 / 8	0.04	0.14			0.288	0	0.288	0
2,4,6-Trichlorophenol	0	8	0 / 8	0.011	0.04			0.208	0	0.208	0
2,4-Dichlorophenol	0	8	0 / 8	0.0094	0.033			0.0817	0	0.0817	0
2,4-Dimethylphenol	0	8	0 / 8	0.088	0.31			0.029	0	0.029	0
2,4-Dinitrophenol	0	8	0 / 8	0.3	1.1			0.00621	0	0.00621	0
2,4-Dinitrotoluene	0	8	0 / 8	0.016	0.056			0.0144	0	0.0144	0
2,6-Dinitrotoluene	0	8	0 / 8	0.021	0.075			0.0398	0	0.0398	0
2-Chloronaphthalene	0	8	0 / 8	0.009	0.032			0.417	0	0.417	0
2-Chlorophenol	0	8	0 / 8	0.01	0.036			0.02716	0	0.02716	0
2-Methylphenol (O-Cresol)	0	8	0 / 8	0.017	0.061			0.011856	0	0.011856	0
2-Nitroaniline	0	8	0 / 8	0.013	0.046						
2-Nitrophenol	0	8	0 / 8	0.013	0.047						
3- And 4- Methylphenol (Total)	3	8	3 / 8	0.011	0.037	0.035	0.49				
3,3'-Dichlorobenzidine	0	8	0 / 8	0.044	0.16			0.127	0	0.127	0
3-Nitroaniline	0	8	0 / 8	0.012	0.042						
4,6-Dinitro-2-Methylphenol	0	8	0 / 8	0.11	0.38						
4-Bromophenyl Phenyl Ether	0	8	0 / 8	0.013	0.044			0.255	0	0.255	0
4-Chloro-3-Methylphenol	0	8	0 / 8	0.017	0.06			0.388	0	0.388	0
4-Chloroaniline	0	8	0 / 8	0.01	0.036			0.146	0	0.146	0
4-Chlorophenyl Phenyl Ether	0	8	0 / 8	0.012	0.042						
4-Nitroaniline	0	8	0 / 8	0.015	0.053						
4-Nitrophenol	0	8	0 / 8	0.19	0.68					0.013	0
Acetophenone	0	8	0 / 8	0.0087	0.031						
Atrazine	0	8	0 / 8	0.018	0.063			0.00662	0	0.00662	0
Benzaldehyde	0	8	0 / 8	0.03	0.11						
Benzyl Butyl Phthalate	0	8	0 / 8	0.012	0.043			1.97	0	1.97	0
Biphenyl (Diphenyl)	0	8	0 / 8	0.034	0.12			1.22	0	1.22	0
Bis(2-Chloroethoxy) Methane	0	8	0 / 8	0.012	0.044						
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	8	0 / 8	0.0094	0.033						
Bis(2-Chloroisopropyl) Ether	0	8	0 / 8	0.016	0.058						
Bis(2-Ethylhexyl) Phthalate	2	8	2 / 8	0.016	0.055	0.018	0.032	0.18	0	0.18	0
Caprolactam	0	8	0 / 8	0.029	0.1						
Carbazole	0	8	0 / 8	0.0099	0.035						
Dibenzofuran	0	8	0 / 8	0.012	0.043			0.300736	0	0.300736	0
Diethyl Phthalate	0	8	0 / 8	0.011	0.04			0.603	0	0.603	0
Dimethyl Phthalate	0	8	0 / 8	0.012	0.041						

Table A-19
Summary of Sediment ESV Exceedances - Flathead River Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Di-N-Butyl Phthalate	0	8	0 / 8	0.012	0.042			1.1989	0	1.1989	0
Di-N-Octylphthalate	0	8	0 / 8	0.02	0.071			16.8858	0	16.8858	0
Hexachlorobenzene	0	8	0 / 8	0.016	0.057			0.02	0	0.02	0
Hexachlorobutadiene	0	8	0 / 8	0.011	0.04			0.0265	0	0.0265	0
Hexachlorocyclopentadiene	0	8	0 / 8	0.025	0.088			0.901	0	0.901	0
Hexachloroethane	0	8	0 / 8	0.015	0.051			0.2136	0	0.2136	0
Isophorone	0	8	0 / 8	0.0086	0.03			0.432	0	0.432	0
Nitrobenzene	0	8	0 / 8	0.013	0.044			0.145	0	0.145	0
N-Nitrosodi-N-Propylamine	0	8	0 / 8	0.013	0.047						
N-Nitrosodiphenylamine	0	8	0 / 8	0.036	0.13			0.516	0	0.516	0
Pentachlorophenol	0	8	0 / 8	0.048	0.17			0.504	0	0.504	0
Phenol	0	8	0 / 8	0.013	0.046			0.001152	0	0.001152	0

Notes:

All sediment samples from the 0-0.5' depth interval within the Flathead River exposure area included in screening assessment.

Quantitation limit used as the detection limit.

Concentration results evaluated against SLERA and BERA sediment ESVs.

Table A-20
Sitewide Summary of Sediment ESBTU Results for PAHs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Site Facility				Company Site CFAC Ecological			Company Site CFAC Ecological			Company Site CFAC Ecological		
Investigation Area				ECO EXP AREA 10 CEDAR CREEK			ECO EXP AREA 10 CEDAR CREEK			ECO EXP AREA 10 CEDAR CREEK		
Water Bearing Zone				--			--			--		
Location ID				CFSDP-010			CFSDP-011			CFSDP-012		
Lab IDs				200-35201-5, 460-119741-2			200-35201-6, 460-119741-3			200-35201-7, 460-119741-4		
Sample Name				CFSDP-010-SO			CFSDP-011-SO			CFSDP-012-SO		
Sample Depth				0-0.5 ft			0-0.5 ft			0-0.5 ft		
Sample Date				9/6/2016			9/6/2016			9/6/2016		
Constituent												
Total organic carbon	mg/kg			92200	foc =	0.0922	51500	foc =	0.0515	61500	foc =	0.0615
Polycyclic Aromatic Hydrocarbons				C _{dww} (µg/g _{dww})	C _{oc} (µg/g _{oc})	ESBTU _{FCVi}	C _{dww} (µg/g _{dww})	C _{oc} (µg/g _{oc})	ESBTU _{FCVi}	C _{dww} (µg/g _{dww})	C _{oc} (µg/g _{oc})	ESBTU _{FCVi}
Acenaphthene	mg/kg	491	33400	0.043	0.47	0.00	0.075	1.46	0.00	0.046	0.75	0.00
Acenaphthylene	mg/kg	452	24000	0.012	0.13	0.00	0.010	0.19	0.00	0.011	0.18	0.00
Anthracene	mg/kg	594	1300	0.082	0.89	0.00	0.140	2.72	0.00	0.096	1.56	0.00
Benzo(A)Anthracene	mg/kg	841	4153	0.820	8.89	0.01	0.740	14.37	0.02	0.640	10.41	0.01
Benzo(A)Pyrene	mg/kg	965	3840	1.100	11.93	0.01	0.940	18.25	0.02	0.830	13.50	0.01
Benzo(B)Fluoranthene	mg/kg	979	2169	1.800	19.52	0.02	1.300	25.24	0.03	1.200	19.51	0.02
Benzo(K)Fluoranthene	mg/kg	981	1220	0.470	5.10	0.01	0.490	9.51	0.01	0.450	7.32	0.01
Chrysene	mg/kg	844	826	1.100	11.93	0.01	0.930	18.06	0.02	0.890	14.47	0.02
Fluoranthene	mg/kg	707	23870	1.100	11.93	0.02	1.100	21.36	0.03	1.000	16.26	0.02
Fluorene	mg/kg	538	26000	0.028	0.30	0.00	0.053	1.03	0.00	0.030	0.49	0.00
Naphthalene	mg/kg	385	61700	0.013	0.14	0.00	0.020	0.39	0.00	0.013	0.21	0.00
Phenanthrene	mg/kg	596	34300	0.530	5.75	0.01	0.690	13.40	0.02	0.550	8.94	0.02
Pyrene	mg/kg	697	9090	1.500	16.27	0.02	1.400	27.18	0.04	1.100	17.89	0.03
				ΣESBTU _{FCV13}			ΣESBTU _{FCV13}			ΣESBTU _{FCV13}		
				0.1			0.2			0.1		
				ΣESBTU ₃₄			ΣESBTU ₃₄			ΣESBTU ₃₄		
				0.32			0.54			0.39		
				tPAH13= 8.6			tPAH13= 7.9			tPAH13= 6.9		

Notes:

ΣESBTU - Sum Equilibrium Partitioning Sediment Benchmark Toxic Units

FCV - Final Chronic Value

tPAH - Total PAH

Table A-20
Sitewide Summary of Sediment ESBTU Results for PAHs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Site Facility				Company Site CFAC Ecological			Company Site CFAC Ecological			Company Site CFAC Ecological		
Investigation Area Water Bearing Zone Location ID Lab IDs Sample Name Sample Depth Sample Date	Units	Coc,PAHi, FCVi (µg/goc)	Coc,PAHi, MAXi (µg/goc)	ECO EXP AREA 10 CEDAR CREEK -- CFSDP-012-DUP 460-119741-6 CFSDP-DUP1-SO 0-0.5 ft 9/6/2016			ECO EXP AREA 10 CEDAR CREEK -- CFSDP-013 200-35201-8, 460-119741-5 CFSDP-013-SO 0-0.5 ft 9/6/2016			ECO EXP AREA 10 CEDAR CREEK -- CFSDP-014 200-35201-1, 460-119363-1 CFSDP-014-SD ?-? ft 8/29/2016		
Constituent												
Total organic carbon	mg/kg			61000	foc =	0.0610	183000	foc =	0.1830	160000	foc =	0.1600
Polycyclic Aromatic Hydrocarbons				C_{dw} (µg/g _{dw})	C_{oc} (µg/g _{oc})	ESBTU_{FCVi}	C_{dw} (µg/g _{dw})	C_{oc} (µg/g _{oc})	ESBTU_{FCVi}	C_{dw} (µg/g _{dw})	C_{oc} (µg/g _{oc})	ESBTU_{FCVi}
Acenaphthene	mg/kg	491	33400	0.037	0.61	0.00	0.014	0.08	0.00	0.025	0.16	0.00
Acenaphthylene	mg/kg	452	24000	0.011	0.18	0.00	0.015	0.08	0.00	0.027	0.17	0.00
Anthracene	mg/kg	594	1300	0.083	1.36	0.00	0.057	0.31	0.00	0.099	0.62	0.00
Benzo(A)Anthracene	mg/kg	841	4153	0.550	9.02	0.01	0.093	0.51	0.00	0.087	0.54	0.00
Benzo(A)Pyrene	mg/kg	965	3840	0.740	12.13	0.01	0.110	0.60	0.00	0.031	0.19	0.00
Benzo(B)Fluoranthene	mg/kg	979	2169	1.100	18.03	0.02	0.190	1.04	0.00	0.040	0.25	0.00
Benzo(K)Fluoranthene	mg/kg	981	1220	0.450	7.38	0.01	0.051	0.28	0.00	0.045	0.28	0.00
Chrysene	mg/kg	844	826	0.820	13.44	0.02	0.130	0.71	0.00	0.038	0.24	0.00
Fluoranthene	mg/kg	707	23870	0.920	15.08	0.02	0.140	0.77	0.00	0.042	0.26	0.00
Fluorene	mg/kg	538	26000	0.024	0.39	0.00	0.013	0.07	0.00	0.023	0.14	0.00
Naphthalene	mg/kg	385	61700	0.011	0.18	0.00	0.015	0.08	0.00	0.026	0.16	0.00
Phenanthrene	mg/kg	596	34300	0.490	8.03	0.01	0.067	0.37	0.00	0.039	0.24	0.00
Pyrene	mg/kg	697	9090	1.000	16.39	0.02	0.130	0.71	0.00	0.047	0.29	0.00
				ΣESBTU _{FCV13}			ΣESBTU _{FCV13}			ΣESBTU _{FCV13}		
				0.1			0.0			0.0		
				ΣESBTU ₃₄			ΣESBTU ₃₄			ΣESBTU ₃₄		
				0.35			0.02			0.01		
				tPAH13= 6.2			tPAH13= 1			tPAH13= 0.6		

Table A-20
Sitewide Summary of Sediment ESBTU Results for PAHs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Site Facility				Company Site CFAC Ecological			Company Site CFAC Ecological			Company Site CFAC Ecological		
Investigation Area	Units	Coc,PAHi, FCVi (µg/goc)	Coc,PAHi, MAXi (µg/goc)	ECO EXP AREA 10 CEDAR CREEK			ECO EXP AREA 10 CEDAR CREEK			ECO EXP AREA 11 CEDAR CREEK RESERVOIR OVERFLOW DITCH		
Water Bearing Zone				--			--			--		
Location ID				CFSDP-015			CFSDP-016			CFSDP-009		
Lab IDs				200-35201-2, 460-119363-2			200-35201-3, 460-119363-3			200-35201-4, 460-119741-1		
Sample Name				CFSDP-015-SD			CFSDP-016-SD			CFSDP-009-SO		
Sample Depth				?-? ft			?-? ft			0-0.5 ft		
Sample Date				8/29/2016			8/29/2016			9/6/2016		
Constituent												
Total organic carbon	mg/kg			266000	foc =	0.2660	277000	foc =	0.2770	42500	foc =	0.0425
Polycyclic Aromatic Hydrocarbons				C_{dW} (µg/g _{dW})	C_{oc} (µg/g _{oc})	ESBTU_{FCVi}	C_{dW} (µg/g _{dW})	C_{oc} (µg/g _{oc})	ESBTU_{FCVi}	C_{dW} (µg/g _{dW})	C_{oc} (µg/g _{oc})	ESBTU_{FCVi}
Acenaphthene	mg/kg	491	33400	0.024	0.09	0.00	0.027	0.10	0.00	0.010	0.23	0.00
Acenaphthylene	mg/kg	452	24000	0.026	0.10	0.00	0.028	0.10	0.00	0.010	0.24	0.00
Anthracene	mg/kg	594	1300	0.095	0.36	0.00	0.100	0.36	0.00	0.038	0.89	0.00
Benzo(A)Anthracene	mg/kg	841	4153	0.083	0.31	0.00	0.120	0.43	0.00	0.100	2.35	0.00
Benzo(A)Pyrene	mg/kg	965	3840	0.043	0.16	0.00	0.094	0.34	0.00	0.120	2.82	0.00
Benzo(B)Fluoranthene	mg/kg	979	2169	0.039	0.15	0.00	0.120	0.43	0.00	0.210	4.94	0.01
Benzo(K)Fluoranthene	mg/kg	981	1220	0.043	0.16	0.00	0.048	0.17	0.00	0.069	1.62	0.00
Chrysene	mg/kg	844	826	0.069	0.26	0.00	0.130	0.47	0.00	0.140	3.29	0.00
Fluoranthene	mg/kg	707	23870	0.080	0.30	0.00	0.190	0.69	0.00	0.130	3.06	0.00
Fluorene	mg/kg	538	26000	0.022	0.08	0.00	0.024	0.09	0.00	0.009	0.20	0.00
Naphthalene	mg/kg	385	61700	0.025	0.09	0.00	0.028	0.10	0.00	0.010	0.24	0.00
Phenanthrene	mg/kg	596	34300	0.072	0.27	0.00	0.170	0.61	0.00	0.065	1.53	0.00
Pyrene	mg/kg	697	9090	0.069	0.26	0.00	0.160	0.58	0.00	0.190	4.47	0.01
				ΣESBTU _{FCV13}			ΣESBTU _{FCV13}			ΣESBTU _{FCV13}		
				0.0			0.0			0.0		
				ΣESBTU ₃₄			ΣESBTU ₃₄			ΣESBTU ₃₄		
				0.01			0.02			0.09		
				tPAH13= 0.7			tPAH13= 1.2			tPAH13= 1.1		

Table A-20
Sitewide Summary of Sediment ESBTU Results for PAHs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Site Facility				Company Site CFAC Ecological			Company Site CFAC Ecological			Company Site CFAC Ecological		
Investigation Area Water Bearing Zone Location ID Lab IDs Sample Name Sample Depth Sample Date	Units	Coc,PAHi, FCVi (µg/goc)	Coc,PAHi, MAXi (µg/goc)	ECO EXP AREA 12 SOUTH PERCOLATION POND AREA -- CFSDP-018 200-35201-13, 460-119830-3 CFSDP-018-SD ?-? ft 9/7/2016			ECO EXP AREA 12 SOUTH PERCOLATION POND AREA -- CFSDP-019 200-35201-14, 460-119830-4 CFSDP-019-SD ?-? ft 9/7/2016			ECO EXP AREA 12 SOUTH PERCOLATION POND AREA -- CFSDP-020 200-35201-15, 460-119830-5 CFSDP-020-SD ?-? ft 9/7/2016		
Constituent												
Total organic carbon	mg/kg			253000	foc =	0.2530	284000	foc =	0.2840	76500	foc =	0.0765
Polycyclic Aromatic Hydrocarbons				C _{dw} (µg/g _{dw})	C _{oc} (µg/g _{oc})	ESBTU _{FCVi}	C _{dw} (µg/g _{dw})	C _{oc} (µg/g _{oc})	ESBTU _{FCVi}	C _{dw} (µg/g _{dw})	C _{oc} (µg/g _{oc})	ESBTU _{FCVi}
Acenaphthene	mg/kg	491	33400	0.015	0.06	0.00	0.038	0.13	0.00	0.025	0.33	0.00
Acenaphthylene	mg/kg	452	24000	0.016	0.06	0.00	0.041	0.14	0.00	0.027	0.35	0.00
Anthracene	mg/kg	594	1300	0.058	0.23	0.00	0.150	0.53	0.00	0.098	1.28	0.00
Benzo(A)Anthracene	mg/kg	841	4153	0.210	0.83	0.00	0.160	0.56	0.00	0.150	1.96	0.00
Benzo(A)Pyrene	mg/kg	965	3840	0.260	1.03	0.00	0.190	0.67	0.00	0.190	2.48	0.00
Benzo(B)Fluoranthene	mg/kg	979	2169	0.370	1.46	0.00	0.270	0.95	0.00	0.280	3.66	0.00
Benzo(K)Fluoranthene	mg/kg	981	1220	0.170	0.67	0.00	0.086	0.30	0.00	0.110	1.44	0.00
Chrysene	mg/kg	844	826	0.330	1.30	0.00	0.230	0.81	0.00	0.230	3.01	0.00
Fluoranthene	mg/kg	707	23870	0.300	1.19	0.00	0.230	0.81	0.00	0.210	2.75	0.00
Fluorene	mg/kg	538	26000	0.013	0.05	0.00	0.034	0.12	0.00	0.023	0.30	0.00
Naphthalene	mg/kg	385	61700	0.015	0.06	0.00	0.040	0.14	0.00	0.026	0.34	0.00
Phenanthrene	mg/kg	596	34300	0.130	0.51	0.00	0.110	0.39	0.00	0.110	1.44	0.00
Pyrene	mg/kg	697	9090	0.350	1.38	0.00	0.250	0.88	0.00	0.290	3.79	0.01
				ΣESBTU _{FCV13}			ΣESBTU _{FCV13}			ΣESBTU _{FCV13}		
				0.0			0.0			0.0		
				ΣESBTU ₃₄			ΣESBTU ₃₄			ΣESBTU ₃₄		
				0.03			0.02			0.08		
				tPAH13= 2.2			tPAH13= 1.8			tPAH13= 1.8		

Table A-20
Sitewide Summary of Sediment ESBTU Results for PAHs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Site Facility				Company Site CFAC Ecological			Company Site CFAC Ecological			Company Site CFAC Ecological		
Investigation Area Water Bearing Zone Location ID Lab IDs Sample Name Sample Depth Sample Date	Units	Coc,PAHi, FCVi (µg/goc)	Coc,PAHi, MAXi (µg/goc)	ECO EXP AREA 13 NORTHERN SURFACE WATER FEATURE -- CFSDP-021 200-35201-9, 460-119741-7 CFSDP-021-SO 0-0.5 ft 9/6/2016			ECO EXP AREA 13 NORTHERN SURFACE WATER FEATURE -- CFSDP-022 200-35201-10, 460-119741-8 CFSDP-022-SO 0-0.5 ft 9/6/2016			ECO EXP AREA 2 NORTH PERCOLATION POND AREA -- CFSDP-023 200-35201-11, 460-119830-1 CFSDP-023-SD ?-? ft 9/7/2016		
Constituent												
Total organic carbon	mg/kg			23200	foc =	0.0232	129000	foc =	0.1290	494000	foc =	0.4940
Polycyclic Aromatic Hydrocarbons				C _{dW} (µg/g _{dW})	C _{oc} (µg/g _{oc})	ESBTU _{FCVi}	C _{dW} (µg/g _{dW})	C _{oc} (µg/g _{oc})	ESBTU _{FCVi}	C _{dW} (µg/g _{dW})	C _{oc} (µg/g _{oc})	ESBTU _{FCVi}
Acenaphthene	mg/kg	491	33400	0.009	0.40	0.00	0.013	0.10	0.00	0.280	0.57	0.00
Acenaphthylene	mg/kg	452	24000	0.010	0.42	0.00	0.013	0.10	0.00	0.086	0.17	0.00
Anthracene	mg/kg	594	1300	0.036	1.55	0.00	0.050	0.39	0.00	1.700	3.44	0.01
Benzo(A)Anthracene	mg/kg	841	4153	0.032	1.38	0.00	0.074	0.57	0.00	14.000	28.34	0.03
Benzo(A)Pyrene	mg/kg	965	3840	0.021	0.91	0.00	0.091	0.71	0.00	19.000	38.46	0.04
Benzo(B)Fluoranthene	mg/kg	979	2169	0.036	1.55	0.00	0.150	1.16	0.00	40.000	80.97	0.08
Benzo(K)Fluoranthene	mg/kg	981	1220	0.017	0.73	0.00	0.053	0.41	0.00	17.000	34.41	0.04
Chrysene	mg/kg	844	826	0.019	0.82	0.00	0.130	1.01	0.00	18.000	36.44	0.04
Fluoranthene	mg/kg	707	23870	0.018	0.78	0.00	0.120	0.93	0.00	21.000	42.51	0.06
Fluorene	mg/kg	538	26000	0.008	0.36	0.00	0.011	0.09	0.00	0.110	0.22	0.00
Naphthalene	mg/kg	385	61700	0.010	0.41	0.00	0.013	0.10	0.00	0.390	0.79	0.00
Phenanthrene	mg/kg	596	34300	0.011	0.47	0.00	0.058	0.45	0.00	6.200	12.55	0.02
Pyrene	mg/kg	697	9090	0.027	1.16	0.00	0.110	0.85	0.00	16.000	32.39	0.05
				ΣESBTU _{FCV13}			ΣESBTU _{FCV13}			ΣESBTU _{FCV13}		
				0.0			0.0			0.4		
				ΣESBTU ₃₄			ΣESBTU ₃₄			ΣESBTU ₃₄		
				0.04			0.02			1.02		
				tPAH13= 0.3			tPAH13= 0.9			tPAH13= 153.8		

Table A-20
Sitewide Summary of Sediment ESBTU Results for PAHs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Site Facility				Company Site CFAC Ecological			Company Site CFAC Ecological			Company Site CFAC Ecological		
Investigation Area Water Bearing Zone Location ID Lab IDs Sample Name Sample Depth Sample Date	Units	Coc,PAHi, FCVi (µg/goc)	Coc,PAHi, MAXi (µg/goc)	ECO EXP AREA 2 NORTH PERCOLATION POND AREA -- CFSDP-023-DUP 460-119830-6 CFSDP-DUP2-SD ?-? ? 9/7/2016			ECO EXP AREA 2 NORTH PERCOLATION POND AREA -- CFSDP-024 200-35201-12, 460-119830-2 CFSDP-024-SD ?-? ft 9/7/2016			ECO EXP AREA 9 FLATHEAD RIVER AREA -- CFSDP-001 200-35201-16, 460-119897-1 CFSDP-001-SO 0-0.5 ft 9/8/2016		
Total organic carbon	mg/kg			555000	foc =	0.5550	470000	foc =	0.4700	8950	foc =	0.0090
Polycyclic Aromatic Hydrocarbons				C_{dW} (µg/g _{dW})	C_{oc} (µg/g _{oc})	ESBTU_{FCVi}	C_{dW} (µg/g _{dW})	C_{oc} (µg/g _{oc})	ESBTU_{FCVi}	C_{dW} (µg/g _{dW})	C_{oc} (µg/g _{oc})	ESBTU_{FCVi}
Acenaphthene	mg/kg	491	33400	0.320	0.58	0.00	4.100	8.72	0.02	0.011	1.23	0.00
Acenaphthylene	mg/kg	452	24000	0.120	0.22	0.00	0.260	0.55	0.00	0.012	1.34	0.00
Anthracene	mg/kg	594	1300	1.300	2.34	0.00	9.900	21.06	0.04	0.043	4.80	0.01
Benzo(A)Anthracene	mg/kg	841	4153	15.000	27.03	0.03	76.000	161.70	0.19	0.038	4.25	0.01
Benzo(A)Pyrene	mg/kg	965	3840	21.000	37.84	0.04	100.000	212.77	0.22	0.014	1.56	0.00
Benzo(B)Fluoranthene	mg/kg	979	2169	55.000	99.10	0.10	210.000	446.81	0.46	0.018	2.01	0.00
Benzo(K)Fluoranthene	mg/kg	981	1220	18.000	32.43	0.03	64.000	136.17	0.14	0.020	2.23	0.00
Chrysene	mg/kg	844	826	19.000	34.23	0.04	150.000	319.15	0.38	0.012	1.34	0.00
Fluoranthene	mg/kg	707	23870	17.000	30.63	0.04	120.000	255.32	0.36	0.013	1.45	0.00
Fluorene	mg/kg	538	26000	0.120	0.22	0.00	2.100	4.47	0.01	0.010	1.09	0.00
Naphthalene	mg/kg	385	61700	0.450	0.81	0.00	0.890	1.89	0.00	0.011	1.23	0.00
Phenanthrene	mg/kg	596	34300	6.900	12.43	0.02	41.000	87.23	0.15	0.012	1.34	0.00
Pyrene	mg/kg	697	9090	26.000	46.85	0.07	120.000	255.32	0.37	0.020	2.23	0.00
				ΣESBTU _{FCV13}			ΣESBTU _{FCV13}			ΣESBTU _{FCV13}		
				0.4			2.3			0.0		
				ΣESBTU ₃₄			ΣESBTU ₃₄			ΣESBTU ₃₄		
				1.06			6.40			0.11		
				tPAH13= 180.2			tPAH13= 898.3			tPAH13= 0.2		

Table A-20
Sitewide Summary of Sediment ESBTU Results for PAHs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Site Facility				Company Site CFAC Ecological			Company Site CFAC Ecological			Company Site CFAC Ecological		
Investigation Area	Units	Coc,PAHi, FCVi (µg/goc)	Coc,PAHi, MAXi (µg/goc)	ECO EXP AREA 9 FLATHEAD RIVER AREA			ECO EXP AREA 9 FLATHEAD RIVER AREA			ECO EXP AREA 9 FLATHEAD RIVER AREA		
Water Bearing Zone				--			--			--		
Location ID				CFSDP-002			CFSDP-002			CFSDP-003		
Lab IDs				460-119897-2			200-35302-1			200-35201-20, 460-119996-1		
Sample Name				CFSDP-002-SO			CFSDP-002-SO			CFSDP-003-SD		
Sample Depth				0-0.5 ft			0-0.5 ft			?-? ft		
Sample Date				9/8/2016			9/16/2016			9/9/2016		
Constituent												
Total organic carbon	mg/kg			7990	foc =	0.0080	--	foc =	--	61800	foc =	0.0618
Polycyclic Aromatic Hydrocarbons				C_{dW} (µg/g _{dW})	C_{oc} (µg/g _{oc})	ESBTU_{FCVi}	C_{dW} (µg/g _{dW})	C_{oc} (µg/g _{oc})	ESBTU_{FCVi}	C_{dW} (µg/g _{dW})	C_{oc} (µg/g _{oc})	ESBTU_{FCVi}
Acenaphthene	mg/kg	491	33400	0.010	1.20	0.00	--	--	--	0.034	0.55	0.00
Acenaphthylene	mg/kg	452	24000	0.010	1.25	0.00	--	--	--	0.036	0.58	0.00
Anthracene	mg/kg	594	1300	0.038	4.76	0.01	--	--	--	0.130	2.10	0.00
Benzo(A)Anthracene	mg/kg	841	4153	0.033	4.13	0.00	--	--	--	0.120	1.94	0.00
Benzo(A)Pyrene	mg/kg	965	3840	0.012	1.50	0.00	--	--	--	0.100	1.62	0.00
Benzo(B)Fluoranthene	mg/kg	979	2169	0.016	2.00	0.00	--	--	--	0.300	4.85	0.00
Benzo(K)Fluoranthene	mg/kg	981	1220	0.017	2.13	0.00	--	--	--	0.110	1.78	0.00
Chrysene	mg/kg	844	826	0.011	1.38	0.00	--	--	--	0.480	7.77	0.01
Fluoranthene	mg/kg	707	23870	0.012	1.50	0.00	--	--	--	0.480	7.77	0.01
Fluorene	mg/kg	538	26000	0.009	1.09	0.00	--	--	--	0.031	0.50	0.00
Naphthalene	mg/kg	385	61700	0.010	1.25	0.00	--	--	--	0.036	0.58	0.00
Phenanthrene	mg/kg	596	34300	0.011	1.38	0.00	--	--	--	0.037	0.60	0.00
Pyrene	mg/kg	697	9090	0.018	2.25	0.00	--	--	--	0.310	5.02	0.01
				ΣESBTU _{FCV13}			ΣESBTU _{FCV13}			ΣESBTU _{FCV13}		
				0.0			--			0.0		
				ΣESBTU ₃₄			ΣESBTU ₃₄			ΣESBTU ₃₄		
				0.11			--			0.13		
				tPAH13= 0.2			tPAH13= 0			tPAH13= 2.2		

Table A-20
Sitewide Summary of Sediment ESBTU Results for PAHs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Site Facility				Company Site CFAC Ecological			Company Site CFAC Ecological			Company Site CFAC Ecological		
Investigation Area Water Bearing Zone Location ID Lab IDs Sample Name Sample Depth Sample Date	Units	Coc,PAHi, FCVi (µg/goc)	Coc,PAHi, MAXi (µg/goc)	ECO EXP AREA 9 FLATHEAD RIVER AREA -- CFSDP-004 200-35201-21, 460-119996-2 CFSDP-004-SD ?-? ft 9/9/2016			ECO EXP AREA 9 FLATHEAD RIVER AREA -- CFSDP-005 200-35201-22, 460-119996-3 CFSDP-005-SD ?-? ft 9/9/2016			ECO EXP AREA 9 FLATHEAD RIVER AREA -- CFSDP-006 460-119996-4 CFSDP-006-SD ?-? ? 9/9/2016		
Constituent												
Total organic carbon	mg/kg			37400	foc =	0.0374	26700	foc =	0.0267	4130	foc =	0.0041
Polycyclic Aromatic Hydrocarbons				C _{dw} (µg/g _{dw})	C _{oc} (µg/g _{oc})	ESBTU _{FCVi}	C _{dw} (µg/g _{dw})	C _{oc} (µg/g _{oc})	ESBTU _{FCVi}	C _{dw} (µg/g _{dw})	C _{oc} (µg/g _{oc})	ESBTU _{FCVi}
Acenaphthene	mg/kg	491	33400	0.027	0.72	0.00	0.025	0.94	0.00	0.010	2.32	0.00
Acenaphthylene	mg/kg	452	24000	0.029	0.78	0.00	0.026	0.97	0.00	0.010	2.42	0.01
Anthracene	mg/kg	594	1300	0.110	2.94	0.00	0.097	3.63	0.01	0.038	9.20	0.02
Benzo(A)Anthracene	mg/kg	841	4153	0.094	2.51	0.00	0.086	3.22	0.00	0.033	7.99	0.01
Benzo(A)Pyrene	mg/kg	965	3840	0.034	0.91	0.00	0.031	1.16	0.00	0.012	2.91	0.00
Benzo(B)Fluoranthene	mg/kg	979	2169	0.044	1.18	0.00	0.040	1.50	0.00	0.016	3.87	0.00
Benzo(K)Fluoranthene	mg/kg	981	1220	0.049	1.31	0.00	0.045	1.69	0.00	0.017	4.12	0.00
Chrysene	mg/kg	844	826	0.031	0.83	0.00	0.028	1.05	0.00	0.011	2.66	0.00
Fluoranthene	mg/kg	707	23870	0.033	0.88	0.00	0.030	1.12	0.00	0.012	2.91	0.00
Fluorene	mg/kg	538	26000	0.025	0.67	0.00	0.022	0.82	0.00	0.009	2.11	0.00
Naphthalene	mg/kg	385	61700	0.029	0.78	0.00	0.026	0.97	0.00	0.010	2.42	0.01
Phenanthrene	mg/kg	596	34300	0.030	0.80	0.00	0.027	1.01	0.00	0.011	2.66	0.00
Pyrene	mg/kg	697	9090	0.051	1.36	0.00	0.047	1.76	0.00	0.018	4.36	0.01
				Σ ESBTU _{FCV13}			Σ ESBTU _{FCV13}			Σ ESBTU _{FCV13}		
				0.0			0.0			0.1		
				Σ ESBTU ₃₄			Σ ESBTU ₃₄			Σ ESBTU ₃₄		
				0.06			0.08			0.20		
				tPAH13= 0.6			tPAH13= 0.5			tPAH13= 0.2		

Table A-20
Sitewide Summary of Sediment ESBTU Results for PAHs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Site Facility				Company Site CFAC Ecological			Company Site CFAC Ecological			Company Site CFAC Ecological		
Investigation Area	Units	Coc,PAHi, FCVi (µg/goc)	Coc,PAHi, MAXi (µg/goc)	ECO EXP AREA 9 FLATHEAD RIVER AREA			ECO EXP AREA 9 FLATHEAD RIVER AREA			ECO EXP AREA 9 FLATHEAD RIVER AREA		
Water Bearing Zone				--			--			--		
Location ID				CFSDP-006			CFSDP-007			CFSDP-008		
Lab IDs				200-35201-23			200-35201-17, 460-119897-3			200-35201-18, 460-119897-4		
Sample Name				CFSDP-006-SO			CFSDP-007-SO			CFSDP-008-SO		
Sample Depth				0-0.5 ft			0-0.5 ft			0-0.5 ft		
Sample Date				9/9/2016			9/8/2016			9/8/2016		
Constituent												
Total organic carbon	mg/kg			--	foc =	--	15000	foc =	0.0150	8800	foc =	0.0088
Polycyclic Aromatic Hydrocarbons				C_{dww} (µg/g _{dww})	C_{oc} (µg/g _{oc})	ESBTU_{FCVi}	C_{dww} (µg/g _{dww})	C_{oc} (µg/g _{oc})	ESBTU_{FCVi}	C_{dww} (µg/g _{dww})	C_{oc} (µg/g _{oc})	ESBTU_{FCVi}
Acenaphthene	mg/kg	491	33400	--	--	--	0.011	0.73	0.00	0.011	1.25	0.00
Acenaphthylene	mg/kg	452	24000	--	--	--	0.012	0.80	0.00	0.012	1.36	0.00
Anthracene	mg/kg	594	1300	--	--	--	0.043	2.87	0.00	0.045	5.11	0.01
Benzo(A)Anthracene	mg/kg	841	4153	--	--	--	0.038	2.53	0.00	0.039	4.43	0.01
Benzo(A)Pyrene	mg/kg	965	3840	--	--	--	0.014	0.93	0.00	0.014	1.59	0.00
Benzo(B)Fluoranthene	mg/kg	979	2169	--	--	--	0.018	1.20	0.00	0.018	2.05	0.00
Benzo(K)Fluoranthene	mg/kg	981	1220	--	--	--	0.020	1.33	0.00	0.020	2.27	0.00
Chrysene	mg/kg	844	826	--	--	--	0.012	0.80	0.00	0.013	1.48	0.00
Fluoranthene	mg/kg	707	23870	--	--	--	0.013	0.87	0.00	0.014	1.59	0.00
Fluorene	mg/kg	538	26000	--	--	--	0.010	0.66	0.00	0.010	1.14	0.00
Naphthalene	mg/kg	385	61700	--	--	--	0.012	0.80	0.00	0.012	1.36	0.00
Phenanthrene	mg/kg	596	34300	--	--	--	0.012	0.80	0.00	0.013	1.48	0.00
Pyrene	mg/kg	697	9090	--	--	--	0.021	1.40	0.00	0.021	2.39	0.00
				ΣESBTU _{FCV13}			ΣESBTU _{FCV13}			ΣESBTU _{FCV13}		
				--			0.0			0.0		
				ΣESBTU ₃₄			ΣESBTU ₃₄			ΣESBTU ₃₄		
				--			0.06			0.11		
				tPAH13= 0			tPAH13= 0.2			tPAH13= 0.2		

Table A-20
Sitewide Summary of Sediment ESBTU Results for PAHs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Site Facility				Company Site CFAC Ecological		
Investigation Area	Units	Coc,PAHi, FCVi (µg/goc)	Coc,PAHi, MAXi (µg/goc)	ECO-UNDEFINED		
Water Bearing Zone				--		
Location ID				CFSDP-017		
Lab IDs				200-35201-19, 460-119897-5		
Sample Name				CFSDP-017-SO		
Sample Depth				0-0.5 ft		
Sample Date				9/8/2016		
Constituent						
Total organic carbon	mg/kg			7640	foc =	0.0076
Polycyclic Aromatic Hydrocarbons				C _{dw} (µg/g _{dw})	C _{oc} (µg/g _{oc})	ESBTU _{FCVi}
Acenaphthene	mg/kg	491	33400	0.011	1.44	0.00
Acenaphthylene	mg/kg	452	24000	0.011	1.44	0.00
Anthracene	mg/kg	594	1300	0.042	5.50	0.01
Benzo(A)Anthracene	mg/kg	841	4153	0.037	4.84	0.01
Benzo(A)Pyrene	mg/kg	965	3840	0.013	1.70	0.00
Benzo(B)Fluoranthene	mg/kg	979	2169	0.017	2.23	0.00
Benzo(K)Fluoranthene	mg/kg	981	1220	0.019	2.49	0.00
Chrysene	mg/kg	844	826	0.012	1.57	0.00
Fluoranthene	mg/kg	707	23870	0.013	1.70	0.00
Fluorene	mg/kg	538	26000	0.010	1.27	0.00
Naphthalene	mg/kg	385	61700	0.011	1.44	0.00
Phenanthrene	mg/kg	596	34300	0.012	1.57	0.00
Pyrene	mg/kg	697	9090	0.020	2.62	0.00
				Σ ESBTU _{FCV13}		0.0
				Σ ESBTU ₃₄		0.12
				tPAH13= 0.2		

Table A-21
Sitewide Summary of Soil ESBTU Results for PAHs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Site Facility Investigation Area Water Bearing Zone Location ID Lab IDs Sample Name Sample Depth Sample Date	Units	Coc,PAHi, FCVi (µg/goc)	Coc,PAHi, MAXi (µg/goc)	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-101 460-117506-1 CFSB-101-SO-0-0.5 0-0.5 ft 7/21/2016	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-102 460-117124-10 CFSB-102-SO-0-0.5 0-0.5 ft 7/13/2016	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-104 460-117124-7 CFSB-104-SO-0-0.5 0-0.5 ft 7/13/2016
Constituent						
Total organic carbon	mg/kg			76500 foc = 0.0765	76500 foc = 0.0765	76500 foc = 0.0765
Polycyclic Aromatic Hydrocarbons				C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU _{FCVi}	C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU _{FCVi}	C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU _{FCVi}
Acenaphthene	mg/kg	491	33400	0.011 0.14 0.00	0.010 0.13 0.00	0.013 0.17 0.00
Acenaphthylene	mg/kg	452	24000	0.012 0.16 0.00	0.011 0.14 0.00	0.014 0.18 0.00
Anthracene	mg/kg	594	1300	0.043 0.56 0.00	0.041 0.54 0.00	0.052 0.68 0.00
Benzo(A)Anthracene	mg/kg	841	4153	0.042 0.55 0.00	0.110 1.44 0.00	0.180 2.35 0.00
Benzo(A)Pyrene	mg/kg	965	3840	0.014 0.18 0.00	0.130 1.70 0.00	0.250 3.27 0.00
Benzo(B)Fluoranthene	mg/kg	979	2169	0.084 1.10 0.00	0.220 2.88 0.00	0.350 4.58 0.00
Benzo(K)Fluoranthene	mg/kg	981	1220	0.022 0.29 0.00	0.079 1.03 0.00	0.150 1.96 0.00
Chrysene	mg/kg	844	826	0.067 0.88 0.00	0.190 2.48 0.00	0.300 3.92 0.00
Fluoranthene	mg/kg	707	23870	0.053 0.69 0.00	0.160 2.09 0.00	0.270 3.53 0.00
Fluorene	mg/kg	538	26000	0.010 0.13 0.00	0.009 0.12 0.00	0.012 0.16 0.00
Naphthalene	mg/kg	385	61700	0.011 0.14 0.00	0.011 0.14 0.00	0.014 0.18 0.00
Phenanthrene	mg/kg	596	34300	0.037 0.48 0.00	0.075 0.98 0.00	0.140 1.83 0.00
Pyrene	mg/kg	697	9090	0.058 0.76 0.00	0.180 2.35 0.00	0.320 4.18 0.01
				ΣESBTU _{FCV13} 0.0	ΣESBTU _{FCV13} 0.0	ΣESBTU _{FCV13} 0.0
				ΣESBTU ₃₄ 0.02	ΣESBTU ₃₄ 0.06	ΣESBTU ₃₄ 0.09
				tPAH ₁₃ = 0.5	tPAH ₁₃ = 1.2	tPAH ₁₃ = 2.1

Notes:

ΣESBTU - Sum Equilibrium Partitioning Sediment Benchmark Toxic Units

FCV - Final Chronic Value

tPAH - Total PAH

Table A-21
Sitewide Summary of Soil ESBTU Results for PAHs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Site Facility Investigation Area Water Bearing Zone Location ID Lab IDs Sample Name Sample Depth Sample Date	Units	Coc,PAHi, FCVi (µg/goc)	Coc,PAHi, MAXi (µg/goc)	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-109 460-117124-14 CFSB-109-SO-0-0.5 0-0.5 ft 7/13/2016	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-110 460-117124-17 CFSB-110-SO-0-0.5 0-0.5 ft 7/14/2016	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-113 460-119512-1 CFSB-113-SO-0-0.5 0-0.5 ft 8/31/2016
Constituent						
Total organic carbon	mg/kg			76500 foc = 0.0765	76500 foc = 0.0765	76500 foc = 0.0765
Polycyclic Aromatic Hydrocarbons				C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU _{FCVi}	C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU _{FCVi}	C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU _{FCVi}
Acenaphthene	mg/kg	491	33400	0.020 0.26 0.00	0.018 0.24 0.00	0.010 0.13 0.00
Acenaphthylene	mg/kg	452	24000	0.018 0.24 0.00	0.019 0.25 0.00	0.011 0.14 0.00
Anthracene	mg/kg	594	1300	0.065 0.85 0.00	0.071 0.93 0.00	0.039 0.51 0.00
Benzo(A)Anthracene	mg/kg	841	4153	0.360 4.71 0.01	0.180 2.35 0.00	0.120 1.57 0.00
Benzo(A)Pyrene	mg/kg	965	3840	0.480 6.27 0.01	0.230 3.01 0.00	0.170 2.22 0.00
Benzo(B)Fluoranthene	mg/kg	979	2169	0.620 8.10 0.01	0.290 3.79 0.00	0.290 3.79 0.00
Benzo(K)Fluoranthene	mg/kg	981	1220	0.250 3.27 0.00	0.120 1.57 0.00	0.100 1.31 0.00
Chrysene	mg/kg	844	826	0.550 7.19 0.01	0.280 3.66 0.00	0.190 2.48 0.00
Fluoranthene	mg/kg	707	23870	0.560 7.32 0.01	0.240 3.14 0.00	0.200 2.61 0.00
Fluorene	mg/kg	538	26000	0.020 0.26 0.00	0.016 0.21 0.00	0.009 0.12 0.00
Naphthalene	mg/kg	385	61700	0.017 0.22 0.00	0.019 0.25 0.00	0.011 0.14 0.00
Phenanthrene	mg/kg	596	34300	0.270 3.53 0.01	0.120 1.57 0.00	0.100 1.31 0.00
Pyrene	mg/kg	697	9090	0.570 7.45 0.01	0.230 3.01 0.00	0.220 2.88 0.00
				ΣESBTU _{FCV13} 0.1	ΣESBTU _{FCV13} 0.0	ΣESBTU _{FCV13} 0.0
				ΣESBTU ₃₄ 0.17	ΣESBTU ₃₄ 0.08	ΣESBTU ₃₄ 0.07
				tPAH13= 3.8	tPAH13= 1.8	tPAH13= 1.5

Table A-21
Sitewide Summary of Soil ESBTU Results for PAHs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Site Facility Investigation Area Water Bearing Zone Location ID Lab IDs Sample Name Sample Depth Sample Date	Units	Coc,PAHi, FCVi (µg/goc)	Coc,PAHi, MAXi (µg/goc)	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-115 460-119512-4 CFSB-115-SO-0-0.5 0-0.5 ft 8/31/2016	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-116 460-117573-1 CFSB-116-SO-0-0.5 0-0.5 ft 7/22/2016	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-118 460-117506-4 CFSB-118-SO-0-0.5 0-0.5 ft 7/21/2016
Total organic carbon	mg/kg			76500 foc = 0.0765	76500 foc = 0.0765	76500 foc = 0.0765
Polycyclic Aromatic Hydrocarbons				C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU_{FCVi}	C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU_{FCVi}	C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU_{FCVi}
Acenaphthene	mg/kg	491	33400	0.009 0.12 0.00	0.013 0.17 0.00	0.010 0.13 0.00
Acenaphthylene	mg/kg	452	24000	0.010 0.13 0.00	0.014 0.18 0.00	0.011 0.14 0.00
Anthracene	mg/kg	594	1300	0.037 0.48 0.00	0.051 0.67 0.00	0.039 0.51 0.00
Benzo(A)Anthracene	mg/kg	841	4153	0.059 0.77 0.00	0.110 1.44 0.00	0.035 0.46 0.00
Benzo(A)Pyrene	mg/kg	965	3840	0.084 1.10 0.00	0.150 1.96 0.00	0.013 0.17 0.00
Benzo(B)Fluoranthene	mg/kg	979	2169	0.170 2.22 0.00	0.250 3.27 0.00	0.016 0.21 0.00
Benzo(K)Fluoranthene	mg/kg	981	1220	0.060 0.78 0.00	0.083 1.08 0.00	0.018 0.24 0.00
Chrysene	mg/kg	844	826	0.100 1.31 0.00	0.170 2.22 0.00	0.011 0.14 0.00
Fluoranthene	mg/kg	707	23870	0.089 1.16 0.00	0.160 2.09 0.00	0.012 0.16 0.00
Fluorene	mg/kg	538	26000	0.009 0.11 0.00	0.012 0.16 0.00	0.009 0.12 0.00
Naphthalene	mg/kg	385	61700	0.010 0.13 0.00	0.015 0.20 0.00	0.011 0.14 0.00
Phenanthrene	mg/kg	596	34300	0.044 0.58 0.00	0.089 1.16 0.00	0.011 0.14 0.00
Pyrene	mg/kg	697	9090	0.096 1.25 0.00	0.170 2.22 0.00	0.019 0.25 0.00
				ΣESBTU_{FCV13} 0.0	ΣESBTU_{FCV13} 0.0	ΣESBTU_{FCV13} 0.0
				ΣESBTU₃₄ 0.04	ΣESBTU₃₄ 0.06	ΣESBTU₃₄ 0.01
				tPAH13= 0.8	tPAH13= 1.3	tPAH13= 0.2

Table A-21
Sitewide Summary of Soil ESBTU Results for PAHs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Site Facility Investigation Area Water Bearing Zone Location ID Lab IDs Sample Name Sample Depth Sample Date	Units	Coc,PAHi, FCVi (µg/goc)	Coc,PAHi, MAXi (µg/goc)	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-014 460-114828-33 CFSB-014-SO-0-0.5 0-0.5 ft 6/2/2016	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-016 460-114828-25 CFSB-016-SO-0-0.5 0-0.5 ft 6/2/2016	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-019 460-115008-10 CFSB-019-SO-0-0.5 0-0.5 ft 6/4/2016
Constituent						
Total organic carbon	mg/kg			470000 foc = 0.4700	470000 foc = 0.4700	470000 foc = 0.4700
Polycyclic Aromatic Hydrocarbons				C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU _{FCVi}	C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU _{FCVi}	C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU _{FCVi}
Acenaphthene	mg/kg	491	33400	0.031 0.07 0.00	0.720 1.53 0.00	0.069 0.15 0.00
Acenaphthylene	mg/kg	452	24000	0.010 0.02 0.00	0.077 0.16 0.00	0.033 0.07 0.00
Anthracene	mg/kg	594	1300	0.130 0.28 0.00	1.900 4.04 0.01	0.049 0.10 0.00
Benzo(A)Anthracene	mg/kg	841	4153	1.700 3.62 0.00	11.000 23.40 0.03	0.032 0.07 0.00
Benzo(A)Pyrene	mg/kg	965	3840	2.000 4.26 0.00	14.000 29.79 0.03	0.012 0.03 0.00
Benzo(B)Fluoranthene	mg/kg	979	2169	6.800 14.47 0.01	30.000 63.83 0.07	0.015 0.03 0.00
Benzo(K)Fluoranthene	mg/kg	981	1220	2.400 5.11 0.01	12.000 25.53 0.03	0.017 0.04 0.00
Chrysene	mg/kg	844	826	2.300 4.89 0.01	16.000 34.04 0.04	0.011 0.02 0.00
Fluoranthene	mg/kg	707	23870	2.300 4.89 0.01	19.000 40.43 0.06	0.029 0.06 0.00
Fluorene	mg/kg	538	26000	0.012 0.03 0.00	0.370 0.79 0.00	0.190 0.40 0.00
Naphthalene	mg/kg	385	61700	0.042 0.09 0.00	0.720 1.53 0.00	0.083 0.18 0.00
Phenanthrene	mg/kg	596	34300	0.650 1.38 0.00	9.000 19.15 0.03	0.510 1.09 0.00
Pyrene	mg/kg	697	9090	2.300 4.89 0.01	21.000 44.68 0.06	0.058 0.12 0.00
				ΣESBTU _{FCV13} 0.1	ΣESBTU _{FCV13} 0.4	ΣESBTU _{FCV13} 0.0
				ΣESBTU ₃₄ 0.14	ΣESBTU ₃₄ 0.99	ΣESBTU ₃₄ 0.01
				tPAH13= 20.7	tPAH13= 135.8	tPAH13= 1.1

Table A-21
Sitewide Summary of Soil ESBTU Results for PAHs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Site Facility Investigation Area Water Bearing Zone Location ID Lab IDs Sample Name Sample Depth Sample Date	Units	Coc,PAHi, FCVi (µg/goc)	Coc,PAHi, MAXi (µg/goc)	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-025 460-115528-18 CFSB-025-SO-0-0.5 0-0.5 ft 6/13/2016	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-026 460-115528-16 CFSB-026-SO-0-0.5 0-0.5 ft 6/13/2016	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-027 460-115528-22 CFSB-027-SO-0-0.5 0-0.5 ft 6/13/2016
Total organic carbon	mg/kg			470000 foc = 0.4700	470000 foc = 0.4700	470000 foc = 0.4700
Polycyclic Aromatic Hydrocarbons				C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU_{FCVi}	C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU_{FCVi}	C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU_{FCVi}
Acenaphthene	mg/kg	491	33400	5.300 11.28 0.02	8.400 17.87 0.04	0.910 1.94 0.00
Acenaphthylene	mg/kg	452	24000	0.800 1.70 0.00	0.440 0.94 0.00	0.046 0.10 0.00
Anthracene	mg/kg	594	1300	38.000 80.85 0.14	21.000 44.68 0.08	2.000 4.26 0.01
Benzo(A)Anthracene	mg/kg	841	4153	190.000 404.26 0.48	89.000 189.36 0.23	13.000 27.66 0.03
Benzo(A)Pyrene	mg/kg	965	3840	140.000 297.87 0.31	76.000 161.70 0.17	15.000 31.91 0.03
Benzo(B)Fluoranthene	mg/kg	979	2169	210.000 446.81 0.46	190.000 404.26 0.41	18.000 38.30 0.04
Benzo(K)Fluoranthene	mg/kg	981	1220	78.000 165.96 0.17	57.000 121.28 0.12	6.100 12.98 0.01
Chrysene	mg/kg	844	826	270.000 574.47 0.68	220.000 468.09 0.55	15.000 31.91 0.04
Fluoranthene	mg/kg	707	23870	320.000 680.85 0.96	250.000 531.91 0.75	22.000 46.81 0.07
Fluorene	mg/kg	538	26000	4.200 8.94 0.02	8.100 17.23 0.03	0.820 1.74 0.00
Naphthalene	mg/kg	385	61700	3.800 8.09 0.02	2.100 4.47 0.01	0.200 0.43 0.00
Phenanthrene	mg/kg	596	34300	56.000 119.15 0.20	86.000 182.98 0.31	12.000 25.53 0.04
Pyrene	mg/kg	697	9090	240.000 510.64 0.73	300.000 638.30 0.92	22.000 46.81 0.07
				ΣESBTU_{FCV13} 4.2	ΣESBTU_{FCV13} 3.6	ΣESBTU_{FCV13} 0.3
				ΣESBTU₃₄ 11.53	ΣESBTU₃₄ 9.94	ΣESBTU₃₄ 0.96
				tPAH13= 1556.1	tPAH13= 1308	tPAH13= 127.1

Table A-21
Sitewide Summary of Soil ESBTU Results for PAHs
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Site Facility Investigation Area Water Bearing Zone Location ID Lab IDs Sample Name Sample Depth Sample Date	Units	Coc,PAHi, FCVi (µg/goc)	Coc,PAHi, MAXi (µg/goc)	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-028 460-117381-1 CFSB-028-SO-0-0.5 0-0.5 ft 7/18/2016	Site CFAC Ecological PERCOLATION POND AREA -- CFSB-030 460-115528-20 CFSB-030-SO-0-0.5 0-0.5 ft 6/13/2016	Site CFAC Ecological PERCOLATION POND AREA Upper Hydrogeologic Unit CFMW-027 460-116402-11 CFMW-027-SO-0-0.5 0-0.5 ft 6/30/2016
Constituent						
Total organic carbon	mg/kg			470000 foc = 0.4700	470000 foc = 0.4700	470000 foc = 0.4700
Polycyclic Aromatic Hydrocarbons				C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU _{FCVi}	C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU _{FCVi}	C_{dw} (µg/g _{dw}) C_{oc} (µg/g _{oc}) ESBTU _{FCVi}
Acenaphthene	mg/kg	491	33400	0.310 0.66 0.00	0.360 0.77 0.00	40.000 85.11 0.17
Acenaphthylene	mg/kg	452	24000	0.019 0.04 0.00	0.022 0.05 0.00	1.200 2.55 0.01
Anthracene	mg/kg	594	1300	0.890 1.89 0.00	0.850 1.81 0.00	41.000 87.23 0.15
Benzo(A)Anthracene	mg/kg	841	4153	4.900 10.43 0.01	6.000 12.77 0.02	280.000 595.74 0.71
Benzo(A)Pyrene	mg/kg	965	3840	5.300 11.28 0.01	6.900 14.68 0.02	320.000 680.85 0.71
Benzo(B)Fluoranthene	mg/kg	979	2169	8.800 18.72 0.02	13.000 27.66 0.03	460.000 978.72 1.00
Benzo(K)Fluoranthene	mg/kg	981	1220	3.300 7.02 0.01	4.300 9.15 0.01	150.000 319.15 0.33
Chrysene	mg/kg	844	826	8.800 18.72 0.02	11.000 23.40 0.03	350.000 744.68 0.88
Fluoranthene	mg/kg	707	23870	7.500 15.96 0.02	11.000 23.40 0.03	430.000 914.89 1.29
Fluorene	mg/kg	538	26000	0.210 0.45 0.00	0.300 0.64 0.00	16.000 34.04 0.06
Naphthalene	mg/kg	385	61700	0.077 0.16 0.00	0.140 0.30 0.00	6.500 13.83 0.04
Phenanthrene	mg/kg	596	34300	3.700 7.87 0.01	4.400 9.36 0.02	200.000 425.53 0.71
Pyrene	mg/kg	697	9090	7.700 16.38 0.02	9.600 20.43 0.03	440.000 936.17 1.34
				ΣESBTU _{FCV13} 0.1	ΣESBTU _{FCV13} 0.2	ΣESBTU _{FCV13} 7.4
				ΣESBTU ₃₄ 0.38	ΣESBTU ₃₄ 0.50	ΣESBTU ₃₄ 20.34
				tPAH13= 51.5	tPAH13= 67.9	tPAH13= 2734.7

Table A-22
Summary of Surface Water ESV Exceedances - Cedar Creek Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
GENERAL CHEMISTRY (Dissolved) µg/L											
Cyanide	0	4	0/4	2	2			5	0	5.2	0
Cyanide (Free)	0	2	0/2	1.5	1.5			5.2	0	5.2	0
Fluoride	4	4	4/4	60	60	121	131	120	4	120	4
GENERAL CHEMISTRY (Total) µg/L											
Cyanide	3	16	3/16	2	2	2.3	15.3	5	2	5.2	2
Cyanide (Free)	0	4	0/4	1.5	1.5			5.2	0	5.2	0
Fluoride	16	16	16/16	30	60	55.8	137	120	9	120	9
METALS (Dissolved) µg/L											
Aluminum	0	4	0/4	18.2	18.2			87	0	1300	0
Antimony	0	4	0/4	0.62	0.62			30	0	30	0
Arsenic	0	4	0/4	0.64	0.64			3.1	0	150	0
Barium	4	4	4/4	1.2	1.2	88.5	93.5	4	4	4	4
Beryllium	0	4	0/4	0.24	0.24			0.66	0	0.66	0
Cadmium	0	4	0/4	0.71	0.71			0.09	0	0.217921	0
Calcium	4	4	4/4	60.5	60.5	50100	50500	116000	0	116000	0
Chromium, Total	0	4	0/4	1.3	1.3			64.3	0	64.3	0
Cobalt	0	4	0/4	1.3	1.3			5.1	0	5.1	0
Copper	0	4	0/4	1.4	1.4			0.23	0	7.71612	0
Iron	0	4	0/4	42.4	42.4			158	0	1000	0
Lead	0	4	0/4	0.38	0.38			0.54	0	2.08046	0
Magnesium	4	4	4/4	63.6	63.6	11400	11700	82000	0	82000	0
Manganese	4	4	4/4	2.5	2.5	2.7	3.5	120	0	120	0
Mercury	0	4	0/4	0.17	0.17			0.026	0	0.77	0
Nickel	0	4	0/4	1.4	1.4			5	0	44.8744	0
Potassium	4	4	4/4	91.4	91.4	421	439	53000	0	53000	0
Selenium	0	4	0/4	0.73	0.73			1	0	5	0
Silver	0	4	0/4	1.3	1.3			0.067	0	0.067	0
Sodium	4	4	4/4	69	69	1960	2070	680000	0	680000	0
Thallium	0	4	0/4	0.26	0.26			0.8	0	0.8	0
Vanadium	0	4	0/4	1.9	1.9			20	0	20	0
Zinc	0	4	0/4	7	7			30	0	101.914	0
METALS (Total) µg/L											
Aluminum	11	16	11/16	18.2	18.2	19.5	85.5	87	0	1300	0
Antimony	4	16	4/16	0.62	0.62	0.64	0.78	30	0	30	0
Arsenic	0	16	0/16	0.64	0.64			3.1	0	150	0
Barium	16	16	16/16	1.2	1.2	94.4	122	4	16	4	16
Beryllium	0	16	0/16	0.24	0.24			0.66	0	0.66	0
Cadmium	0	16	0/16	0.71	0.71			0.09	0	0.217921	0

Table A-22
Summary of Surface Water ESV Exceedances - Cedar Creek Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Chromium, Total	2	16	2/16	1.3	1.3	8.9	37.7	64.3	0	64.3	0
Cobalt	0	16	0/16	1.3	1.3			5.1	0	5.1	0
Copper	3	16	3/16	1.4	1.4	1.9	5.4	0.23	3	7.71612	0
Iron	3	16	3/16	42.4	42.4	100	304	158	1	1000	0
Lead	1	16	1/16	0.38	0.38	0.41	0.41	0.54	0	2.08046	0
Manganese	16	16	16/16	2.5	2.5	3.5	14.7	120	0	120	0
Mercury	0	16	0/16	0.17	0.17			0.026	0	0.77	0
Nickel	0	16	0/16	1.4	1.4			5	0	44.8744	0
Selenium	0	16	0/16	0.73	0.73			1	0	5	0
Silver	0	16	0/16	1.3	1.3			0.067	0	0.067	0
Thallium	0	16	0/16	0.26	0.26			0.8	0	0.8	0
Vanadium	0	16	0/16	1.9	1.9			20	0	20	0
Zinc	2	16	2/16	7	7	13.5	16.4	30	0	101.914	0

Notes:

All surface water samples within the Cedar Creek exposure area included in screening assessment.
Quantitation limit used as the detection limit.
Concentration results evaluated against SLERA and BERA surface water ESVs.

Table A-23
Summary of Surface Water ESV Exceedances - Cedar Creek Overflow Ditch Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
GENERAL CHEMISTRY (Dissolved) µg/L											
Cyanide	0	5	0/5	2	2			5	0	5.2	0
Fluoride	5	5	5/5	60	60	126	185	120	5	120	5
GENERAL CHEMISTRY (Total) µg/L											
Cyanide	0	16	0/16	2	4			5	0	5.2	0
Fluoride	16	16	16/16	15	60	38.7	2600	120	8	120	8
METALS (Dissolved) µg/L											
Aluminum	0	5	0/5	18.2	18.2			87	0	1330	0
Antimony	0	5	0/5	0.62	0.62			30	0	30	0
Arsenic	1	5	1/5	0.64	0.64	0.69	0.69	3.1	0	150	0
Barium	5	5	5/5	1.2	1.2	85	116	4	5	4	5
Beryllium	0	5	0/5	0.24	0.24			0.66	0	0.66	0
Cadmium	0	5	0/5	0.71	0.71			0.09	0	0.217921	0
Calcium	5	5	5/5	60.5	60.5	48600	52200	116000	0	116000	0
Chromium, Total	0	5	0/5	1.3	1.3			64.3	0	64.3	0
Cobalt	0	5	0/5	1.3	1.3			5.1	0	5.1	0
Copper	0	5	0/5	1.4	1.4			0.23	0	7.71612	0
Iron	0	5	0/5	42.4	42.4			158	0	1000	0
Lead	0	5	0/5	0.38	0.38			0.54	0	2.08046	0
Magnesium	5	5	5/5	63.6	63.6	10900	12800	82000	0	82000	0
Manganese	1	5	1/5	2.5	2.5	3.2	3.2	120	0	120	0
Mercury	0	5	0/5	0.17	0.17			0.026	0	0.77	0
Nickel	0	5	0/5	1.4	1.4			5	0	44.8744	0
Potassium	5	5	5/5	91.4	91.4	410	511	53000	0	53000	0
Selenium	0	5	0/5	0.73	0.73			1	0	5	0
Silver	0	5	0/5	1.3	1.3			0.067	0	0.067	0
Sodium	5	5	5/5	69	69	2010	2250	680000	0	680000	0
Thallium	0	5	0/5	0.26	0.26			0.8	0	0.8	0
Vanadium	0	5	0/5	1.9	1.9			20	0	20	0
Zinc	0	5	0/5	7	7			30	0	101.914	0
METALS (Total) µg/L											
Aluminum	13	16	13/16	13.5	18.2	16.8	1610	87	2	1330	1
Antimony	0	16	0/16	0.62	0.76			30	0	30	0
Arsenic	4	16	4/16	0.64	0.71	0.8	2.2	3.1	0	150	0
Barium	16	16	16/16	1.2	1.5	63.4	183	4	16	4	16
Beryllium	0	16	0/16	0.24	0.29			0.66	0	0.66	0
Cadmium	0	16	0/16	0.71	0.72			0.09	0	0.217921	0
Chromium, Total	1	16	1/16	1.3	1.5	1.4	1.4	64.3	0	64.3	0
Cobalt	1	16	1/16	1.3	1.5	2.4	2.4	5.1	0	5.1	0

Table A-23
Summary of Surface Water ESV Exceedances - Cedar Creek Overflow Ditch Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Copper	5	16	5/16	1.4	1.6	1.5	6.2	0.23	5	7.71612	0
Iron	4	16	4/16	42.4	49.1	49.3	2910	158	2	1000	1
Lead	2	16	2/16	0.38	0.44	0.54	2.1	0.54	1	2.08046	1
Manganese	15	16	15/16	2.5	3	3	3750	120	1	120	1
Mercury	0	16	0/16	0.14	0.17			0.026	0	0.77	0
Nickel	1	16	1/16	1.4	1.6	2.3	2.3	5	0	44.8744	0
Selenium	0	16	0/16	0.73	0.79			1	0	5	0
Silver	0	16	0/16	1.3	1.5			0.067	0	0.067	0
Thallium	0	16	0/16	0.26	0.31			0.8	0	0.8	0
Vanadium	6	16	6/16	1.4	1.9	1.9	2.2	20	0	20	0
Zinc	2	16	2/16	6.5	7	14.1	18.9	30	0	101.914	0

Notes:

All surface water samples within the Cedar Creek Overflow Ditch exposure area included in screening assessment.

Quantitation limit used as the detection limit.

Concentration results evaluated against SLERA and BERA surface water ESVs.

Table A-24
Summary of Surface Water ESV Exceedances - South Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
GENERAL CHEMISTRY (Dissolved) µg/L											
Cyanide	2	3	2/3	2	2	5.3	68.2	5	2	5.2	2
Cyanide (Free)	1	1	1/1	1.5	1.5	1.7	1.7	5.2	0	5.2	0
Fluoride	3	3	3/3	60	60	289	1860	120	3	120	3
GENERAL CHEMISTRY (Total) µg/L											
Cyanide	4	12	4/12	2	4	11.3	77.2	5	4	5.2	4
Cyanide (Free)	2	2	2/2	1.5	1.5	2.1	9	5.2	1	5.2	1
Fluoride	12	12	12/12	15	60	250	1700	120	12	120	12
METALS (Dissolved) µg/L											
Aluminum	0	3	0/3	18.2	18.2			87	0	990	0
Antimony	0	3	0/3	0.62	0.62			30	0	30	0
Arsenic	0	3	0/3	0.64	0.64			3.1	0	150	0
Barium	3	3	3/3	1.2	1.2	194	270	4	3	4	3
Beryllium	0	3	0/3	0.24	0.24			0.66	0	0.66	0
Cadmium	0	3	0/3	0.71	0.71			0.09	0	0.217921	0
Calcium	3	3	3/3	60.5	60.5	37800	49400	116000	0	116000	0
Chromium, Total	0	3	0/3	1.3	1.3			64.3	0	64.3	0
Cobalt	0	3	0/3	1.3	1.3			5.1	0	5.1	0
Copper	0	3	0/3	1.4	1.4			0.23	0	7.71612	0
Iron	1	3	1/3	42.4	42.4	60.5	60.5	158	0	1000	0
Lead	0	3	0/3	0.38	0.38			0.54	0	2.08046	0
Magnesium	3	3	3/3	63.6	63.6	12700	14800	82000	0	82000	0
Manganese	1	3	1/3	2.5	2.5	4.5	4.5	120	0	120	0
Mercury	0	3	0/3	0.17	0.17			0.026	0	0.77	0
Nickel	0	3	0/3	1.4	1.4			5	0	44.8744	0
Potassium	3	3	3/3	91.4	91.4	619	970	53000	0	53000	0
Selenium	0	3	0/3	0.73	0.73			1	0	5	0
Silver	0	3	0/3	1.3	1.3			0.067	0	0.067	0
Sodium	3	3	3/3	69	69	3670	23500	680000	0	680000	0
Thallium	0	3	0/3	0.26	0.26			0.8	0	0.8	0
Vanadium	0	3	0/3	1.9	1.9			20	0	20	0
Zinc	0	3	0/3	7	7			30	0	101.914	0
METALS (Total) µg/L											
Aluminum	8	12	8/12	13.5	18.2	15.3	615	87	3	990	0
Antimony	0	12	0/12	0.62	0.76			30	0	30	0
Arsenic	1	12	1/12	0.64	0.71	0.71	0.71	3.1	0	150	0
Barium	12	12	12/12	1.2	1.5	156	424	4	12	4	12
Beryllium	0	12	0/12	0.24	0.29			0.66	0	0.66	0
Cadmium	0	12	0/12	0.71	0.72			0.09	0	0.217921	0

Table A-24
Summary of Surface Water ESV Exceedances - South Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Chromium, Total	3	12	3/12	1.3	1.5	1.8	4.3	64.3	0	64.3	0
Cobalt	0	12	0/12	1.3	1.5			5.1	0	5.1	0
Copper	9	12	9/12	1.4	1.6	1.6	9.8	0.23	9	7.71612	1
Iron	9	12	9/12	42.4	49.1	43.1	451	158	3	1000	0
Lead	3	12	3/12	0.38	0.44	0.91	1.7	0.54	3	2.08046	0
Manganese	9	12	9/12	2.5	3	3.4	10.1	120	0	120	0
Mercury	0	12	0/12	0.14	0.17			0.026	0	0.77	0
Nickel	1	12	1/12	1.4	1.6	1.6	1.6	5	0	44.8744	0
Selenium	0	12	0/12	0.73	0.79			1	0	5	0
Silver	0	12	0/12	1.3	1.5			0.067	0	0.067	0
Thallium	0	12	0/12	0.26	0.31			0.8	0	0.8	0
Vanadium	3	12	3/12	1.4	1.9	2.1	2.1	20	0	20	0
Zinc	2	12	2/12	6.5	7	15.2	18.2	30	0	101.914	0
PESTICIDES µg/L											
Endrin	0	1	0/1	0.004	0.004			0.0023	0	0.036	0
Aldrin	0	3	0/3	0.004	0.004			0.004	0	0.3	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	3	0/3	0.006	0.006			2.2	0	2.2	0
Alpha Endosulfan	0	3	0/3	0.005	0.005			0.003	0	0.056	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	3	0/3	0.005	0.005			2.2	0	2.2	0
Beta Endosulfan	0	3	0/3	0.004	0.004			0.051	0	0.056	0
cis-Chlordane	0	3	0/3	0.004	0.004			0.0043	0	0.0043	0
Delta BHC (Delta Hexachlorocyclohexane)	0	3	0/3	0.006	0.006			2.2	0	2.2	0
Dieldrin	0	3	0/3	0.004	0.004			0.056	0	0.056	0
Endosulfan Sulfate	0	3	0/3	0.005	0.005			0.051	0	0.056	0
Endrin	0	3	0/3	0.004	0.004			0.0023	0	0.036	0
Endrin Aldehyde	0	3	0/3	0.004	0.004			0.036	0	0.036	0
Endrin Ketone	0	3	0/3	0.004	0.004			0.036	0	0.036	0
Gamma Bhc (Lindane)	0	3	0/3	0.004	0.004			0.01	0	0.095	0
Heptachlor	0	3	0/3	0.004	0.004			0.0019	0	0.0038	0
Heptachlor Epoxide	0	3	0/3	0.004	0.004			0.0019	0	0.0038	0
Methoxychlor	0	3	0/3	0.004	0.004			0.019	0	0.03	0
P,P'-DDD	0	3	0/3	0.005	0.005			0.001	0	0.001	0
P,P'-DDE	0	3	0/3	0.004	0.004			0.001	0	0.001	0
P,P'-DDT	0	3	0/3	0.004	0.004			0.0005	0	0.001	0
Toxaphene	0	3	0/3	0.06	0.06			0.0002	0	0.0002	0
trans-Chlordane	0	3	0/3	0.005	0.005			0.0043	0	0.0043	0

Table A-24
Summary of Surface Water ESV Exceedances - South Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
POLYCHLORINATED BIPHENYLS µg/L											
PCB-1016 (Aroclor 1016)	0	3	0/3	0.098	0.098			0.000074	0	0.014	0
PCB-1221 (Aroclor 1221)	0	3	0/3	0.098	0.098			0.000074	0	0.014	0
PCB-1232 (Aroclor 1232)	0	3	0/3	0.098	0.098			0.000074	0	0.014	0
PCB-1242 (Aroclor 1242)	0	3	0/3	0.098	0.098			0.000074	0	0.014	0
PCB-1248 (Aroclor 1248)	0	3	0/3	0.098	0.098			0.000074	0	0.014	0
PCB-1254 (Aroclor 1254)	0	3	0/3	0.084	0.084			0.000074	0	0.014	0
PCB-1260 (Aroclor 1260)	0	3	0/3	0.084	0.084			0.000074	0	0.014	0
PCB-1262 (Aroclor 1262)	0	3	0/3	0.084	0.084						
PCB-1268 (Aroclor 1268)	0	3	0/3	0.084	0.084			0.014	0	0.014	0
Polychlorinated Biphenyl (PCBs)	0	3	0/3	0.098	0.098			0.000074	0	0.014	0
SEMIVOLATILE ORGANIC COMPOUNDS µg/L											
1,2,4,5-Tetrachlorobenzene	0	3	0/3	0.43	0.47			3	0	3	0
1,4-Dioxane (P-Dioxane)	0	3	0/3	3.1	3.4						
2,3,4,6-Tetrachlorophenol	0	3	0/3	0.69	0.75			1	0	1	0
2,4,5-Trichlorophenol	0	3	0/3	0.49	0.53						
2,4,6-Trichlorophenol	0	3	0/3	0.53	0.58			4.9	0	4.9	0
2,4-Dichlorophenol	0	3	0/3	0.63	0.68			11	0	11	0
2,4-Dimethylphenol	0	3	0/3	0.91	0.99						
2,4-Dinitrophenol	0	3	0/3	2.4	2.6						
2,4-Dinitrotoluene	0	3	0/3	1	1.1			44	0	44	0
2,6-Dinitrotoluene	0	3	0/3	0.88	0.96			81	0	81	0
2-Chloronaphthalene	0	3	0/3	0.61	0.66						
2-Chlorophenol	0	3	0/3	0.74	0.8			24	0	24	0
2-Methylnaphthalene	0	3	0/3	0.88	0.96			4.7	0	4.7	0
2-Methylphenol (O-Cresol)	0	3	0/3	1.3	1.4			13	0	13	0
2-Nitroaniline	0	3	0/3	0.65	0.71			0	0	0	0
2-Nitrophenol	0	3	0/3	0.59	0.64			300	0	300	0
3- And 4- Methylphenol (Total)	0	3	0/3	0.88	0.96						
3,3'-Dichlorobenzidine	0	3	0/3	1	1.1			4.5	0	4.5	0
3-Nitroaniline	0	3	0/3	0.82	0.89						
4,6-Dinitro-2-Methylphenol	0	3	0/3	2	2.2						
4-Bromophenyl Phenyl Ether	0	3	0/3	1	1.1			1.5	0	1.5	0
4-Chloro-3-Methylphenol	0	3	0/3	0.76	0.83						
4-Chloroaniline	0	3	0/3	0.73	0.79			232	0	232	0
4-Chlorophenyl Phenyl Ether	0	3	0/3	0.96	1						
4-Nitroaniline	0	3	0/3	0.48	0.52						
4-Nitrophenol	0	3	0/3	4.7	5.1			60	0	60	0
Acenaphthene	0	3	0/3	0.88	0.96			5.8	0	5.8	0

Table A-24
Summary of Surface Water ESV Exceedances - South Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Acenaphthylene	0	3	0/3	0.65	0.71						
Acetophenone	0	3	0/3	1	1.1						
Anthracene	0	3	0/3	0.57	0.62			0.012	0	0.012	0
Atrazine	0	3	0/3	0.77	0.84			1.8	0	1.8	0
Benzaldehyde	0	3	0/3	0.86	0.93						
Benzo(A)Anthracene	0	3	0/3	0.55	0.6			0.018	0	0.018	0
Benzo(A)Pyrene	0	3	0/3	0.16	0.17			0.014	0	0.014	0
Benzo(B)Fluoranthene	0	3	0/3	0.44	0.48						
Benzo(G,H,I)Perylene	0	3	0/3	0.75	0.82						
Benzo(K)Fluoranthene	0	3	0/3	0.18	0.2						
Benzyl Butyl Phthalate	0	3	0/3	0.6	0.65			19	0	19	0
Biphenyl (Diphenyl)	0	3	0/3	0.63	0.68			14	0	14	0
Bis(2-Chloroethoxy) Methane	0	3	0/3	0.69	0.75						
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	3	0/3	0.12	0.13						
Bis(2-Chloroisopropyl) Ether	0	3	0/3	0.93	1						
Bis(2-Ethylhexyl) Phthalate	0	3	0/3	0.72	0.78			3	0	3	0
Caprolactam	0	3	0/3	1.1	1.1						
Carbazole	0	3	0/3	0.85	0.92						
Chrysene	0	3	0/3	0.67	0.73						
Dibenz(A,H)Anthracene	0	3	0/3	0.09	0.098						
Dibenzofuran	0	3	0/3	0.85	0.92			3.7	0	3.7	0
Diethyl Phthalate	0	3	0/3	1	1.1			210	0	210	0
Dimethyl Phthalate	0	3	0/3	0.98	1.1						
Di-N-Butyl Phthalate	0	3	0/3	0.82	0.89			19	0	19	0
Di-N-Octylphthalate	0	3	0/3	0.69	0.75			22	0	22	0
Fluoranthene	0	3	0/3	0.72	0.78			0.04	0	0.04	0
Fluorene	0	3	0/3	0.8	0.87			3	0	3	0
Hexachlorobenzene	0	3	0/3	0.47	0.51			0.0003	0	0.0003	0
Hexachlorobutadiene	0	3	0/3	0.76	0.83			1.3	0	1.3	0
Hexachlorocyclopentadiene	0	3	0/3	0.61	0.66						
Hexachloroethane	0	3	0/3	0.09	0.098			12	0	12	0
Indeno(1,2,3-C,D)Pyrene	0	3	0/3	0.21	0.23						
Isophorone	0	3	0/3	0.67	0.73						
Naphthalene	0	3	0/3	0.8	0.87			1.1	0	1.1	0
Nitrobenzene	0	3	0/3	0.49	0.53						
N-Nitrosodi-N-Propylamine	0	3	0/3	0.83	0.9						
N-Nitrosodiphenylamine	0	3	0/3	0.74	0.8			210	0	210	0
Pentachlorophenol	0	3	0/3	2.2	2.4			0.5	0	4	0
Phenanthrene	0	3	0/3	0.65	0.71			0.4	0	0.4	0

Table A-24
Summary of Surface Water ESV Exceedances - South Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Phenol	0	3	0/3	0.41	0.45			4	0	4	0
Pyrene	0	3	0/3	0.83	0.9			0.025	0	0.025	0
VOLATILE ORGANIC COMPOUNDS µg/L											
1,1,1-Trichloroethane	0	3	0/3	0.28	0.28			11	0	11	0
1,1,1,2,2-Tetrachloroethane	0	3	0/3	0.19	0.19			610	0	610	0
1,1,2-Trichloro-1,2,2-Trifluoroethane	0	3	0/3	0.34	0.34						
1,1,2-Trichloroethane	0	3	0/3	0.08	0.08			1200	0	1200	0
1,1-Dichloroethane	0	3	0/3	0.24	0.24			47	0	47	0
1,1-Dichloroethene	0	3	0/3	0.34	0.34			25	0	25	0
1,2,3-Trichlorobenzene	0	3	0/3	0.35	0.35			8	0	8	0
1,2,4-Trichlorobenzene	0	3	0/3	0.27	0.27			24	0	24	0
1,2-Dibromo-3-Chloropropane	0	3	0/3	0.23	0.23						
1,2-Dibromoethane (Ethylene Dibromide)	0	3	0/3	0.19	0.19						
1,2-Dichlorobenzene	0	3	0/3	0.22	0.22			0.7	0	0.7	0
1,2-Dichloroethane	0	3	0/3	0.25	0.25			100	0	100	0
1,2-Dichloropropane	0	3	0/3	0.18	0.18						
1,3-Dichlorobenzene	0	3	0/3	0.33	0.33			71	0	71	0
1,4-Dichlorobenzene	0	3	0/3	0.33	0.33			15	0	15	0
2-Hexanone	0	3	0/3	0.72	0.72			99	0	99	0
Acetone	0	3	0/3	1.1	1.1			1500	0	1500	0
Benzene	0	3	0/3	0.09	0.09			130	0	130	0
Bromochloromethane	0	3	0/3	0.3	0.3						
Bromodichloromethane	0	3	0/3	0.15	0.15						
Bromoform	0	3	0/3	0.18	0.18			320	0	320	0
Bromomethane	0	3	0/3	0.18	0.18						
Carbon Disulfide	0	3	0/3	0.22	0.22			0.92	0	0.92	0
Carbon Tetrachloride	0	3	0/3	0.33	0.33			9.8	0	9.8	0
Chlorobenzene	0	3	0/3	0.24	0.24			1.3	0	1.3	0
Chloroethane	0	3	0/3	0.37	0.37						
Chloroform	0	3	0/3	0.22	0.22			1.8	0	1.8	0
Chloromethane	0	3	0/3	0.22	0.22						
Cis-1,2-Dichloroethylene	0	3	0/3	0.26	0.26			590	0	590	0
Cis-1,3-Dichloropropene	0	3	0/3	0.16	0.16			0.055	0	0.055	0
Cyclohexane	0	3	0/3	0.26	0.26						
Dibromochloromethane	0	3	0/3	0.22	0.22						
Dichlorodifluoromethane	0	3	0/3	0.14	0.14						
Ethylbenzene	0	3	0/3	0.3	0.3			7.3	0	7.3	0
Isopropylbenzene (Cumene)	0	3	0/3	0.32	0.32			2.6	0	2.6	0
M,P-Xylene	0	3	0/3	0.28	0.28			1.8	0	1.8	0

Table A-24
Summary of Surface Water ESV Exceedances - South Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Methyl Acetate	0	3	0/3	0.58	0.58						
Methyl Ethyl Ketone (2-Butanone)	0	3	0/3	2.2	2.2			14000	0	14000	0
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	0	3	0/3	0.63	0.63			170	0	170	0
Methylcyclohexane	0	3	0/3	0.22	0.22						
Methylene Chloride	3	3	3/3	0.21	0.21	0.47	1	98.1	0	98.1	0
O-Xylene (1,2-Dimethylbenzene)	0	3	0/3	0.32	0.32			13	0	13	0
Styrene	0	3	0/3	0.17	0.17			72	0	72	0
Tert-Butyl Methyl Ether	0	3	0/3	0.13	0.13			10000	0	10000	0
Tetrachloroethylene (PCE)	0	3	0/3	0.12	0.12			98	0	98	0
Toluene	0	3	0/3	0.25	0.25			2	0	2	0
Trans-1,2-Dichloroethene	0	3	0/3	0.18	0.18			590	0	590	0
Trans-1,3-Dichloropropene	0	3	0/3	0.19	0.19			0.055	0	0.055	0
Trichloroethylene (TCE)	0	3	0/3	0.22	0.22			21	0	21	0
Trichlorofluoromethane	0	3	0/3	0.15	0.15						
Vinyl Chloride	0	3	0/3	0.06	0.06			930	0	930	0

Notes:

All surface water samples within the South Percolation Pond exposure area included in screening assessment.
Quantitation limit used as the detection limit.
Concentration results evaluated against SLERA and BERA surface water ESVs.

Table A-25
Summary of Surface Water ESV Exceedances - Northern Surface Water Feature Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
GENERAL CHEMISTRY (Dissolved) µg/L											
Cyanide	0	1	0/1	2	2			5	0	5.2	0
Fluoride	1	1	1/1	60	60	188	188	120	1	120	1
GENERAL CHEMISTRY (Total) µg/L											
Cyanide	0	6	0/6	2	4			5	0	5.2	0
Fluoride	6	6	6/6	15	60	166	243	120	6	120	6
METALS (Dissolved) µg/L											
Aluminum	0	1	0/1	18.2	18.2			87	0	1000	0
Antimony	0	1	0/1	0.62	0.62			30	0	30	0
Arsenic	1	1	1/1	0.64	0.64	0.93	0.93	3.1	0	150	0
Barium	1	1	1/1	1.2	1.2	96.5	96.5	4	1	4	1
Beryllium	0	1	0/1	0.24	0.24			0.66	0	0.66	0
Cadmium	0	1	0/1	0.71	0.71			0.09	0	0.217921	0
Calcium	1	1	1/1	60.5	60.5	54100	54100	116000	0	116000	0
Chromium, Total	0	1	0/1	1.3	1.3			64.3	0	64.3	0
Cobalt	0	1	0/1	1.3	1.3			5.1	0	5.1	0
Copper	0	1	0/1	1.4	1.4			0.23	0	7.71612	0
Iron	0	1	0/1	42.4	42.4			158	0	1000	0
Lead	0	1	0/1	0.38	0.38			0.54	0	2.08046	0
Magnesium	1	1	1/1	63.6	63.6	12100	12100	82000	0	82000	0
Manganese	1	1	1/1	2.5	2.5	3.4	3.4	120	0	120	0
Mercury	0	1	0/1	0.17	0.17			0.026	0	0.77	0
Nickel	0	1	0/1	1.4	1.4			5	0	44.8744	0
Potassium	1	1	1/1	91.4	91.4	397	397	53000	0	53000	0
Selenium	0	1	0/1	0.73	0.73			1	0	5	0
Silver	0	1	0/1	1.3	1.3			0.067	0	0.067	0
Sodium	1	1	1/1	69	69	10400	10400	680000	0	680000	0
Thallium	0	1	0/1	0.26	0.26			0.8	0	0.8	0
Vanadium	0	1	0/1	1.9	1.9			20	0	20	0
Zinc	0	1	0/1	7	7			30	0	101.914	0
METALS (Total) µg/L											
Aluminum	6	6	6/6	13.5	18.2	95.3	5750	87	6	1000	1
Antimony	0	6	0/6	0.62	0.76			30	0	30	0
Arsenic	4	6	4/6	0.64	0.71	0.87	3.7	3.1	1	150	0
Barium	6	6	6/6	1.2	1.5	77.9	219	4	6	4	6
Beryllium	0	6	0/6	0.24	0.29			0.66	0	0.66	0
Cadmium	0	6	0/6	0.71	0.72			0.09	0	0.217921	0
Chromium, Total	1	6	1/6	1.3	1.5	3.4	3.4	64.3	0	64.3	0
Cobalt	1	6	1/6	1.3	1.5	2	2	5.1	0	5.1	0

Table A-25
Summary of Surface Water ESV Exceedances - Northern Surface Water Feature Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Copper	2	6	2/6	1.4	1.6	2.6	5.7	0.23	2	7.71612	0
Iron	6	6	6/6	42.4	49.1	50.2	4760	158	3	1000	1
Lead	2	6	2/6	0.38	0.44	0.66	4.5	0.54	2	2.08046	1
Manganese	5	6	5/6	2.5	3	3.3	127	120	1	120	1
Mercury	0	6	0/6	0.14	0.17			0.026	0	0.77	0
Nickel	2	6	2/6	1.4	1.6	2.1	3.9	5	0	44.8744	0
Selenium	0	6	0/6	0.73	0.79			1	0	5	0
Silver	0	6	0/6	1.3	1.5			0.067	0	0.067	0
Thallium	0	6	0/6	0.26	0.31			0.8	0	0.8	0
Vanadium	3	6	3/6	1.4	1.9	2.1	3.9	20	0	20	0
Zinc	2	6	2/6	6.5	7	9.1	19.2	30	0	101.914	0

Notes:

All surface water samples within the Northern Surface Water Feature exposure area included in screening assessment.

Quantitation limit used as the detection limit.

Concentration results evaluated against SLERA and BERA surface water ESVs.

Table A-26
Summary of Surface Water ESV Exceedances - North Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
GENERAL CHEMISTRY (Dissolved) µg/L											
Cyanide	0	1	0/1	2	2			5	0	5.2	0
Fluoride	1	1	1/1	600	600	21500	21500	120	1	120	1
GENERAL CHEMISTRY (Total) µg/L											
Cyanide	1	2	1/2	2	2	7.6	7.6	5	1	5.2	1
Fluoride	2	2	2/2	60	600	2150	22400	120	2	120	2
METALS (Dissolved) µg/L											
Aluminum	1	1	1/1	18.2	18.2	4780	4780	87	1	1300	1
Antimony	1	1	1/1	0.62	0.62	7.2	7.2	30	0	30	0
Arsenic	1	1	1/1	0.64	0.64	1	1	3.1	0	150	0
Barium	1	1	1/1	1.2	1.2	26.4	26.4	4	1	4	1
Beryllium	1	1	1/1	0.24	0.24	0.51	0.51	0.66	0	0.66	0
Cadmium	1	1	1/1	0.71	0.71	2.5	2.5	0.09	1	0.217921	1
Calcium	1	1	1/1	60.5	60.5	7020	7020	116000	0	116000	0
Chromium, Total	0	1	0/1	1.3	1.3			64.3	0	64.3	0
Cobalt	0	1	0/1	1.3	1.3			5.1	0	5.1	0
Copper	1	1	1/1	1.4	1.4	2	2	0.23	1	7.71612	0
Iron	0	1	0/1	42.4	42.4			158	0	1000	0
Lead	0	1	0/1	0.38	0.38			0.54	0	2.08046	0
Magnesium	1	1	1/1	63.6	63.6	384	384	82000	0	82000	0
Manganese	1	1	1/1	2.5	2.5	31.8	31.8	120	0	120	0
Mercury	0	1	0/1	0.17	0.17			0.026	0	0.77	0
Nickel	1	1	1/1	1.4	1.4	22.1	22.1	5	1	44.8744	0
Potassium	1	1	1/1	91.4	91.4	760	760	53000	0	53000	0
Selenium	0	1	0/1	0.73	0.73			1	0	5	0
Silver	0	1	0/1	1.3	1.3			0.067	0	0.067	0
Sodium	1	1	1/1	69	69	6180	6180	680000	0	680000	0
Thallium	0	1	0/1	0.26	0.26			0.8	0	0.8	0
Vanadium	1	1	1/1	1.9	1.9	4.3	4.3	20	0	20	0
Zinc	1	1	1/1	7	7	512	512	30	1	101.914	1
METALS (Total) µg/L											
Aluminum	2	2	2/2	18.2	18.2	109	8630	87	2	1300	1
Antimony	1	2	1/2	0.62	0.62	7.7	7.7	30	0	30	0
Arsenic	1	2	1/2	0.64	0.64	2.4	2.4	3.1	0	150	0
Barium	2	2	2/2	1.2	1.2	43.4	234	4	2	4	2
Beryllium	1	2	1/2	0.24	0.24	0.71	0.71	0.66	1	0.66	1
Cadmium	1	2	1/2	0.71	0.71	3	3	0.09	1	0.217921	1
Chromium, Total	1	2	1/2	1.3	1.3	2.7	2.7	64.3	0	64.3	0

Table A-26
Summary of Surface Water ESV Exceedances - North Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Cobalt	1	2	1/2	1.3	1.3	1.6	1.6	5.1	0	5.1	0
Copper	2	2	2/2	1.4	1.4	3.8	16.5	0.23	2	7.71612	1
Iron	1	2	1/2	42.4	42.4	817	817	158	1	1000	0
Lead	1	2	1/2	0.38	0.38	7.6	7.6	0.54	1	2.08046	1
Manganese	1	2	1/2	2.5	2.5	37.4	37.4	120	0	120	0
Mercury	0	2	0/2	0.17	0.17			0.026	0	0.77	0
Nickel	2	2	2/2	1.4	1.4	1.9	55.9	5	1	44.8744	1
Selenium	0	2	0/2	0.73	0.73			1	0	5	0
Silver	0	2	0/2	1.3	1.3			0.067	0	0.067	0
Thallium	1	2	1/2	0.26	0.26	0.27	0.27	0.8	0	0.8	0
Vanadium	2	2	2/2	1.9	1.9	6.9	18	20	0	20	0
Zinc	1	2	1/2	7	7	537	537	30	1	101.914	1
PESTICIDES µg/L											
Aldrin	0	1	0/1	0.003	0.003			0.004	0	0.3	0
Alpha Bhc (Alpha Hexachlorocyclohexane)	0	1	0/1	0.007	0.007			2.2	0	2.2	0
Alpha Endosulfan	0	1	0/1	0.002	0.002			0.003	0	0.056	0
Beta Bhc (Beta Hexachlorocyclohexane)	0	1	0/1	0.004	0.004			2.2	0	2.2	0
Beta Endosulfan	0	1	0/1	0.004	0.004			0.051	0	0.056	0
cis-Chlordane	0	1	0/1	0.002	0.002			0.0043	0	0.0043	0
Delta BHC (Delta Hexachlorocyclohexane)	0	1	0/1	0.005	0.005			2.2	0	2.2	0
Dieldrin	0	1	0/1	0.003	0.003			0.056	0	0.056	0
Endosulfan Sulfate	0	1	0/1	0.006	0.006			0.051	0	0.056	0
Endrin	0	1	0/1	0.004	0.004			0.0023	0	0.036	0
Endrin Aldehyde	0	1	0/1	0.008	0.008			0.036	0	0.036	0
Endrin Ketone	0	1	0/1	0.008	0.008			0.036	0	0.036	0
Gamma Bhc (Lindane)	0	1	0/1	0.012	0.012			0.01	0	0.095	0
Heptachlor	0	1	0/1	0.003	0.003			0.0019	0	0.0038	0
Heptachlor Epoxide	0	1	0/1	0.005	0.005			0.0019	0	0.0038	0
Methoxychlor	0	1	0/1	0.004	0.004			0.019	0	0.03	0
P,P'-DDD	0	1	0/1	0.006	0.006			0.001	0	0.001	0
P,P'-DDE	0	1	0/1	0.002	0.002			0.001	0	0.001	0
P,P'-DDT	0	1	0/1	0.004	0.004			0.0005	0	0.001	0
Toxaphene	0	1	0/1	0.11	0.11			0.0002	0	0.0002	0
trans-Chlordane	0	1	0/1	0.003	0.003			0.0043	0	0.0043	0
POLYCHLORINATED BIPHENYLS µg/L											
PCB-1016 (Aroclor 1016)	0	1	0/1	0.1	0.1			0.000074	0	0.014	0
PCB-1221 (Aroclor 1221)	0	1	0/1	0.1	0.1			0.000074	0	0.014	0
PCB-1232 (Aroclor 1232)	0	1	0/1	0.1	0.1			0.000074	0	0.014	0

Table A-26
Summary of Surface Water ESV Exceedances - North Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
PCB-1242 (Aroclor 1242)	0	1	0/1	0.1	0.1			0.000074	0	0.014	0
PCB-1248 (Aroclor 1248)	0	1	0/1	0.1	0.1			0.000074	0	0.014	0
PCB-1254 (Aroclor 1254)	0	1	0/1	0.099	0.099			0.000074	0	0.014	0
PCB-1260 (Aroclor 1260)	0	1	0/1	0.099	0.099			0.000074	0	0.014	0
PCB-1262 (Aroclor 1262)	0	1	0/1	0.099	0.099						
PCB-1268 (Aroclor 1268)	0	1	0/1	0.099	0.099			0.014	0	0.014	0
Polychlorinated Biphenyl (PCBs)	0	1	0/1	0.1	0.1			0.000074	0	0.014	0
SEMIVOLATILE ORGANIC COMPOUNDS µg/L											
1,2,4,5-Tetrachlorobenzene	0	1	0/1	0.43	0.43			3	0	3	0
1,4-Dioxane (P-Dioxane)	0	1	0/1	3.1	3.1						
2,3,4,6-Tetrachlorophenol	0	1	0/1	0.69	0.69			1	0	1	0
2,4,5-Trichlorophenol	0	1	0/1	0.49	0.49						
2,4,6-Trichlorophenol	0	1	0/1	0.53	0.53			4.9	0	4.9	0
2,4-Dichlorophenol	0	1	0/1	0.63	0.63			11	0	11	0
2,4-Dimethylphenol	0	1	0/1	0.91	0.91						
2,4-Dinitrophenol	0	1	0/1	2.4	2.4						
2,4-Dinitrotoluene	0	1	0/1	1	1			44	0	44	0
2,6-Dinitrotoluene	0	1	0/1	0.88	0.88			81	0	81	0
2-Chloronaphthalene	0	1	0/1	0.61	0.61						
2-Chlorophenol	0	1	0/1	0.74	0.74			24	0	24	0
2-Methylnaphthalene	0	1	0/1	0.88	0.88			4.7	0	4.7	0
2-Methylphenol (O-Cresol)	0	1	0/1	1.3	1.3			13	0	13	0
2-Nitroaniline	0	1	0/1	0.65	0.65						
2-Nitrophenol	0	1	0/1	0.59	0.59			300	0	300	0
3- And 4- Methylphenol (Total)	0	1	0/1	0.88	0.88						
3,3'-Dichlorobenzidine	0	1	0/1	1	1			4.5	0	4.5	0
3-Nitroaniline	0	1	0/1	0.82	0.82						
4,6-Dinitro-2-Methylphenol	0	1	0/1	2	2						
4-Bromophenyl Phenyl Ether	0	1	0/1	1	1			1.5	0	1.5	0
4-Chloro-3-Methylphenol	0	1	0/1	0.76	0.76						
4-Chloroaniline	0	1	0/1	0.73	0.73			232	0	232	0
4-Chlorophenyl Phenyl Ether	0	1	0/1	0.96	0.96						
4-Nitroaniline	0	1	0/1	0.48	0.48						
4-Nitrophenol	0	1	0/1	4.7	4.7			60	0	60	0
Acenaphthene	0	1	0/1	0.88	0.88			5.8	0	5.8	0
Acenaphthylene	0	1	0/1	0.65	0.65						
Acetophenone	0	1	0/1	1	1						
Anthracene	0	1	0/1	0.57	0.57			0.012	0	0.012	0

Table A-26
Summary of Surface Water ESV Exceedances - North Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Atrazine	0	1	0/1	0.77	0.77			1.8	0	1.8	0
Benzaldehyde	0	1	0/1	0.86	0.86						
Benzo(A)Anthracene	1	1	1/1	0.55	0.55	3	3	0.018	1	0.018	1
Benzo(A)Pyrene	1	1	1/1	0.16	0.16	3.9	3.9	0.014	1	0.014	1
Benzo(B)Fluoranthene	1	1	1/1	0.44	0.44	10	10				
Benzo(G,H,I)Perylene	1	1	1/1	0.75	0.75	3.9	3.9				
Benzo(K)Fluoranthene	0	1	0/1	0.18	0.18						
Benzyl Butyl Phthalate	0	1	0/1	0.6	0.6			19	0	19	0
Biphenyl (Diphenyl)	0	1	0/1	0.63	0.63			14	0	14	0
Bis(2-Chloroethoxy) Methane	0	1	0/1	0.69	0.69						
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	1	0/1	0.12	0.12						
Bis(2-Chloroisopropyl) Ether	0	1	0/1	0.93	0.93						
Bis(2-Ethylhexyl) Phthalate	0	1	0/1	0.72	0.72			3	0	3	0
Caprolactam	0	1	0/1	1.1	1.1						
Carbazole	0	1	0/1	0.85	0.85						
Chrysene	1	1	1/1	0.67	0.67	7.6	7.6				
Dibenz(A,H)Anthracene	0	1	0/1	0.09	0.09						
Dibenzofuran	0	1	0/1	0.85	0.85			3.7	0	3.7	0
Diethyl Phthalate	0	1	0/1	1	1			210	0	210	0
Dimethyl Phthalate	0	1	0/1	0.98	0.98						
Di-N-Butyl Phthalate	0	1	0/1	0.82	0.82			19	0	19	0
Di-N-Octylphthalate	0	1	0/1	0.69	0.69			22	0	22	0
Fluoranthene	1	1	1/1	0.72	0.72	9.3	9.3	0.04	1	0.04	1
Fluorene	0	1	0/1	0.8	0.8			3	0	3	0
Hexachlorobenzene	0	1	0/1	0.47	0.47			0.0003	0	0.0003	0
Hexachlorobutadiene	0	1	0/1	0.76	0.76			1.3	0	1.3	0
Hexachlorocyclopentadiene	0	1	0/1	0.61	0.61						
Hexachloroethane	0	1	0/1	0.09	0.09			12	0	12	0
Indeno(1,2,3-C,D)Pyrene	1	1	1/1	0.21	0.21	3.1	3.1				
Isophorone	0	1	0/1	0.67	0.67						
Naphthalene	0	1	0/1	0.8	0.8			1.1	0	1.1	0
Nitrobenzene	0	1	0/1	0.49	0.49						
N-Nitrosodi-N-Propylamine	0	1	0/1	0.83	0.83						
N-Nitrosodiphenylamine	0	1	0/1	0.74	0.74			210	0	210	0
Pentachlorophenol	0	1	0/1	2.2	2.2			0.5	0	4	0
Phenanthrene	1	1	1/1	0.65	0.65	1.5	1.5	0.4	1	0.4	1
Phenol	0	1	0/1	0.41	0.41			4	0	4	0
Pyrene	1	1	1/1	0.83	0.83	7	7	0.025	1	0.025	1

Table A-26
Summary of Surface Water ESV Exceedances - North Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
VOLATILE ORGANIC COMPOUNDS µg/L											
1,1,1-Trichloroethane	0	1	0/1	0.28	0.28			11	0	11	0
1,1,2,2-Tetrachloroethane	0	1	0/1	0.19	0.19			610	0	610	0
1,1,2-Trichloro-1,2,2-Trifluoroethane	0	1	0/1	0.34	0.34						
1,1,2-Trichloroethane	0	1	0/1	0.08	0.08			1200	0	1200	0
1,1-Dichloroethane	0	1	0/1	0.24	0.24			47	0	47	0
1,1-Dichloroethene	0	1	0/1	0.34	0.34			25	0	25	0
1,2,3-Trichlorobenzene	0	1	0/1	0.35	0.35			8	0	8	0
1,2,4-Trichlorobenzene	0	1	0/1	0.27	0.27			24	0	24	0
1,2-Dibromo-3-Chloropropane	0	1	0/1	0.23	0.23						
1,2-Dibromoethane (Ethylene Dibromide)	0	1	0/1	0.19	0.19						
1,2-Dichlorobenzene	0	1	0/1	0.22	0.22			0.7	0	0.7	0
1,2-Dichloroethane	0	1	0/1	0.25	0.25			100	0	100	0
1,2-Dichloropropane	0	1	0/1	0.18	0.18						
1,3-Dichlorobenzene	0	1	0/1	0.33	0.33			71	0	71	0
1,4-Dichlorobenzene	0	1	0/1	0.33	0.33			15	0	15	0
2-Hexanone	0	1	0/1	0.72	0.72			99	0	99	0
Acetone	1	1	1/1	1.1	1.1	12	12	1500	0	1500	0
Benzene	0	1	0/1	0.09	0.09			130	0	130	0
Bromochloromethane	0	1	0/1	0.3	0.3						
Bromodichloromethane	0	1	0/1	0.15	0.15						
Bromoform	0	1	0/1	0.18	0.18			320	0	320	0
Bromomethane	0	1	0/1	0.18	0.18						
Carbon Disulfide	0	1	0/1	0.22	0.22			0.92	0	0.92	0
Carbon Tetrachloride	0	1	0/1	0.33	0.33			9.8	0	9.8	0
Chlorobenzene	0	1	0/1	0.24	0.24			1.3	0	1.3	0
Chloroethane	0	1	0/1	0.37	0.37						
Chloroform	0	1	0/1	0.22	0.22			1.8	0	1.8	0
Chloromethane	0	1	0/1	0.22	0.22						
Cis-1,2-Dichloroethylene	0	1	0/1	0.26	0.26			590	0	590	0
Cis-1,3-Dichloropropene	0	1	0/1	0.16	0.16			0.055	0	0.055	0
Cyclohexane	0	1	0/1	0.26	0.26						
Dibromochloromethane	0	1	0/1	0.22	0.22						
Dichlorodifluoromethane	0	1	0/1	0.14	0.14						
Ethylbenzene	0	1	0/1	0.3	0.3			7.3	0	7.3	0
Isopropylbenzene (Cumene)	0	1	0/1	0.32	0.32			2.6	0	2.6	0
M,P-Xylene	0	1	0/1	0.28	0.28			1.8	0	1.8	0
Methyl Acetate	0	1	0/1	0.58	0.58						

Table A-26
Summary of Surface Water ESV Exceedances - North Percolation Pond Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Methyl Ethyl Ketone (2-Butanone)	0	1	0/1	2.2	2.2			14000	0	14000	0
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	0	1	0/1	0.63	0.63			170	0	170	0
Methylcyclohexane	0	1	0/1	0.22	0.22						
Methylene Chloride	0	1	0/1	0.21	0.21			98.1	0	98.1	0
O-Xylene (1,2-Dimethylbenzene)	0	1	0/1	0.32	0.32			13	0	13	0
Styrene	0	1	0/1	0.17	0.17			72	0	72	0
Tert-Butyl Methyl Ether	0	1	0/1	0.13	0.13			10000	0	10000	0
Tetrachloroethylene (PCE)	0	1	0/1	0.12	0.12			98	0	98	0
Toluene	0	1	0/1	0.25	0.25			2	0	2	0
Trans-1,2-Dichloroethene	0	1	0/1	0.18	0.18			590	0	590	0
Trans-1,3-Dichloropropene	0	1	0/1	0.19	0.19			0.055	0	0.055	0
Trichloroethylene (TCE)	0	1	0/1	0.22	0.22			21	0	21	0
Trichlorofluoromethane	0	1	0/1	0.15	0.15						
Vinyl Chloride	0	1	0/1	0.06	0.06			930	0	930	0

Notes:

All surface water samples within the North Percolation Pond exposure area included in screening assessment.
Quantitation limit used as the detection limit.
Concentration results evaluated against SLERA and BERA surface water ESVs.

Table A-27
Summary of Surface Water ESV Exceedances - Flathead River Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
GENERAL CHEMISTRY (Dissolved) µg/L											
Cyanide	3	8	3/8	2	2	11.7	162	5	3	5.2	3
Cyanide (Free)	4	4	4/4	1.5	1.5	1.6	42.2	5.2	3	5.2	3
Fluoride	8	8	8/8	60	60	109	558	120	3	120	3
GENERAL CHEMISTRY (Total) µg/L											
Cyanide	13	32	13/32	2	2	3.2	213	5	12	5.2	12
Cyanide (Free)	5	8	5/8	1.5	1.5	3.5	45.6	5.2	3	5.2	3
Fluoride	32	32	32/32	15	300	33.5	2570	120	18	120	18
METALS (Dissolved) µg/L											
Aluminum	0	8	0/8	18.2	18.2			87	0	1330	0
Antimony	0	8	0/8	0.62	0.62			30	0	30	0
Arsenic	0	8	0/8	0.64	0.64			3.1	0	150	0
Barium	8	8	8/8	1.2	1.2	63.7	98.3	4	8	4	8
Beryllium	0	8	0/8	0.24	0.24			0.66	0	0.66	0
Cadmium	0	8	0/8	0.71	0.71			0.09	0	0.217921	0
Calcium	8	8	8/8	60.5	60.5	18200	32700	116000	0	116000	0
Chromium, Total	0	8	0/8	1.3	1.3			64.3	0	64.3	0
Cobalt	0	8	0/8	1.3	1.3			5.1	0	5.1	0
Copper	2	8	2/8	1.4	1.4	3	26.4	0.23	2	7.71612	1
Iron	2	8	2/8	42.4	42.4	56	164	158	1	1000	0
Lead	0	8	0/8	0.38	0.38			0.54	0	2.08046	0
Magnesium	8	8	8/8	63.6	63.6	4460	8770	82000	0	82000	0
Manganese	3	8	3/8	2.5	2.5	8.2	27.1	120	0	120	0
Mercury	0	8	0/8	0.17	0.17			0.026	0	0.77	0
Nickel	1	8	1/8	1.4	1.4	32.2	32.2	5	1	44.8744	0
Potassium	8	8	8/8	91.4	91.4	237	521	53000	0	53000	0
Selenium	0	8	0/8	0.73	0.73			1	0	5	0
Silver	0	8	0/8	1.3	1.3			0.067	0	0.067	0
Sodium	8	8	8/8	69	69	562	14300	680000	0	680000	0
Thallium	0	8	0/8	0.26	0.26			0.8	0	0.8	0
Vanadium	0	8	0/8	1.9	1.9			20	0	20	0
Zinc	0	8	0/8	7	7			30	0	101.914	0
METALS (Total) µg/L											
Aluminum	30	32	30/32	18.2	18.2	19.9	1540	87	18	1330	2
Antimony	3	32	3/32	0.62	0.62	0.64	0.66	30	0	30	0
Arsenic	3	32	3/32	0.64	0.64	0.78	0.88	3.1	0	150	0
Barium	32	32	32/32	1.2	1.2	62.8	197	4	32	4	32
Beryllium	0	32	0/32	0.24	0.24			0.66	0	0.66	0
Cadmium	0	32	0/32	0.71	0.71			0.09	0	0.217921	0

Table A-27
Summary of Surface Water ESV Exceedances - Flathead River Exposure Area
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Chromium, Total	4	32	4/32	1.3	1.3	1.3	2	64.3	0	64.3	0
Cobalt	2	32	2/32	1.3	1.3	1.3	1.3	5.1	0	5.1	0
Copper	7	32	7/32	1.4	1.4	1.4	3.4	0.23	7	7.71612	0
Iron	20	32	20/32	42.4	42.4	127	1640	158	17	1000	4
Lead	13	32	13/32	0.38	0.38	0.38	2.9	0.54	8	2.08046	1
Manganese	21	32	21/32	2.5	2.5	3.9	212	120	1	120	1
Mercury	0	32	0/32	0.17	0.17			0.026	0	0.77	0
Nickel	1	32	1/32	1.4	1.4	1.4	1.4	5	0	44.8744	0
Selenium	0	32	0/32	0.73	0.73			1	0	5	0
Silver	0	32	0/32	1.3	1.3			0.067	0	0.067	0
Thallium	0	32	0/32	0.26	0.26			0.8	0	0.8	0
Vanadium	1	32	1/32	1.9	1.9	1.9	1.9	20	0	20	0
Zinc	2	32	2/32	7	7	8.8	19.9	30	0	101.914	0

Notes:

All surface water samples within the Flathead River exposure area included in screening assessment.
Quantitation limit used as the detection limit.
Concentration results evaluated against SLERA and BERA surface water ESVs.

Table A-28
Summary of Surface Water ESV Groundwater Exceedances - South Perimeter of Western Undeveloped and Main Plant Exposure Areas
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
GENERAL CHEMISTRY (Dissolved) µg/L											
Cyanide	7	9	7 / 9	2	4	62.6	428	5	7	5.2	7
Cyanide (Free)	6	8	6 / 8	1.5	1.5	3.3	19.1	5.2	2	5.2	2
Fluoride	9	9	9 / 9	60	60	96	2370	120	8	120	8
GENERAL CHEMISTRY (Total) µg/L											
Alkalinity, Total (As CaCO3)	35	35	35 / 35	5000	5000	204000	280000	20000	35	20000	35
Chloride (As Cl)	34	35	34 / 35	30	620	637	91000	120000	0	230000	0
Cyanide	29	35	29 / 35	2	20	4	450	5	28	5.2	28
Cyanide (Free)	8	15	8 / 15	1.5	1.5	2.9	40.3	5.2	5	5.2	5
Fluoride	35	35	35 / 35	15	60	59.5	2550	120	32	120	32
Hardness (As CaCO3)	8	8	8 / 8	5000	10000	198000	264000				
Nitrogen, Ammonia (As N)	0	35	0 / 35	72	72						
Nitrogen, Nitrite + Nitrate	34	35	34 / 35	100	500	104	5240				
Phosphorus, Total Orthophosphate (As P)	0	34	0 / 34	42	48						
Sulfate (As SO4)	35	35	35 / 35	105	254	3310	29600				
Total Dissolved Solids (Residue, Filterable)	35	35	35 / 35	10000	10000	183000	355000				
Total Hardness	27	27	27 / 27	5000	25000	188000	320000				
Total Suspended Solids	31	35	31 / 35	1000	6700	1000	181000				
METALS (Dissolved) µg/L											
Aluminum	2	35	2 / 35	18.2	18.2	18.5	20.7	87	0	87	0
Antimony	0	35	0 / 35	0.62	0.62			30	0	30	0
Arsenic	0	35	0 / 35	0.64	0.64			3.1	0	150	0
Barium	35	35	35 / 35	1.2	1.2	130	339	4	35	4	35
Beryllium	0	35	0 / 35	0.24	0.24			0.66	0	0.66	0
Cadmium	0	35	0 / 35	0.71	0.71			0.09	0	0.217921	0
Calcium	35	35	35 / 35	60.5	60.5	45000	72100	116000	0	116000	0
Chromium, Total	0	35	0 / 35	1.3	1.3			64.3	0	64.3	0
Cobalt	1	35	1 / 35	1.3	1.3	1.3	1.3	5.1	0	5.1	0
Copper	11	35	11 / 35	1.4	1.4	1.4	4.6	0.23	11	7.71612	0
Iron	16	35	16 / 35	42.4	42.4	45.6	179	158	5	1000	0
Lead	0	35	0 / 35	0.38	0.38			0.54	0	2.08046	0
Magnesium	35	35	35 / 35	63.6	63.6	13700	20600	82000	0	82000	0
Manganese	14	35	14 / 35	2.5	2.5	2.7	88.4	120	0	120	0
Mercury	0	35	0 / 35	0.17	0.17			0.026	0	0.77	0
Nickel	1	35	1 / 35	1.4	1.4	2.1	2.1	5	0	44.8744	0
Potassium	35	35	35 / 35	91.4	91.4	667	1200				
Selenium	0	35	0 / 35	0.73	0.73			1	0	5	0
Silver	0	35	0 / 35	1.3	1.3			0.067	0	0.067	0
Sodium	35	35	35 / 35	69	69	5420	44300	680000	0	680000	0
Thallium	0	35	0 / 35	0.26	0.26			0.8	0	0.8	0

Table A-28
Summary of Surface Water ESV Groundwater Exceedances - South Perimeter of Western Undeveloped and Main Plant Exposure Areas
Baseline Ecological Risk Assessment Work Plan
Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Vanadium	0	35	0 / 35	1.9	1.9			20	0	20	0
Zinc	0	35	0 / 35	7	7			30	0	101.914	0
METALS (Total) µg/L											
Aluminum	5	9	5 / 9	18.2	18.2	23.2	619	87	3	87	3
Antimony	0	9	0 / 9	0.62	0.62			30	0	30	0
Arsenic	0	9	0 / 9	0.64	0.64			3.1	0	150	0
Barium	9	9	9 / 9	1.2	1.2	145	345	4	9	4	9
Beryllium	0	9	0 / 9	0.24	0.24			0.66	0	0.66	0
Cadmium	0	9	0 / 9	0.71	0.71			0.09	0	0.217921	0
Calcium	9	9	9 / 9	60.5	60.5	46400	68700	116000	0	116000	0
Chromium, Total	0	9	0 / 9	1.3	1.3			64.3	0	64.3	0
Cobalt	1	9	1 / 9	1.3	1.3	1.3	1.3	5.1	0	5.1	0
Copper	3	9	3 / 9	1.4	1.4	2	2.3	0.23	3	7.71612	0
Iron	7	9	7 / 9	42.4	42.4	42.4	940	158	3	1000	0
Lead	1	9	1 / 9	0.38	0.38	0.73	0.73	0.54	1	2.08046	0
Magnesium	9	9	9 / 9	63.6	63.6	15200	20000	82000	0	82000	0
Manganese	3	9	3 / 9	2.5	2.5	3.5	40.5	120	0	120	0
Mercury	0	9	0 / 9	0.17	0.17			0.026	0	0.77	0
Nickel	0	9	0 / 9	1.4	1.4			5	0	44.8744	0
Potassium	9	9	9 / 9	91.4	91.4	692	1230				
Selenium	0	9	0 / 9	0.73	0.73			1	0	5	0
Silver	0	9	0 / 9	1.3	1.3			0.067	0	0.067	0
Sodium	9	9	9 / 9	69	69	6010	54200	680000	0	680000	0
Thallium	0	9	0 / 9	0.26	0.26			0.8	0	0.8	0
Vanadium	0	9	0 / 9	1.9	1.9			20	0	20	0
Zinc	0	9	0 / 9	7	7			30	0	101.914	0
SEMIVOLATILE ORGANIC COMPOUNDS µg/L											
1,2,4,5-Tetrachlorobenzene	0	31	0 / 31	0.43	0.45			3	0	3	0
1,4-Dioxane (P-Dioxane)	0	31	0 / 31	3.1	3.3						
2,3,4,6-Tetrachlorophenol	0	31	0 / 31	0.69	0.72			1	0	1	0
2,4,5-Trichlorophenol	0	31	0 / 31	0.49	0.51						
2,4,6-Trichlorophenol	0	31	0 / 31	0.53	0.56			4.9	0	4.9	0
2,4-Dichlorophenol	0	31	0 / 31	0.63	0.66			11	0	11	0
2,4-Dimethylphenol	0	31	0 / 31	0.91	0.96						
2,4-Dinitrophenol	0	31	0 / 31	2.4	2.5						
2,4-Dinitrotoluene	0	31	0 / 31	1	1.1			44	0	44	0
2,6-Dinitrotoluene	0	31	0 / 31	0.88	0.92			81	0	81	0
2-Chloronaphthalene	0	31	0 / 31	0.61	0.64						
2-Chlorophenol	0	31	0 / 31	0.74	0.78			24	0	24	0
2-Methylnaphthalene	0	31	0 / 31	0.88	0.92			4.7	0	4.7	0

Table A-28
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Columbia Falls Aluminum Company
Columbia Falls, Montana

Constituent	Number of Detections	Number of Samples	Detection Frequency	Min Detection Limit	Max Detection Limit	Min Detection	Max Detection	SLERA		BERA	
								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
2-Methylphenol (O-Cresol)	0	31	0 / 31	1.3	1.4			13	0	13	0
2-Nitroaniline	0	31	0 / 31	0.65	0.68						
2-Nitrophenol	0	31	0 / 31	0.59	0.62			300	0	300	0
3- And 4- Methylphenol (Total)	0	31	0 / 31	0.88	0.92						
3,3'-Dichlorobenzidine	0	31	0 / 31	1	1.1			4.5	0	4.5	0
3-Nitroaniline	0	31	0 / 31	0.82	0.86						
4,6-Dinitro-2-Methylphenol	0	31	0 / 31	2	2.1						
4-Bromophenyl Phenyl Ether	0	31	0 / 31	1	1.1			1.5	0	1.5	0
4-Chloro-3-Methylphenol	0	31	0 / 31	0.76	0.8						
4-Chloroaniline	0	31	0 / 31	0.73	0.77			232	0	232	0
4-Chlorophenyl Phenyl Ether	0	31	0 / 31	0.96	1						
4-Nitroaniline	0	31	0 / 31	0.48	0.5						
4-Nitrophenol	0	31	0 / 31	4.7	4.9			60	0	60	0
Acenaphthene	0	31	0 / 31	0.88	0.92			5.8	0	5.8	0
Acenaphthylene	0	31	0 / 31	0.65	0.68						
Acetophenone	0	31	0 / 31	1	1.1						
Anthracene	0	31	0 / 31	0.57	0.6			0.012	0	0.012	0
Atrazine	0	31	0 / 31	0.77	0.81			1.8	0	1.8	0
Benzaldehyde	0	31	0 / 31	0.86	0.9						
Benzo(A)Anthracene	0	31	0 / 31	0.55	0.58			0.018	0	0.018	0
Benzo(A)Pyrene	0	31	0 / 31	0.16	0.17			0.014	0	0.014	0
Benzo(B)Fluoranthene	0	31	0 / 31	0.44	0.46						
Benzo(G,H,I)Perylene	0	31	0 / 31	0.75	0.79						
Benzo(K)Fluoranthene	0	31	0 / 31	0.18	0.19						
Benzyl Butyl Phthalate	0	31	0 / 31	0.6	0.63			19	0	19	0
Biphenyl (Diphenyl)	0	31	0 / 31	0.63	0.66			14	0	14	0
Bis(2-Chloroethoxy) Methane	0	31	0 / 31	0.69	0.72						
Bis(2-Chloroethyl) Ether (2-Chloroethyl Ether)	0	31	0 / 31	0.12	0.13						
Bis(2-Chloroisopropyl) Ether	0	31	0 / 31	0.93	0.98						
Bis(2-Ethylhexyl) Phthalate	0	31	0 / 31	0.72	0.76			3	0	3	0
Caprolactam	0	31	0 / 31	1.1	1.1						
Carbazole	0	31	0 / 31	0.85	0.89						
Chrysene	0	31	0 / 31	0.67	0.7						
Dibenz(A,H)Anthracene	0	31	0 / 31	0.09	0.095						
Dibenzofuran	0	31	0 / 31	0.85	0.89			3.7	0	3.7	0
Diethyl Phthalate	0	31	0 / 31	1	1.1			210	0	210	0
Dimethyl Phthalate	0	31	0 / 31	0.98	1						
Di-N-Butyl Phthalate	1	31	1 / 31	0.82	0.86	1.1	1.1	19	0	19	0
Di-N-Octylphthalate	0	31	0 / 31	0.69	0.72			22	0	22	0
Fluoranthene	0	31	0 / 31	0.72	0.76			0.04	0	0.04	0

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								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Fluorene	0	31	0 / 31	0.8	0.84			3	0	3	0
Hexachlorobenzene	0	31	0 / 31	0.47	0.49			0.0003	0	0.0003	0
Hexachlorobutadiene	0	31	0 / 31	0.76	0.8			1.3	0	1.3	0
Hexachlorocyclopentadiene	0	31	0 / 31	0.61	0.64						
Hexachloroethane	0	31	0 / 31	0.09	0.095			12	0	12	0
Indeno(1,2,3-C,D)Pyrene	0	31	0 / 31	0.21	0.22						
Isophorone	0	31	0 / 31	0.67	0.7						
Naphthalene	0	31	0 / 31	0.8	0.84			1.1	0	1.1	0
Nitrobenzene	0	31	0 / 31	0.49	0.51						
N-Nitrosodi-N-Propylamine	0	31	0 / 31	0.83	0.87						
N-Nitrosodiphenylamine	0	31	0 / 31	0.74	0.78			210	0	210	0
Pentachlorophenol	0	31	0 / 31	2.2	2.3			0.5	0	4	0
Phenanthrene	0	31	0 / 31	0.65	0.68			0.4	0	0.4	0
Phenol	0	31	0 / 31	0.41	0.43			4	0	4	0
Pyrene	0	31	0 / 31	0.83	0.87			0.025	0	0.025	0
VOLATILE ORGANIC COMPOUNDS µg/L											
1,1,1-Trichloroethane	0	31	0 / 31	0.28	0.28			11	0	11	0
1,1,2,2-Tetrachloroethane	0	31	0 / 31	0.19	0.19			610	0	610	0
1,1,2-Trichloro-1,2,2-Trifluoroethane	0	31	0 / 31	0.34	0.34						
1,1,2-Trichloroethane	0	31	0 / 31	0.08	0.08			1200	0	1200	0
1,1-Dichloroethane	0	31	0 / 31	0.24	0.24			47	0	47	0
1,1-Dichloroethene	0	31	0 / 31	0.34	0.34			25	0	25	0
1,2,3-Trichlorobenzene	0	31	0 / 31	0.35	0.35			8	0	8	0
1,2,4-Trichlorobenzene	0	31	0 / 31	0.27	0.27			24	0	24	0
1,2-Dibromo-3-Chloropropane	0	31	0 / 31	0.23	0.23						
1,2-Dibromoethane (Ethylene Dibromide)	0	31	0 / 31	0.19	0.19						
1,2-Dichlorobenzene	0	31	0 / 31	0.22	0.22			0.7	0	0.7	0
1,2-Dichloroethane	0	31	0 / 31	0.25	0.25			100	0	100	0
1,2-Dichloropropane	0	31	0 / 31	0.18	0.18						
1,3-Dichlorobenzene	0	31	0 / 31	0.33	0.33			71	0	71	0
1,4-Dichlorobenzene	0	31	0 / 31	0.33	0.33			15	0	15	0
2-Hexanone	0	31	0 / 31	0.72	0.72			99	0	99	0
Acetone	6	31	6 / 31	1.1	1.1	2.6	10	1500	0	1500	0
Benzene	0	31	0 / 31	0.09	0.09			130	0	130	0
Bromochloromethane	0	31	0 / 31	0.3	0.3						
Bromodichloromethane	0	31	0 / 31	0.15	0.15						
Bromoform	0	31	0 / 31	0.18	0.18			320	0	320	0
Bromomethane	0	31	0 / 31	0.18	0.18						
Carbon Disulfide	1	31	1 / 31	0.22	0.22	3	3	0.92	1	0.92	1
Carbon Tetrachloride	0	31	0 / 31	0.33	0.33			9.8	0	9.8	0

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								Ecological Screening Value	Number of Exceedances	Ecological Screening Value	Number of Exceedances
Chlorobenzene	0	31	0 / 31	0.24	0.24			1.3	0	1.3	0
Chloroethane	0	31	0 / 31	0.37	0.37						
Chloroform	0	31	0 / 31	0.22	0.22			1.8	0	1.8	0
Chloromethane	0	31	0 / 31	0.22	0.22						
Cis-1,2-Dichloroethylene	0	31	0 / 31	0.26	0.26			590	0	590	0
Cis-1,3-Dichloropropene	0	31	0 / 31	0.16	0.16			0.055	0	0.055	0
Cyclohexane	0	31	0 / 31	0.26	0.26						
Dibromochloromethane	0	31	0 / 31	0.22	0.22						
Dichlorodifluoromethane	0	31	0 / 31	0.14	0.14						
Ethylbenzene	0	31	0 / 31	0.3	0.3			7.3	0	7.3	0
Isopropylbenzene (Cumene)	0	31	0 / 31	0.32	0.32			2.6	0	2.6	0
M,P-Xylene	0	31	0 / 31	0.28	0.28			1.8	0	1.8	0
Methyl Acetate	0	31	0 / 31	0.58	0.58						
Methyl Ethyl Ketone (2-Butanone)	0	31	0 / 31	2.2	2.2			14000	0	14000	0
Methyl Isobutyl Ketone (4-Methyl-2-Pentanone)	0	31	0 / 31	0.63	0.63			170	0	170	0
Methylcyclohexane	0	31	0 / 31	0.22	0.22						
Methylene Chloride	1	31	1 / 31	0.21	0.21	0.51	0.51	98.1	0	98.1	0
O-Xylene (1,2-Dimethylbenzene)	0	31	0 / 31	0.32	0.32			13	0	13	0
Styrene	0	31	0 / 31	0.17	0.17			72	0	72	0
Tert-Butyl Methyl Ether	0	31	0 / 31	0.13	0.13			10000	0	10000	0
Tetrachloroethylene (PCE)	1	31	1 / 31	0.12	0.12	0.14	0.14	98	0	98	0
Toluene	2	31	2 / 31	0.25	0.25	0.66	2.2	2	1	2	1
Trans-1,2-Dichloroethene	0	31	0 / 31	0.18	0.18			590	0	590	0
Trans-1,3-Dichloropropene	0	31	0 / 31	0.19	0.19			0.055	0	0.055	0
Trichloroethylene (TCE)	0	31	0 / 31	0.22	0.22			21	0	21	0
Trichlorofluoromethane	0	31	0 / 31	0.15	0.15						
Vinyl Chloride	0	31	0 / 31	0.06	0.06			930	0	930	0

Notes:

Groundwater samples collected along the southern perimeter of the Western Undeveloped and Main Plant exposure areas included in screening assessment.
Quantitation limit used as the detection limit.
Concentration results evaluated against SLERA and BERA surface water ESVs.