Feasibility Study Report Executive Summary

Columbia Falls Aluminum Company
Columbia Falls, Flathead County, Montana

November 7, 2022

Prepared for:

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Feasibility Study Report Executive Summary

I. Introduction

On behalf of Columbia Falls Aluminum Company, LLC (CFAC), Roux Environmental Engineering and Geology, D.P.C. (Roux), prepared a Feasibility Study Report ("FS Report") as part of the approved Remedial Investigation/Feasibility Study (RI/FS) of the Superfund Site referred to as Anaconda Aluminum Co. Columbia Falls Reduction Plant, located two miles northeast of Columbia Falls in Flathead County, Montana (hereinafter, "the Site"). The RI/FS was conducted pursuant to the Administrative Settlement Agreement and Order on Consent dated November 30, 2015, as amended, between CFAC and the United States Environmental Protection Agency (USEPA) (Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Docket No. 08-2016-0002). The FS was approved by USEPA, in consultation with the Montana Department of Environmental Quality (MDEQ) on June 17, 2022.

As part of the RI, multiple phases of Site investigation and baseline risk assessments have been performed at the Site. The overall scope of work and results of the Site characterization, Baseline Human Health Risk Assessment (BHHRA), and Baseline Ecological Risk Assessment (BERA) are presented collectively within the Remedial Investigation Report (Roux, 2020a; "RI Report") dated February 21, 2020.

II. Feasibility Study Purpose

The purpose of the FS is to identify possible alternatives to address the exposure areas identified in the RI Report and evaluate those alternatives according to criteria in CERCLA, applicable implementing rules and guidance. To accomplish this objective, the FS report grouped the various areas of the Site identified in the RI where risk or constituent levels exceeded applicable levels into decision units. The FS report then identified various alternatives for each decision unit and evaluated those alternatives according to legally required criteria using a scoring system that ranked each option according to the various criteria. This ranking process produced a set of remedial options for the Site as a whole that would, if implemented, protect human health and the environment.

Based on the results of the RI, a Feasibility Study Work Plan (FSWP) was prepared to document the Site areas to be addressed in the FS, as well as the scope of work to be performed to complete the FS, in accordance with the "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (USEPA, 1988).

The elements of the FS process addressed in this FS Report include:

- Finalization of the preliminary Applicable or Relevant and Appropriate Requirements (ARARs) and Remedial Action Objectives (RAOs);
- Screening of Remedial Technologies;
- Development of Remedial Action Alternatives;
- Detailed Evaluation of Remedial Action Alternatives; and
- Comparative Analysis of Remedial Action Alternatives.

III. Site Characteristics

The Site is located at 2000 Aluminum Drive near Columbia Falls, Flathead County, Montana. As shown on Figure ES-1, the Site consists of approximately 1,340 acres bounded by Cedar Creek Reservoir to the north, Teakettle Mountain to the east, Flathead River to the south, and Cedar Creek to the west.

The Site includes seven closed landfills, one open landfill, two closed leachate ponds, and several percolation ponds. A map showing the locations of these and other Site features is provided for reference on Figure ES-2.

A. Exposure Areas Requiring Additional Evaluation

The RI Report and other documents include descriptions of the Site, the Site operational history and the results of the risk assessments. A map showing the investigation sampling locations as referenced in the RI Report is provided as Figure ES-3. Based on the Site assessment, including the risk assessments, and as detailed in Sections 7 and 8.4 of the RI Report and summarized in Section 8.5 of the RI Report and Section 2.3.5 of the FSWP, the following exposure areas were carried forward for evaluation of remedial alternatives in the FS:

- Main Plant Area (including the Main Plant Incremental Sampling Methodology (ISM) Grid Area);
- North Percolation Pond Area;
- Central Landfills Area (including the Central Landfills ISM Grid Area);
- Industrial Landfill Area;
- South Percolation Ponds;
- Backwater Seep Sampling Area and Flathead River Riparian Area Channel; and
- Groundwater.

Based on the findings of the BHHRA and BERA, and as discussed in the RI Report, exposure areas not listed above generally exhibit minimal risk to human health and ecological receptors and, as such, do not require further evaluation in the FS.

B. Decision Unit and Related Contaminants of Concern

Based on the size and complexity of the Site, decision units (DUs) with common elements or conditions were established in the FSWP to evaluate and address COCs specific to an environmental media and/or area of the Site. A total of six (6) DUs were defined to encompass exposure areas requiring additional evaluation:

- Landfills DU1;
- Landfills DU2;
- Soil DU;
- North Percolation Pond DU;
- River Area DU; and
- Groundwater DU.

Each DU is described below. A map showing the areal extent of each DU is provided as Figure ES-4.

1. Landfills DU1

The Landfills DU1 includes the West Landfill, the Wet Scrubber Sludge Pond, the Center Landfill, and the surficial and shallow soil, if any, within their footprints. The RI Report identified each of these waste management units as a source of cyanide and/or fluoride groundwater contamination at the Site to varying degrees. Specifically, the West Landfill and Wet Scrubber Sludge Pond area and, to a lesser degree, the Center Landfill are potentially contributing sources to groundwater contamination.

2. Landfills DU2

The Landfills DU2 is defined as the remaining waste management units in the Central Landfills Area and Industrial Landfill Area exposure areas and the surficial and shallow soil, if any, within their footprints. This includes the East Landfill, the Industrial Landfill, the Sanitary Landfill, and the Asbestos Landfills. The RI Report states these landfills are not contributing sources of groundwater contamination at the Site.

3. Soil DU

The Soil DU is the soil within the Main Plant Area, the ISM Grid Area, and the areas surrounding the waste management units in the Central Landfills Area exposure area.

The COCs for the Soil DU include several metals and PAHs in soil. Cyanide and fluoride are present in the soils in the Soil DU but are not the source of Site cyanide and fluoride groundwater plumes.

4. North Percolation Pond DU

The North Percolation Pond DU consists of the North-East Percolation Pond and its influent ditch, the North-West Percolation Pond, and the approximately 1,440-foot-long overflow ditch. The COCs for the North Percolation Pond DU include numerous metals and PAHs in soil and sediment as well as metals, PAHs, and fluoride in surface water. Surface water in the North Percolation Pond DU is seasonal in nature and is the result of stormwater accumulating in the topographic depressions created to form the North Percolation Ponds as part of the Site's historical operations and management of process water.

5. River Area DU

The River Area DU is defined as the soil, sediment, sediment porewater, and surface water in the South Percolation Ponds, Backwater Seep Sampling Area, and Riparian Area Channel. The hydrogeologic studies performed at the Site indicate that groundwater discharges to the Flathead River. The three Site features comprising the River Area DU are all located within the extent of the "Seep Area." The "Seep Area" was defined as the area that has potential to receive groundwater expressed from the upper hydrogeologic unit to the Flathead River.

The COCs for the River Area DU include several metals in soil, surface water, sediment, and sediment porewater. In addition, cyanide (total and/or free) is an identified COC in sediment, sediment porewater, and surface water in each of the Site features comprising the River Area DU. The results of the RI indicated that groundwater discharge to the Seep Area is the primary source of the cyanide in the River Area DU.

The presence of metals in the River Area DU, on the other hand, is not attributed to the discharge of groundwater at the Seep Area.

The presence of metals at elevated concentrations in the discharge water collected at the South Percolation Ponds influent pipe for Montana Pollutant Discharge Elimination System (MPDES) permit sampling suggests that the River Area DU metal COCs were conveyed to surface water in the River Area DU via this influent pipe. These metals are not present at elevated concentrations in groundwater immediately upgradient of the Seep, further supporting this conclusion. CFAC has since decommissioned the influent pipe to eliminate the direct discharge of stormwater into the Ponds as part of the Removal Action at the South Percolation Ponds.

Removal Action at the South Percolation Ponds

The only feature within the River Area DU that contained sediments with COCs at concentrations exceeding preliminary remediation goals (PRGs) was the South Percolation Ponds. CFAC performed a Removal Action at the South Percolation Ponds to remediate sediments in accordance with the requirements of the Administrative Order on Consent effective July 21, 2020, between CFAC and USEPA (CERCLA Docket No. 08-2020-0002) ("South Ponds ACOC"). Under the South Ponds ACOC, CFAC decommissioned the South Percolation Ponds, removed sediments to satisfy ecological PRGs, and removed the dam to allow the river to reclaim the channel that occupied this area prior to construction of the South Percolation Ponds. This work was implemented in 2020 and 2021, in advance of FS completion, to prevent erosion and transport of contaminated sediments by the Flathead River.

6. Groundwater DU

The Groundwater DU is defined as the groundwater within the extent of the upper hydrogeologic unit underlying the Site described in Section 3.2.1 of the RI Report. The COCs for groundwater within the upper hydrogeologic unit include cyanide, fluoride, and arsenic, which all exceed groundwater ARARs downgradient of the Landfills DU1. A figure depicting the extent of groundwater exceeding ARARs is provided as Figure ES-5. In addition, cyanide in groundwater discharging to the River Area DU results in potential ecological risk and exceedances of surface water ARARs, as outlined in Section 2.3.2 of the FSWP.

Groundwater at the Site generally flows in a southerly direction, from the Landfills DU1 source area toward the Flathead River.

IV. Remedial Objectives and Evaluation Criteria

Based upon the review of available data, Site physical characteristics and hydrogeology, and results of the BHHRA and BERA, remedial objectives and evaluation criteria were developed for the Site. These include applicable or relevant and appropriate requirements (ARARs), Remedial Action Objectives (RAOs), and Preliminary Remediation Goals (PRGs).

A. Applicable or Relevant and Appropriate Requirements

Preliminary ARARs have been identified by USEPA in consultation with Montana Department of Environmental Quality (MDEQ). An ARAR is defined as a legally applicable or relevant and appropriate standard, requirement, criterion, or limitation under federal environmental law, or promulgated under state environmental or facility siting law that is more stringent than the federal law. "Applicable" requirements are established cleanup standards, control requirements, or other environmental protection requirements promulgated under federal or state law that specifically address a situation encountered at the Site. "Relevant and appropriate" requirements are those federal or state requirements that, while not legally "applicable" to the Site, address situations sufficiently similar to those encountered at the Site. CERCLA Section 121(d) requires that remedial actions either comply with, or have been granted a waiver from, an ARAR.

The ARARs will be further refined in the Record of Decision (ROD) upon final selection of the remedy. In addition to the ARARs, the work performed within the RI/FS has been and will continue to be completed in general accordance with the National Contingency Plan (NCP; 40 Code of Federal Regulations (CFR) Part 300).

B. Remedial Action Objectives

RAOs are qualitative statements that describe what a remedial action is intended to accomplish at a Site. RAOs can be specific to certain COCs, environmental media, and the exposure pathways and receptors to be protected. RAOs can take into consideration both current and future land use, as well as groundwater and surface water beneficial use designations.

Based upon the results of the BHHRA and BERA, preliminary RAOs (PRAOs) were identified in collaboration with USEPA and MDEQ and presented in the FSWP. Since then, legal review of the PRAOs by USEPA and MDEQ has determined the final RAOs as presented below. These RAOs are based upon reasonable anticipated future use of each exposure area as outlined in the BHHRA. The approach for developing and applying the PRGs referenced below is discussed in the next subsection.

Solid Media

- Prevent ingestion, direct contact, and inhalation of contaminated soils and sediments that would result in unacceptable risk [cancer risk of 1E-05 or a target hazard quotient (HQ) of 1 or greater] from PAHs[1] assuming reasonably anticipated future land uses.

  1 Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-c,d)pyrene

- Reduce migration of arsenic, cyanide, and fluoride from contaminated soils and wastes that results in exceedances of Montana DEQ-7 standards in groundwater.

- Reduce migration of metals[2], cyanide, fluoride, and PAHs[3] from contaminated soils, sediments, and wastes that results in exceedances of Montana DEQ-7 aquatic life criteria in surface water and porewater.

  2 Aluminum, arsenic, barium, cadmium, copper, iron, lead, mercury, thallium, and zinc

  3 Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, chrysene, fluoranthene, and indeno(1,2,3-C,D)pyrene

- Reduce ingestion of and direct contact with metals[4] and LMW/HMW PAHs[1] from contaminated surficial and shallow soils that would result in LOEC- or LOAEL-based HQs greater than 1 for terrestrial and transitional ecological receptors.

  4 Barium, copper, nickel, selenium, thallium, vanadium, and zinc

- Reduce ingestion of and direct contact with metals[5], cyanide, and LMW/HMW PAHs from contaminated surficial and shallow soils and sediments that would result in LOEC- or LOAEL-based HQs greater than 1 for aquatic and semi-aquatic ecological receptors.

  5 Barium, cadmium, lead, nickel, selenium, vanadium, and zinc

Groundwater

- Reduce cyanide, fluoride, and arsenic concentrations in groundwater within the upper hydrogeologic unit to levels below Montana DEQ-7 standards, prevent further degradation of groundwater that exceeds Montana DEQ-7 standards (i.e., ensure no actions are taken that could increase

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1 Low molecular weight (LMW) PAHs include acenaphthene, acenaphthylene, anthracene, fluoranthene, fluorene, naphthalene, phenanthrene, and/or 2-methylnaphthalene. High molecular weight (HMW) PAHs include 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-cd)pyrene, and/or pyrene.

concentrations of COCs within the contaminant plume), and prevent expansion of the contaminant plume into groundwater that meets Montana DEQ-7 standards.

- Prevent ingestion of or direct contact with groundwater contaminated with arsenic, cyanide, and fluoride in excess of Montana DEQ-7 standards.
- Reduce migration of cyanide in groundwater that results in exceedances of Montana DEQ-7 aquatic life criteria in surface water and porewater.

Surface Water

- Restore metals[6], cyanide, fluoride, and PAH[7] concentrations in River Area DU surface water to the aquatic life criteria identified in Montana DEQ-7 as applied to State of Montana B-1 class waters.

6 Aluminum, arsenic, barium, copper, iron, lead, mercury, and thallium

7 Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-C,D)pyrene

C. Preliminary Remediation Goals

PRGs are target concentrations to be used in the development, evaluation, and selection of remedial alternatives. Ideally, a remedy that achieves PRGs will both comply with ARARs and reduce risk to levels that satisfy the NCP requirements for protection of public health and the environment (USEPA, 1991a). In general, human health PRGs are risk-based values such that, if not achieved, a cancer risk of 1E-05 or a target HQ of 1 or greater would result. Similarly, ecological PRGs are risk-based values such that, if not achieved, a lowest observed effect concentration (LOEC) or lowest observed adverse effect level (LOAEL)-based HQ greater than 1 would result for ecological receptors. In addition, chemical-specific ARARs were also identified as PRGs where appropriate (i.e., groundwater, surface water, and sediment porewater). The PRGs as presented in the FSWP are provided by DU in Sections 3.3.1 through 3.3.6 of the FS Report. See Section 3.3 of the FS Report for discussion pertaining to the application of PRGs.

V. Identification and Screening of Technologies

In accordance with the USEPA RI/FS Guidance (USEPA, 1988), technologies and process options were identified and screened for each general response action (GRA) described below.

GRAs are initial broad response actions considered during technology screening to address the RAOs for the contaminated media identified at the Site. GRAs may include one or more of the following:

- No Action;
- Access Restrictions, including institutional controls (ICs) and engineering controls (ECs);
- Treatment in place, including Monitored Natural Attenuation (MNA) processes;
- Treatment following excavation or groundwater extraction, with treatment performed at an onsite treatment unit;
- Containment; and
- Removal/ Collection and Disposal.

The FS considered the state of technology development, Site conditions, characteristics and distribution of impacted media, and specific COCs that could limit the effectiveness or implementability of a technology in evaluating a broad range of technologies and process options with a focus on implementable treatment technologies.

The technology screening qualitatively assesses each technology's ability to achieve the RAOs using the CERCLA criteria of effectiveness, implementability, and cost as defined in the NCP (40 CFR 300.430(e)(7)). Technologies that are not viable based on these considerations were eliminated from further consideration.

VI. Development of Remedial Action Alternatives

Technologies and process options that were not screened out were assembled to formulate a range of remedial action alternatives for each DU. Since the Landfills DU1 waste management units are sources of groundwater contamination in the Groundwater DU, these two decision units and their remedies strongly impact each other. For example, an alternative that implements a containment response action for the West Landfill and the Wet Scrubber Sludge Pond area which is the primary source of cyanide and fluoride in groundwater addresses both the Landfills DU1 and the Groundwater DU. As such, the alternatives for these two decisions units have been assembled jointly to provide an appropriate range of remedial action alternatives for detailed evaluation. The FS identifies the need for pre-design activities as appropriate.

1. Landfills DU1 and Groundwater DU Joint Alternatives

The following twelve alternatives (LDU1/GW-1 through LDU1/GW-6) were assembled for the combined Landfills DU1 and Groundwater DU. Except for the "No Action" Alternative, all but one of the alternatives include one or all of the following technologies: improved landfill caps, isolation using a slurry wall and groundwater extraction. Some of the alternatives also include a permeable reactive barrier and one alternative includes excavation.

For all alternatives excluding the "No Action" Alternative (LDU1/GW-1) and the Excavation Alternative (LDU1/GW-6), the Landfills DU1 waste management units would be subject to ICs and ECs to prevent exposure to human and ecological receptors. For all alternatives excluding the No Action Alternative (LDU1/GW-1), Site groundwater would be subject to ICs to prevent or minimize human exposure to impacted groundwater at the Site until groundwater PRGs are achieved, including ARARs.

Alternative LDU1/GW-1: No Action

Alternative LDU1/GW-2: Containment via Capping and Monitored Natural Attenuation

Alternative LDU1/GW-3A: Containment via Capping and Upgradient Slurry Wall

Alternative LDU1/GW-3B: Containment via Capping and Upgradient Slurry Wall with Downgradient Permeable Reactive Barrier (PRB)

Alternative LDU1/GW-3C: Containment via Capping and Upgradient Slurry Wall with Downgradient Extraction

Alternative LDU1/GW-4A: Containment via Capping and Fully-Encompassing Slurry Wall

Alternative LDU1/GW-4B: Containment via Capping and Fully-Encompassing Slurry Wall, with Downgradient PRB

Alternative LDU1/GW-4C: Containment via Capping and Fully-Encompassing Slurry Wall with Downgradient Extraction

Alternative LDU1/GW-5A: Containment via Capping and Hydraulic Control at the Source Area

Alternative LDU1/GW-5B: Containment via Capping and Downgradient Hydraulic Control

Alternative LDU1/GW-5C: Containment via Capping and Hydraulic Control at the Source Area and Downgradient

Alternative LDU1/GW-6: Excavation with Onsite Consolidation

2. Landfills DU2 Alternatives

The following two alternatives (LDU2-1 and LDU2-2) were assembled for the Landfills DU2.

Alternative LDU2-1: No Action

Alternative LDU2-2: Containment Capping

3. Soil DU Alternatives

The following four alternatives (SO-1 through SO-4) were assembled for the Soil DU. For all active alternatives, the Soil DU would be subject to a Commercial Use designation for the entire footprint of the DU to reflect the assumptions made in the risk assessments. Another common element for all Soil DU Alternatives, excluding the No Action Alternative, is excavation of the top two feet of soil within the Former Drum Storage Area (included as a hotspot excavation within the active alternatives below). For the alternative selected for implementation, the actual extent of containment, treatment, or excavation would be further delineated during remedial design via further soil sampling.

Alternative SO-1: No Action

Alternative SO-2: Covers with Hotspot Excavation

Alternative SO-3: Phytoremediation in place with Hotspot Excavation

Alternative SO-4: Excavation with Onsite Consolidation

4. North Percolation Pond DU Alternatives

The following four alternatives (NPP-1 through NPP-4) were assembled for the North Percolation Pond DU. For all active alternatives, the North Percolation Pond DU would be subject to a Commercial Use designation for the entire footprint of the DU to reflect the assumptions made in the risk assessments. For each alternative comprising an excavation component, the actual depth of excavation will be determined during design or remediation using confirmatory sampling.

Alternative NPP-1: No Action

Alternative NPP-2: Limited Excavation with Covers

Alternative NPP-3: Excavation with Cover

Alternative NPP-4: Excavation with Onsite Consolidation

5. River Area DU Alternatives

The following two alternatives (RADU-1 and RADU-2) were assembled for the River Area DU.

Excavation and onsite consolidation activities were completed as a part of the Removal Action at the South Percolation Ponds (“Removal Action”) in accordance with the requirements of the Administrative Order on Consent effective July 21, 2020. The potential risk attributed to cyanide in sediment, sediment porewater, and surface water within the River Area DU will be mitigated by addressing groundwater inputs to benthic habitats and demonstrating reductions over time to total cyanide concentrations in surface water and free

cyanide concentrations in porewater in those areas. Groundwater is addressed within the Landfills DU1 and Groundwater DU joint alternatives.

Alternative RADU-1: No Further Action

Alternative RADU-2: Excavation with Onsite Consolidation and Long-Term Monitoring

VII. Detailed Evaluation of Remedial Action Alternatives

Remedial alternatives must address threats to human health and the environment posed by the various contaminated media at the Site and meet the RAOs. To facilitate the selection of remedial actions for implementation at the Site, each alternative is evaluated in detail in the FS against seven of the nine CERCLA evaluation criteria.

Summary of Evaluation Criteria

Evaluation Criteria		
Effectiveness	1	Overall protection of human health and the environment
	2	Compliance with ARARs
	3	Long-term effectiveness and permanence
	4	Reduction of toxicity, mobility, or volume
	5	Short-term effectiveness
Implementability	6	Implementability
Cost	7	Cost

The first two criteria are “threshold” criteria that must be met for an alternative to be considered for implementation. Alternatives that satisfy the threshold criteria are evaluated further using the five “balancing” criteria to make comparisons and to identify the major trade-offs between the remedial alternatives. The remaining two criteria (not listed in the above table) are state acceptance and community acceptance. These are “modifying” criteria and will be assessed by USEPA prior to their selection of the remedy.

VIII. Comparative Analysis of Remedial Action Alternatives

The final step of the FS is to perform a comparative analysis of the remedial action alternatives. The comparative analysis uses the same criteria above for the detailed evaluation but focuses on identifying the advantages and disadvantages of each remedial action alternative relative to one another. The results of the comparative evaluation were summarized for each DU using the scoring system described in Section 7 of the FS Report to rank how well each remedial alternative satisfies each of the evaluation criteria. The remedial alternative that scored the highest across all the criteria for each DU was identified as the highest-ranked remedial action alternative for that DU.

The highest-ranked remedial action alternatives for each DU were then assembled into a comprehensive, Site-wide remedial action alternative that is depicted in Figure ES-6.

A. Description of the Highest-Ranked Site-Wide Remedial Action Alternative

The comprehensive highest-ranked Site-wide alternative is comprised of a suite of response actions to address identified COC-impacted material resulting in exceedances of PRGs and ARARs at the Site; provide source control of waste and impacted material contributing to groundwater contamination; and, to the extent practicable, consolidate impacted soil/sediment remaining onsite. Implemented together, these response actions which comprise the highest-ranked remedial action alternatives for each DU would form an effective Site-wide remedy if chosen by USEPA in the ROD.

In addition, the Site-wide remedial action alternative incorporates components from the alternatives determined to best satisfy the balancing criteria for each DU. Those alternatives and their primary elements are:

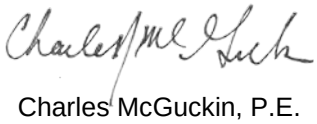
- Alternative LDU1/GW-4A: Containment via Capping and Fully-Encompassing Slurry Wall
    - Containment of source area waste management units via capping, including maintenance of the existing West Landfill cap and construction of low-permeability caps on the Wet Scrubber Sludge Pond and Center Landfill;
    - Construction of a slurry wall fully encompassing the West Landfill and Wet Scrubber Sludge Pond keyed into the top of the low-permeability glacial till unit that typically occurs between 100 and 125 ft-bls near Landfills DU1;
    - Monitored natural attenuation including analysis of groundwater COCs (i.e., cyanide, fluoride, and arsenic) and geochemical indicator parameters to identify and assess performance of the active MNA processes; and
    - Establish necessary and appropriate ICs and ECs including deed restrictions for the Landfills DU1 waste management units.
- Alternative LDU2-2: Containment via Capping
    - Maintaining the existing caps on the East Landfill and Sanitary Landfill;
    - Containment of the Industrial Landfill via capping by constructing a low-permeability cap;
    - Improving the existing soil covers at the Asbestos Landfills; and
    - Establish necessary and appropriate ICs and ECs including deed restrictions for the Landfills DU2 waste management units.
- Alternative SO-4: Excavation with Onsite Consolidation
    - Excavate approximately 32,500 cubic yards (CY) of impacted soil from the Soil DU with disposal at an onsite repository; and
    - Establish land use restrictions for the DU to allow for commercial or industrial use, only.
- Alternative NPP-4: Excavation with Onsite Consolidation
    - Excavate approximately 35,180 CY of impacted material from the North-East Percolation Pond, North-West Percolation Pond, influent ditch, and effluent ditch;
    - Consolidate excavated materials at an onsite repository with physical solidification as needed;
    - Establish land use restrictions for the DU to allow for commercial or industrial use, only; and
    - Decommission stormwater influent pipes.
- Alternative RADU-2: Long-Term Monitoring of Surface Water and Sediment Porewater
    - Implementation of the Removal Action at the South Percolation Ponds, including decommissioning the influent pipe from which stormwater enters the South Percolation Pond

system and excavating approximately 22,000 CY of impacted sediment from the South Percolation Ponds with disposal at an existing onsite repository; and

- Comprehensive long-term monitoring of cyanide in the River Area DU surface water and sediment porewater.

Respectfully submitted,

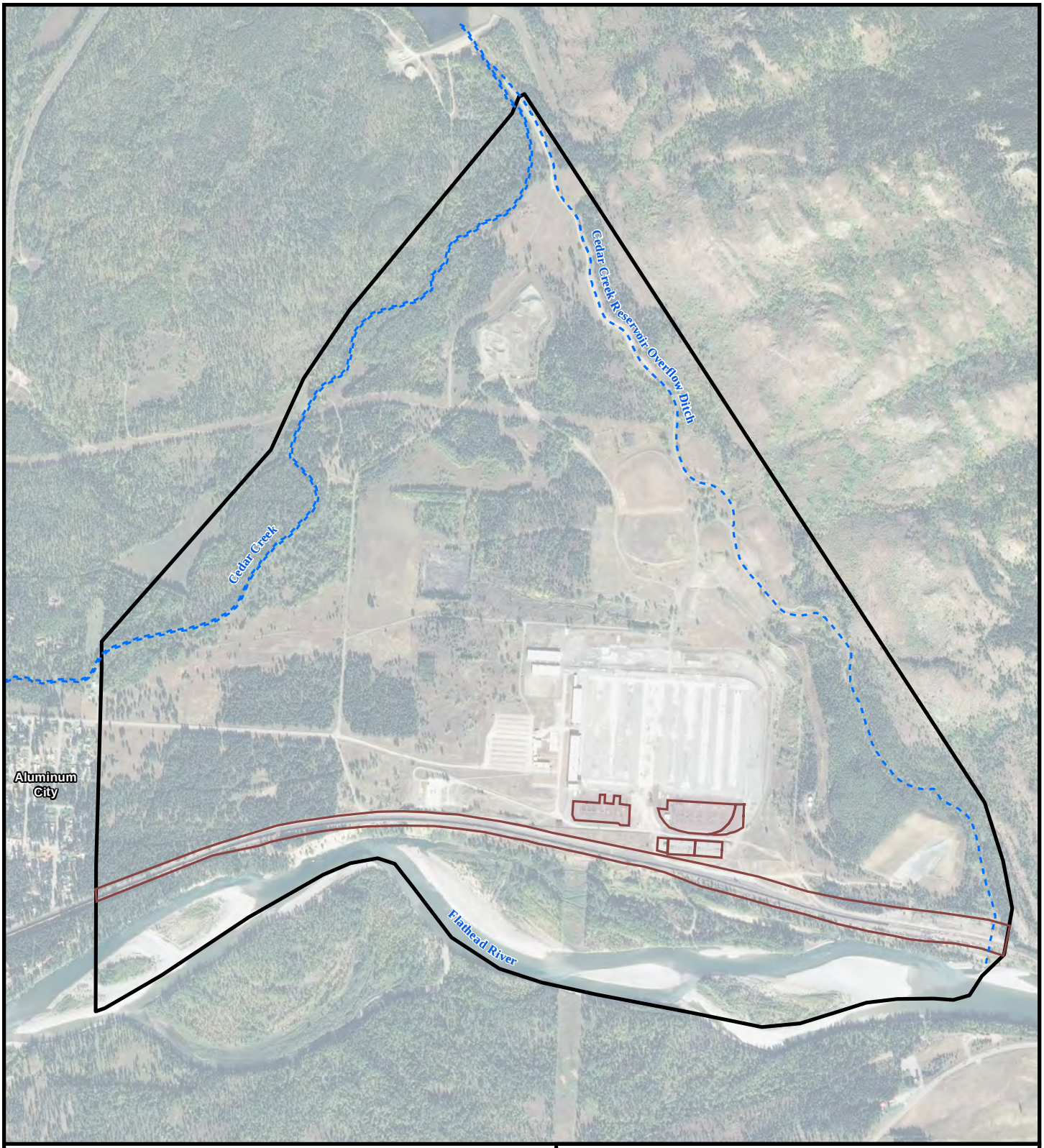
ROUX ENVIRONMENTAL ENGINEERING AND GEOLOGY, D.P.C.



Charles McGuckin, P.E.
FS Manager /
Principal Engineer /
Vice President

Andrew Baris, P.G. (NY)
RI/FS Manager /
Principal Hydrogeologist /
Executive Vice President

FIGURES



LEGEND

- CREEK FEATURES
- APPROXIMATE THIRD PARTY PROPERTY BOUNDARIES
- SITE BOUNDARY

N

1,500 0 1,500'

Title:

RI/FS SITE BOUNDARY

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

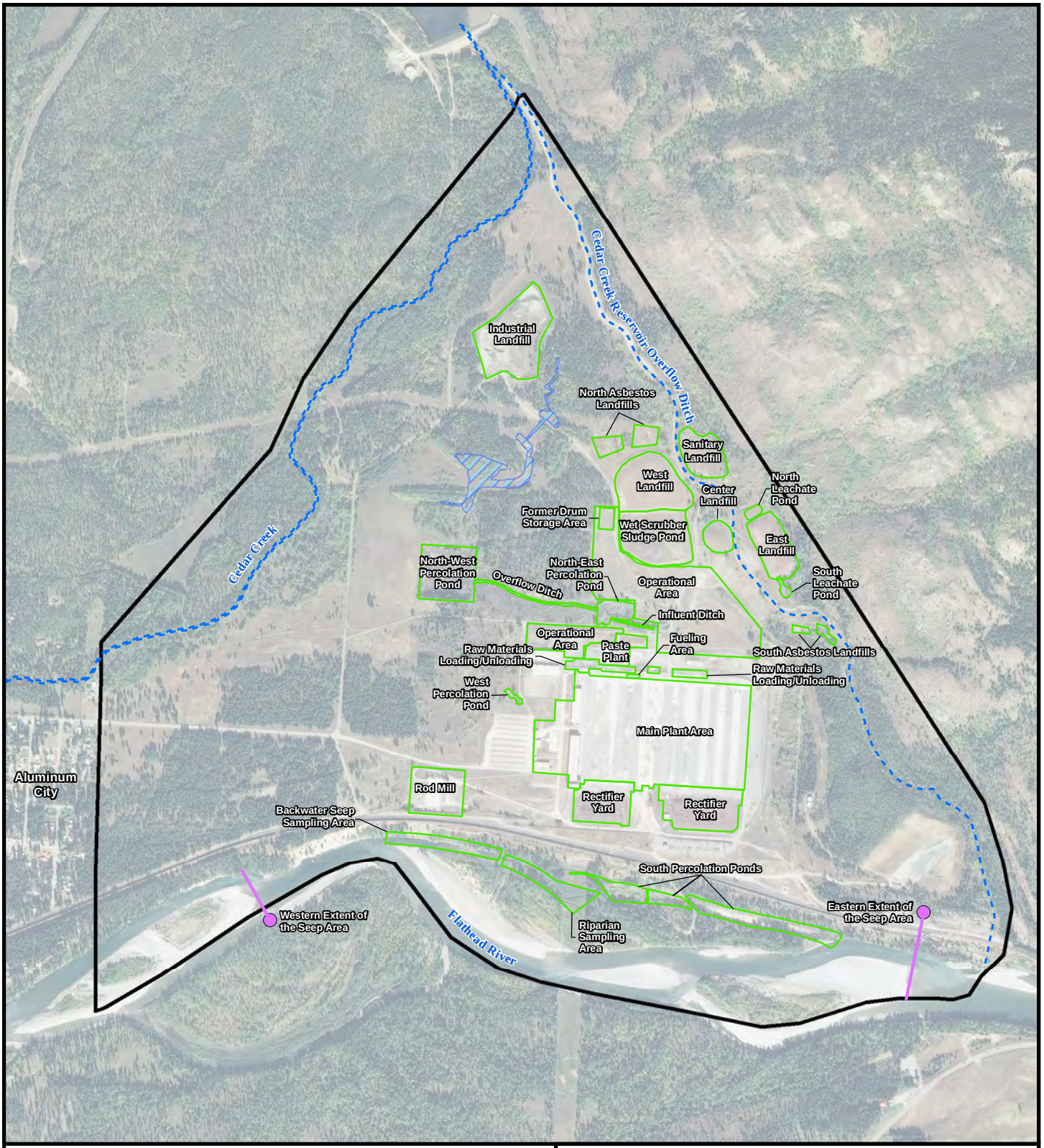
Prepared for:

COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX

Compiled by: MB.L.	Date: 11/04/22	FIGURE
Prepared by: E.W.C.	Scale: AS SHOWN	
Project Mgr: C.S.	Project: 2476.0001Y014	ES-1
File: 2476.0001Y304.ES1.mxd		

V:\GIS\PROJECTS\2476\Y0001Y\304\RESIZED\2476.0001Y304.ES1.MXD



LEGEND

- MARKER IDENTIFYING THE EXTENT OF THE SEEP AREA AS DEFINED IN THE FORMER MPDES PERMIT (#MT00300066)
- SITE FEATURES
- CREEK FEATURES
- NORTHERN SURFACE WATER FEATURE EXTENT
- SITE BOUNDARY

N

1,500 0 1,500'

Title:

SITE FEATURES

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared for:

COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX

Compiled by: MB.L.	Date: 11/04/22	FIGURE
Prepared by: E.W.C.	Scale: AS SHOWN	
Project Mgr: C.S.	Project: 2476.0001Y014	ES-2
File: 2476.0001Y304.ES2.mxd		

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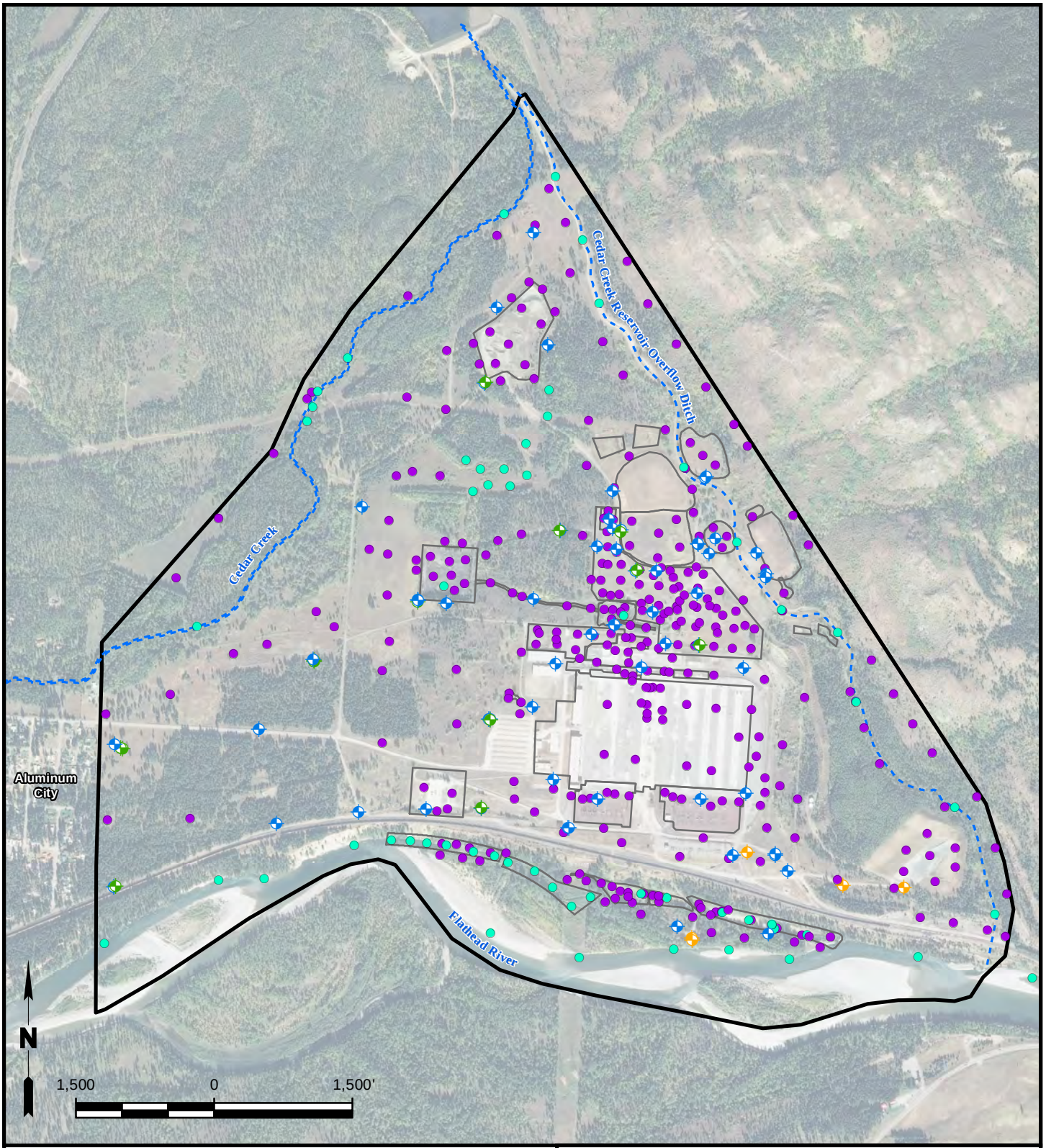

LEGEND

- FORMER PRODUCTION WELL LOCATION
- MONITORING WELL LOCATION SCREENED BELOW UPPPER HYDROGEOLOGIC UNIT
- MONITORING WELL LOCATION SCREENED IN UPPER HYDROGEOLOGIC UNIT
- SOIL BORING LOCATION
- SURFACE WATER SAMPLE LOCATION
- SITE FEATURES
- CREEK FEATURES
- SITE BOUNDARY

Title:

REMEDIAL INVESTIGATION SAMPLING LOCATIONS

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared for:

COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX

Compiled by: MB.L.	Date: 11/04/22	FIGURE
Prepared by: E.W.C.	Scale: AS SHOWN	
Project Mgr: C.S.	Project: 2476.0001Y014	ES-3
File: 2476.0001Y304.ES3.mxd		

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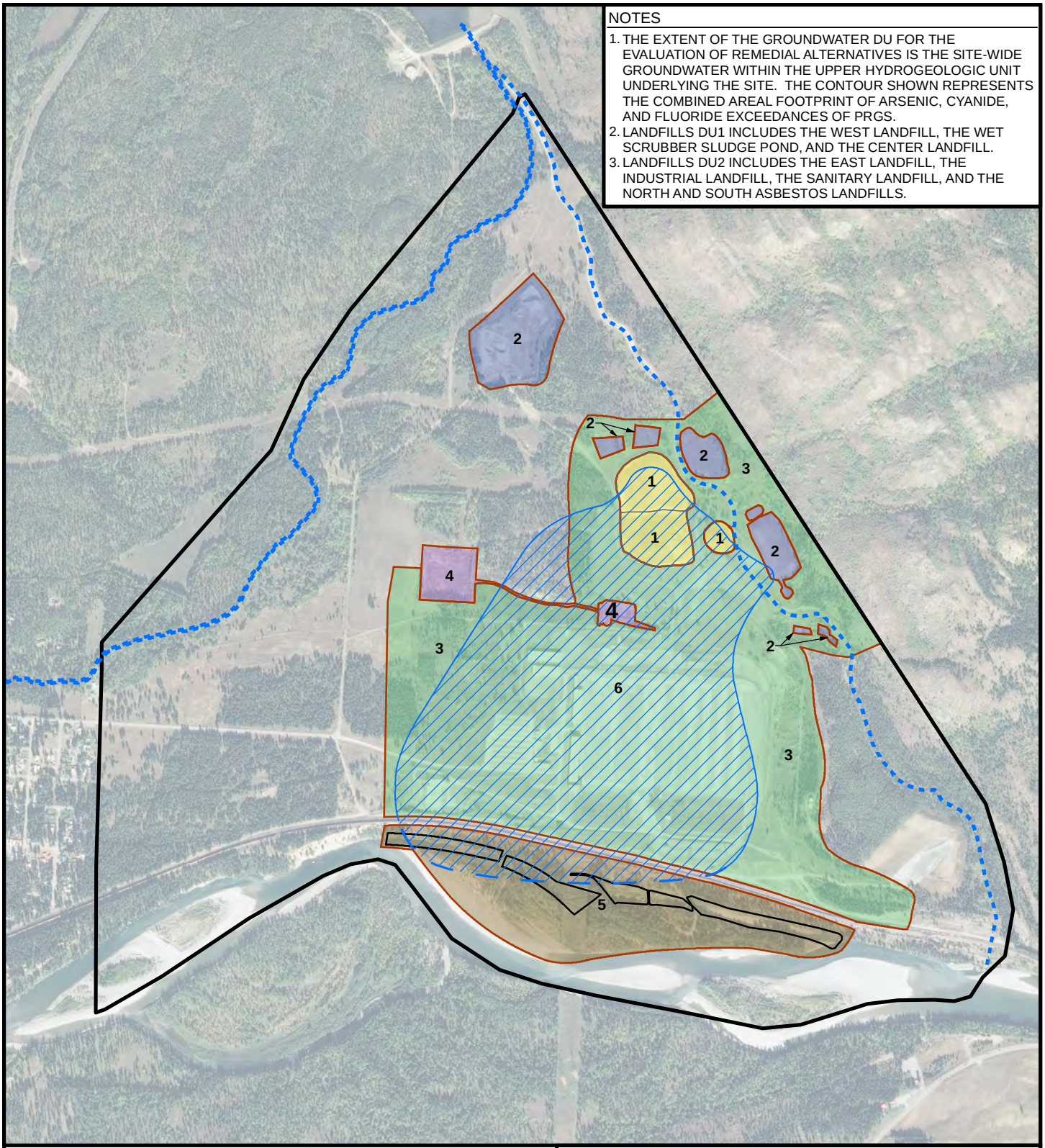

NOTES

1. THE EXTENT OF THE GROUNDWATER DU FOR THE EVALUATION OF REMEDIAL ALTERNATIVES IS THE SITE-WIDE GROUNDWATER WITHIN THE UPPER HYDROGEOLOGIC UNIT UNDERLYING THE SITE. THE CONTOUR SHOWN REPRESENTS THE COMBINED AREAL FOOTPRINT OF ARSENIC, CYANIDE, AND FLUORIDE EXCEEDANCES OF PRGS.
2. LANDFILLS DU1 INCLUDES THE WEST LANDFILL, THE WET SCRUBBER SLUDGE POND, AND THE CENTER LANDFILL.
3. LANDFILLS DU2 INCLUDES THE EAST LANDFILL, THE INDUSTRIAL LANDFILL, THE SANITARY LANDFILL, AND THE NORTH AND SOUTH ASBESTOS LANDFILLS.

LEGEND

- CREEK FEATURES
- 1 LANDFILLS DECISION UNIT1
- 2 LANDFILLS DECISION UNIT2
- 3 SOIL DECISION UNIT
- 4 NORTH PERCOLATION POND DECISION UNIT
- 5 RIVER AREA DECISION UNIT
- 6 GROUNDWATER DECISION UNIT
- SITE FEATURES WITHIN RIVER AREA DU
- SITE BOUNDARY

N

1,500 0 1,500'

Title:

DECISION UNITS

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared for:

COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX

Compiled by: MB.L.	Date: 11/04/22	FIGURE
Prepared by: E.W.C.	Scale: AS SHOWN	
Project Mgr: C.S.	Project: 2476.0001Y014	ES-4
File: 2476.0001Y304.ES4.mxd		

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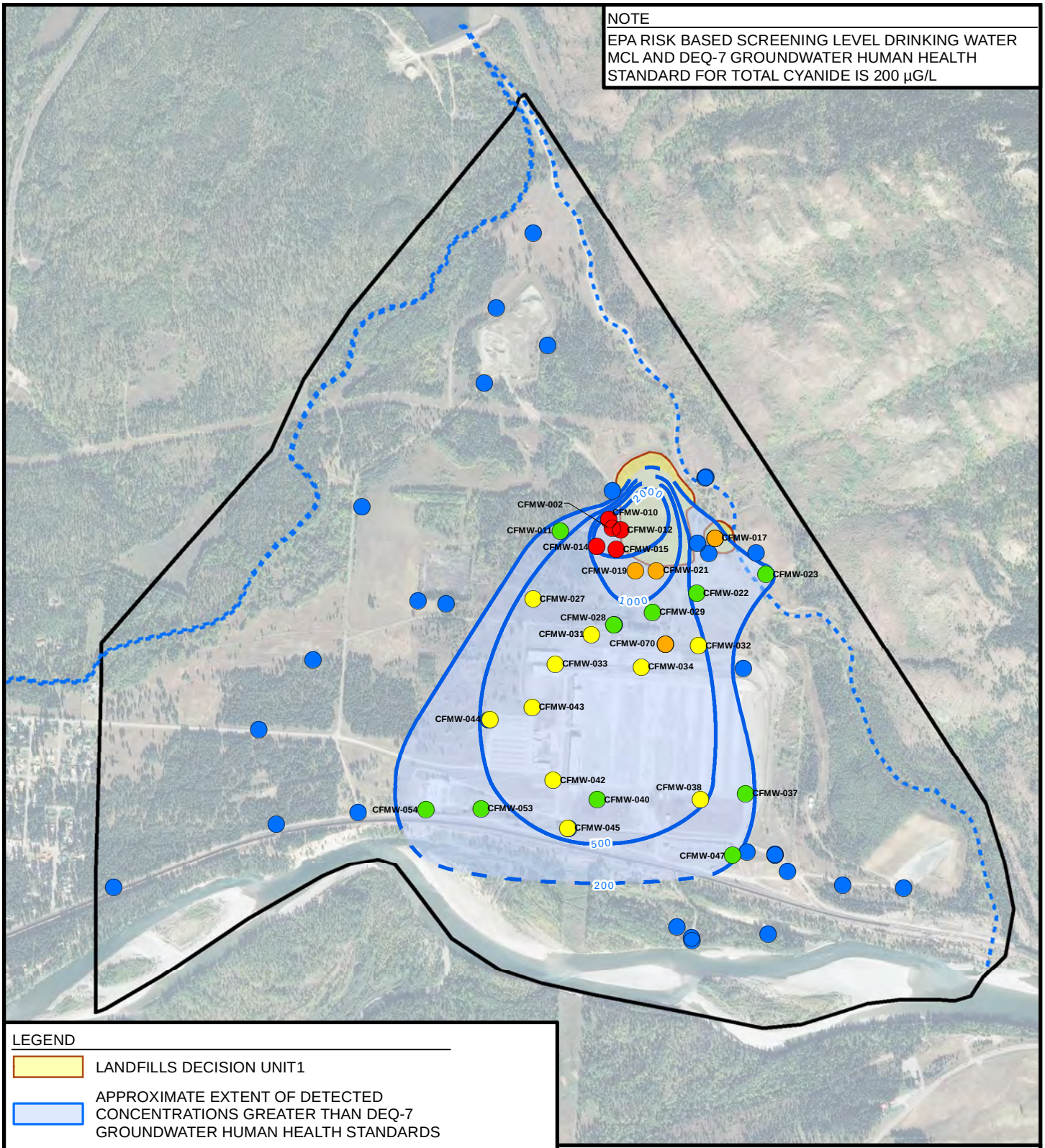

LEGEND

- LANDFILLS DECISION UNIT1
- APPROXIMATE EXTENT OF DETECTED CONCENTRATIONS GREATER THAN DEQ-7 GROUNDWATER HUMAN HEALTH STANDARDS
- 200 APPROXIMATE EXTENT OF DENOTED CONCENTRATION (DASHED WHERE INFERRED)
- CREEK FEATURES
- SITE BOUNDARY

CONCENTRATION LEGEND

- <200
- 200 - 500
- 500 - 1,000
- 1,000 - 2,000
- >2,000

1,500 0 1,500'

N

Title:

CONCENTRATIONS OF TOTAL CYANIDE IN UPPER HYDROGEOLOGIC UNIT

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared for:

COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX

Compiled by: MB.L.	Date: 11/04/22
Prepared by: E.W.C.	Scale: AS SHOWN
Project Mgr: C.S.	Project: 2476.0001Y014
File: 2476.0001Y304.ES5.mxd	

FIGURE
ES-5

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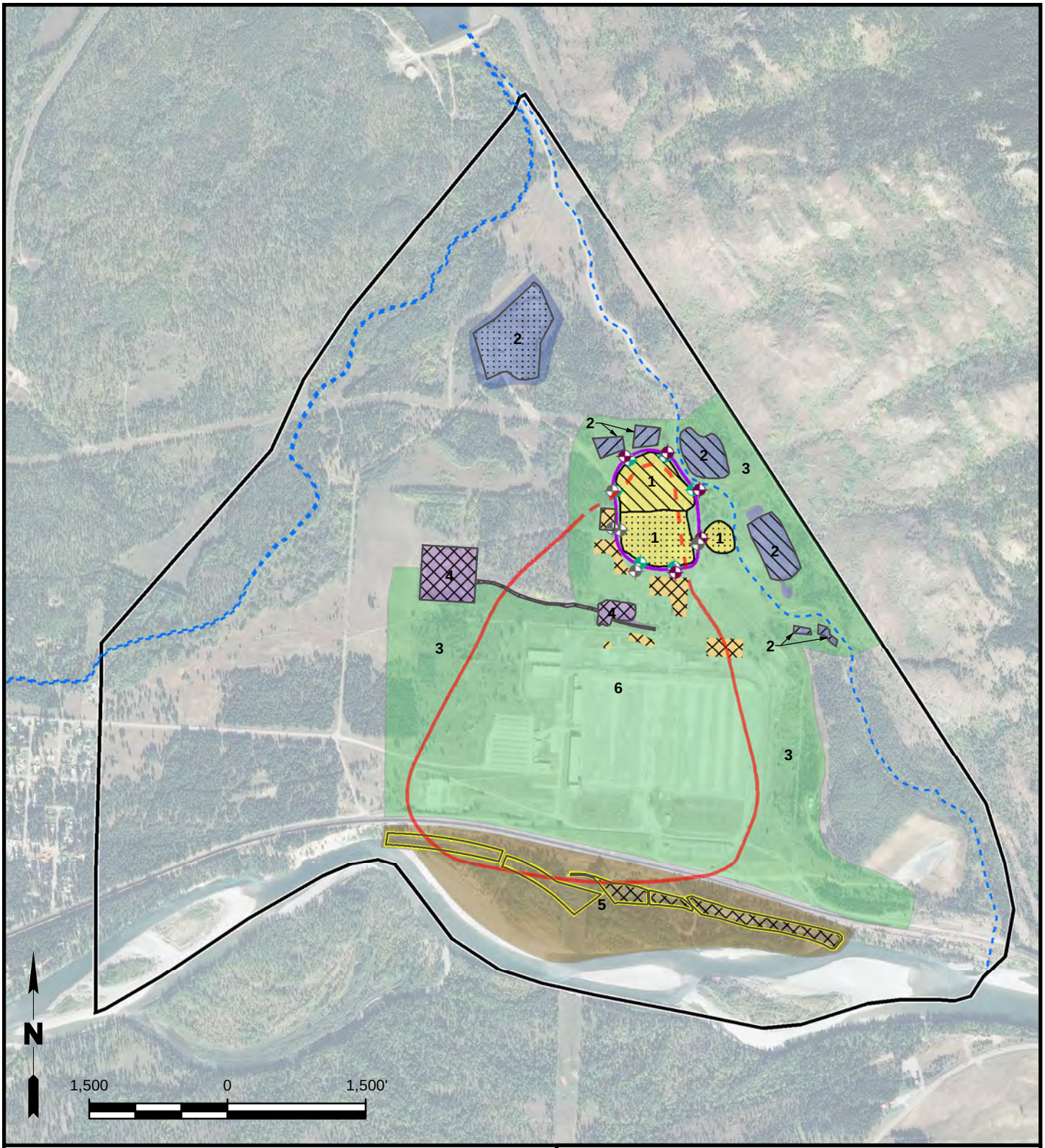

LEGEND - LANDFILLS DECISION UNIT 1/GROUNDWATER DU

- LANDFILLS DECISION UNIT 1
- LOCATION OF PROPOSED PIEZOMETER PAIRS - INSIDE MONITORING WELL
- LOCATION OF PROPOSED PIEZOMETER PAIRS - OUTSIDE MONITORING WELL
- LOCATION OF EXISTING MONITORING WELL
- PROPOSED SLURRY WALL
- EXTENT OF TOTAL CYANIDE EXCEEDING 200 UG/L IN OCTOBER 2018 (DASHED WHERE INFERRED)
- MAINTAIN EXISTING LOW PERMEABILITY CAP ON WEST LANDFILL
- CONSTRUCT NEW LOW PERMEABILITY CAPS ON WET SCRUBBER SLUDGE POND AND CENTER LANDFILL

LEGEND - NORTH PERCOLATION POND DECISION UNIT

- NORTH PERCOLATION POND DECISION UNIT
- AREA OF PROPOSED EXCAVATION

LEGEND - LANDFILLS DECISION UNIT 2

- LANDFILLS DECISION UNIT 2
- MAINTAIN EXISTING CAPS AT EAST LANDFILL AND SANITARY LANDFILL
- INSTALL IMPERMEABLE MEMBRANE CAP OR GCL CAP AT THE INDUSTRIAL LANDFILL
- IMPROVE EXISTING SOIL COVERS AT ASBESTOS LANDFILLS

LEGEND - SOIL DECISION UNIT

- SOIL DECISION UNIT
- AREAS OF CONCERN
- AREA OF PROPOSED EXCAVATION

LEGEND - RIVER AREA DECISION UNIT

- RIVER AREA DECISION UNIT
- AREA OF EXCAVATION UNDER THE REMOVAL ACTION AT THE SOUTH PERCOLATION PONDS
- PROPOSED AREA OF LONG-TERM MONITORING OF SURFACE WATER AND SEDIMENT POREWATER

Title:

HIGHEST RANKED SITE-WIDE REMEDIAL ACTION ALTERNATIVE

2000 ALUMINUM DRIVE
COLUMBIA FALLS, MONTANA

Prepared for:

COLUMBIA FALLS ALUMINUM COMPANY, LLC

ROUX

Compiled by: MB.L.	Date: 11/04/22	FIGURE
Prepared by: E.W.C.	Scale: AS SHOWN	
Project Mgr: C.S.	Project: 2476.0001Y014	ES-6
File: 2476.0001Y304.ES6.mxd		

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