



U.S. Department of the Interior
Bureau of Land Management

Red Devil Mine

Proposed Plan

FINAL

February 2020



Mission

To sustain the health, diversity, and productivity of the public lands for the future use and enjoyment of present and future generations.

BLM/AK/PL-20/005+3720+A010

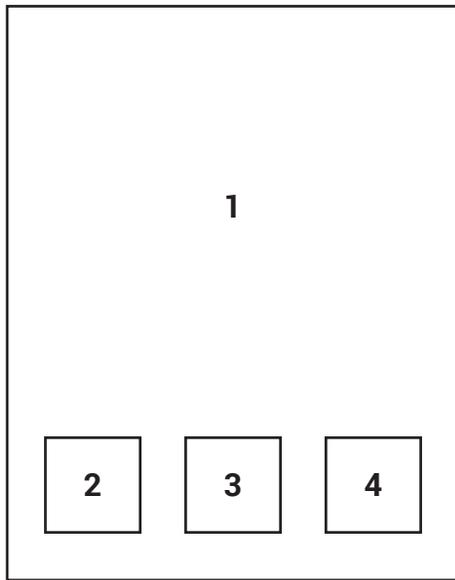


Photo Credits:

Photo 1: Red Devil Mine. BLM Photo

Photo 2: Recontouring mine tailings. BLM Photo

Photo 3: BLM contractors stream gaging. BLM Photo

Photo 4: BLM biologists electrofishing at Fuller Creek.
Matt Varner, BLM



Proposed Plan for the Red Devil Mine



Bureau of Land Management Department of the Interior

MARK YOUR CALENDARS

PUBLIC COMMENT PERIOD:

March 1 – April 30, 2020

The BLM will accept written comments on the Proposed Plan during the public comment period. Comments can be provided via email, regular mail, or fax to the following:

Email: blm_ak_reddevil@blm.gov

Mailing Address:

Mike McCrum
Red Devil Mine Project Manager
BLM – Alaska State Office
222 West 7th Avenue, #13
Anchorage, Alaska 99513

Fax: (907) 271-5479

To ask for an extension, send a request in writing to Mr. McCrum by April 30, 2020.

PUBLIC MEETINGS:

The BLM will hold public meetings in Kuskokwim River communities. Meeting dates, times, and locations are shown on the Red Devil Mine Community Involvement & Tribal Consultation web page. Use the link below to access the Red Devil web page: <https://www.blm.gov/alaska/red-devil-mine>.

Activate the Community Involvement link to see the community meeting schedule. If you have any questions regarding the public meetings, contact Maureen Clark, BLM Public Affairs Officer, at (907) 267-1420.

The Administrative Record for the Red Devil Mine can be viewed online at https://www.ak.blm.gov/red_devil_mine/Red_Devil_Mine_Admin_Record.html or:

BLM Public Room
222 West 7th Avenue, #13
Anchorage, Alaska 99513
Mon. through Fri., 8 am to 4 pm, AST

The BLM Announces Proposed Plan

This Proposed Plan summarizes the results of the Remedial Investigation (RI), Feasibility Study (FS), and related supplemental studies for the Red Devil Mine. The preferred alternative for the site-wide remediation of contaminated tailings, waste rock, soil, groundwater, and creek and river sediment at the Red Devil Mine (see Figure 1) was established based on the results of the RI/FS and supplemental studies. This Proposed Plan explains why that alternative is preferred.

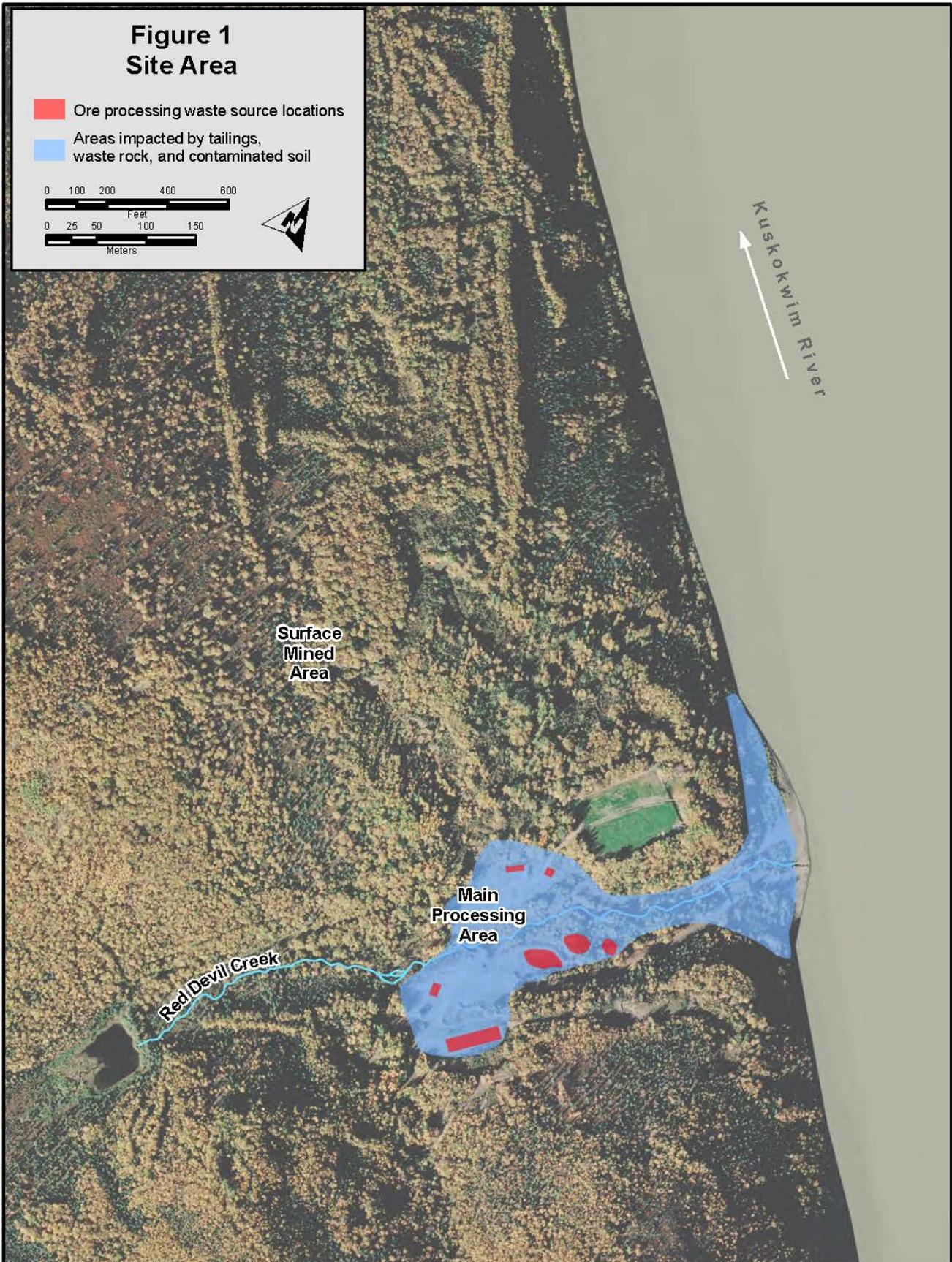
This document was prepared by the Bureau of Land Management (BLM), the lead agency for response activities on public land at the Red Devil Mine. The President has delegated Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) response action authority to the Department of the Interior (DOI) for any release or threatened release of a hazardous substance on or from land under DOI's jurisdiction, custody, or control. The Secretary of the Interior has further delegated this authority to the BLM for land under the BLM's jurisdiction. While the site is not on the CERCLA National Priorities List, the BLM has studied and intends to select a remedial action to respond to contamination at the Red Devil Mine under its delegated CERCLA authority, using the CERCLA process.

SECTIONS

Site Background.....	3
Site Characteristics	8
Scope and Role of the Response Action at the Red Devil Mine.....	9
Summary of Site Risks.....	9
Remedial Action Objectives	11
Summary of Remedial Alternatives	13
Evaluation of Alternatives.....	18
Summary of the Preferred Alternative.....	22
Community Participation	23

**Figure 1
Site Area**

- Ore processing waste source locations
- Areas impacted by tailings, waste rock, and contaminated soil



The BLM will select a cleanup remedy at the Red Devil Mine after reviewing and considering all information submitted during the 60-day public comment period. The BLM may modify the preferred alternative or select another remedial action based on new information or public comments. Therefore, the public is encouraged to review and comment on all of the alternatives presented in this Proposed Plan. The BLM has extended the normal 30-day comment period to accommodate the time and logistics necessary for the BLM to meet with interested stakeholders and communities in the vicinity of the site.

The BLM is issuing this Proposed Plan as part of its public participation responsibilities under Section 117(a) of CERCLA, 42 U.S. Code Section 9617(a), and Section 300.430(f)(3) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

This Proposed Plan summarizes information that can be found in the RI and FS reports and other documents contained in the Administrative Record for the Red Devil Mine. The Administrative Record can be accessed using the link provided in the text box on page 1. The BLM encourages the public to review these documents to gain a more comprehensive understanding of the Red Devil Mine and response activities that have been conducted at the site to date. This Proposed Plan summarizes the results of the investigation and analysis of alternatives for cleaning up tailings, waste rock, soil, groundwater, and sediment generally located in the area shown in Figure 1.

Site Background

Mining and Ore Processing History

The Red Devil Mine is located on BLM-managed land, near the village of Red Devil, in western Alaska. During its operational years, it was the largest mercury mine in Alaska and was one of several mercury mines operating in the Kuskokwim River region. See Figure 2 for locations of mine features.

Mercury ore was discovered in the Red Devil Creek drainage in 1933. By 1939, mercury ore was being mined from creek sediments and overburden. The highly mineralized ore zone contained naturally high levels of antimony and arsenic in addition to mercury. In the early 1940s, mining was conducted underground, with access to ore zones through two horizontal openings (adits) and a main shaft located on the northwest side of Red Devil Creek.

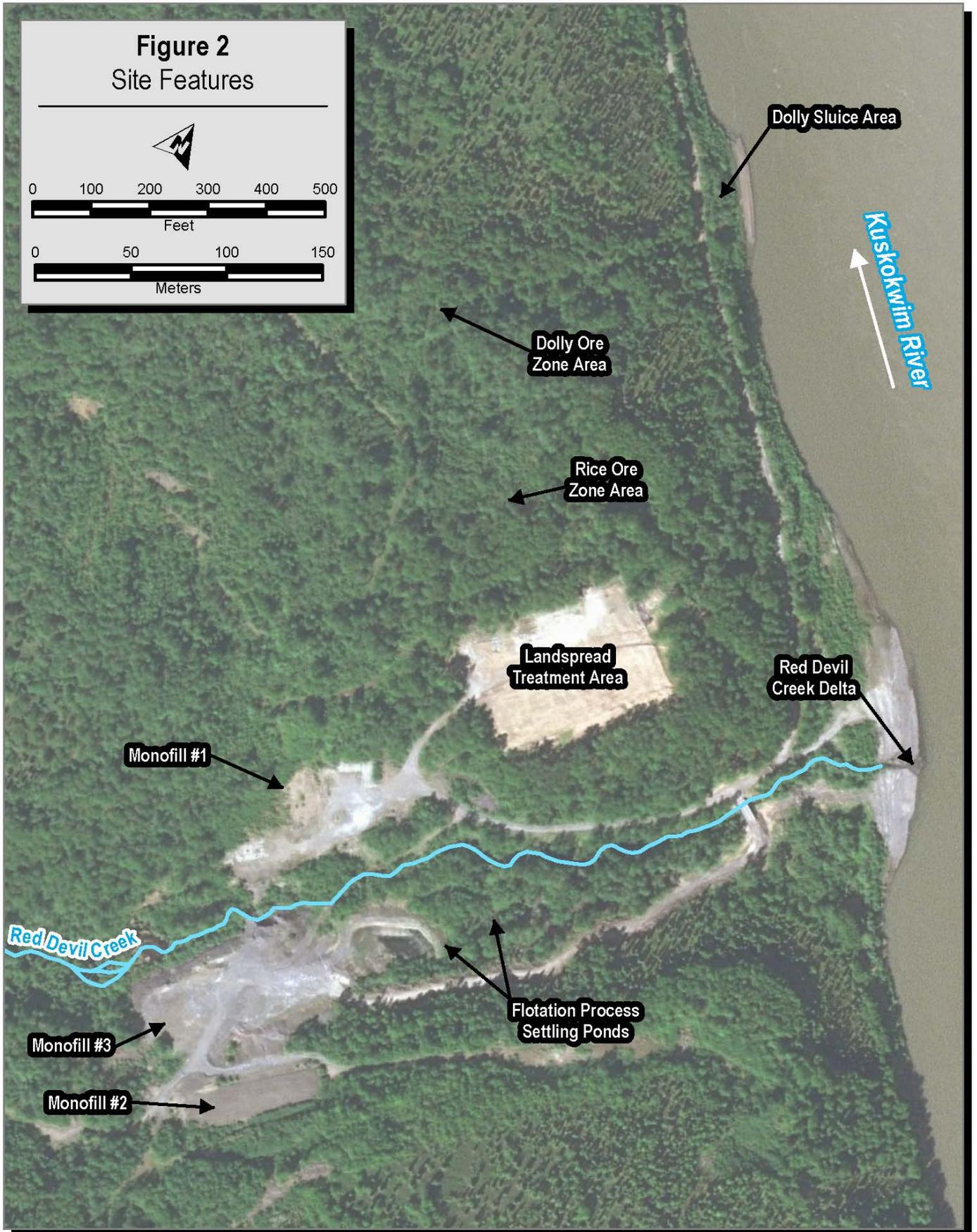
During this period, a 40-ton rotary kiln was installed at the site for thermal processing of the mercury. Burned ore, referred to as tailings, and waste rock were deposited outside of the rotary furnace building into the drainage channel of Red Devil Creek.

In October 1954, a fire destroyed a large portion of the mine surface structures and equipment. Following the 1954 fire, a more efficient modern mercury furnace was built on the southeast side of Red Devil Creek. Tailings and waste rock continued to be disposed of into the drainage channel of Red Devil Creek.

Extensive surface exploration and mining continued after 1956. Operations at this time included hydraulic sluicing, the washing of loose overburden through a sluice to recover ore. The waste material from the sluice operation was washed down a gully toward the Kuskokwim River. This resulted in the formation of the Dolly Sluice Area (Figure 2) delta on the Kuskokwim River at the base of the gully. Surface mining also included trenching, bulldozing, and pit excavations over the hillside northwest of the mine area.



1940s era retort building and miner.

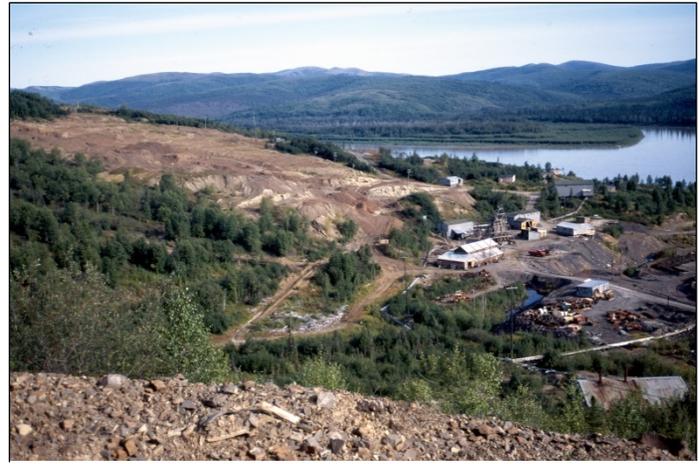


Cinnabar and stibnite concentrates were produced after 1969 using a flotation process. Tailings from the flotation unit were sluiced from the flotation mill into three settling ponds (Figure 2). The mine closed in June 1971 due to a drop in the price of mercury and then it was formally abandoned. There has not been any production at the mine since that time and the BLM was not able to locate a responsible party to assist with mine cleanup.

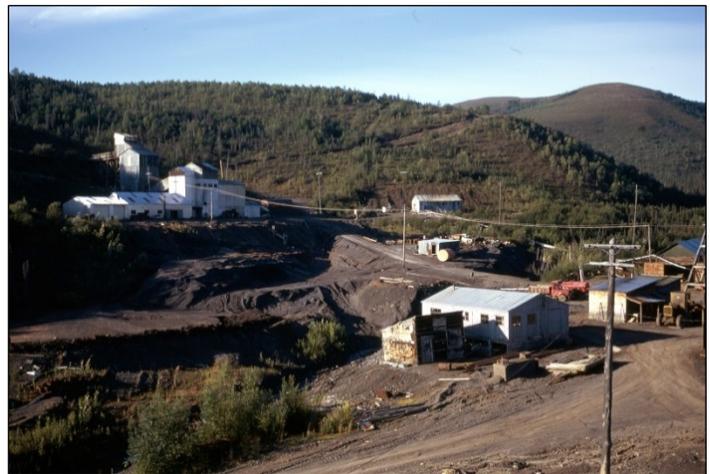
Previous Investigations and Response Actions

Environmental investigations and response actions have been conducted at the Red Devil Mine since the early 1970s. The most significant of these activities are summarized below.

Site investigations and sampling were conducted three times prior to 1990, and these investigations documented the presence of antimony, arsenic, and mercury in on-site tailings, soil, and surface water. Two waste removal actions were conducted at the site in 1999 and 2001. These removal actions involved the collection and off-site disposal of abandoned batteries; drums containing waste oil, solvents, and grease; and contaminated debris around the retort building. In addition, many of the site structures were demolished and mine shafts were plugged. In 2002, the BLM demolished all the remaining site structures and constructed two monofills at the site. Monofill #1 contains approximately 4,400 cubic yards of inert debris including wood, concrete, scrap metal, non-friable asbestos building materials, and 23 drained transformer casings. Monofill #2, a lined containment structure built over the foundation of the former retort building, contains 940 cubic yards of treated mercury- and arsenic-contaminated retort building debris and bricks. Monofill #2 is covered with contaminated tailings and soil.



Overview of the Red Devil Mine in 1971, with Surface Mined Area on left.



Post-1955 Retort Building and tailings waste dump in the 1970s.



Liner placement during construction of Monofill #2.

2004 Above Ground Storage Tank and Ore Hopper Demolition and Petroleum Release Investigation. The BLM demolished and disposed of five above ground fuel storage tanks and an ore hopper at the process building. The demolished materials were consolidated in Monofill #3 (Figure 2). Environmental sampling, including 12 soil borings, was conducted to characterize the above ground storage tank area, and the existing monitoring wells were sampled.

WHAT IS THE DIFFERENCE BETWEEN A LANDFILL, MONOFILL, AND REPOSITORY?

- A **landfill** is a place where refuse or other waste material is disposed of by burying it and covering it with soil, especially as a method of filling in or extending usable land.
- A **monofill** is a landfill that primarily receives only one type of waste.
- A **repository** is an engineered structure where large volumes of waste material are placed, usually above the natural land surface.

Soils investigations at the above ground storage tank area detected petroleum hydrocarbons above Alaska Department of Environmental Conservation (ADEC) cleanup levels in excavations and soil borings. These soils were later excavated and placed in a landspread treatment area near the Main Processing Area (Figure 2). Groundwater samples collected from the existing monitoring wells contained antimony, arsenic, and mercury at concentrations above ADEC cleanup levels.

2014 RI. In 2010, the BLM began a CERCLA RI at the site to characterize the nature and extent of

remaining contamination and to develop a long-term remedy. The tailings/waste rock were extensively investigated along with native soils, surface water, groundwater, creek and river sediments, and vegetation as part of the RI. Through analysis of 2011 RI data, it was determined that some data gaps had yet to be adequately addressed, and the overall RI effort was extended. Baseline monitoring data collected in 2012 were appended to the RI report. Data collected during the RI were used to define the site physical setting, the nature and extent of contamination, and the fate and transport of contaminants. The RI report does not fully address site impacts to groundwater and the Kuskokwim River. The RI results were used to assess risk to human health and the environment due to exposure to contaminated tailings/waste rock, soil, and Red Devil Creek sediments. *The RI report was finalized in 2013 with concurrence from ADEC and the U.S. Environmental Protection Agency (EPA).*

2012-present Baseline Groundwater and Surface Water Monitoring. The BLM is conducting baseline monitoring at the site to establish a statistical basis for comparing physical and chemical conditions prior to, during, and after completion of cleanup actions. Baseline monitoring data have been used to support the RI and Supplemental RI work at the site. A second round of baseline monitoring of groundwater and surface water was performed in the spring and fall of 2015. The 2015 baseline monitoring was performed in conjunction with additional groundwater characterization conducted as part of the RI Supplement. Results of the 2015 baseline monitoring are presented in the 2018 RI Supplement report. After the 2015 monitoring, the BLM performed further baseline monitoring in 2016, 2017, 2018 and 2019. The BLM plans to continue baseline monitoring in 2020. *The ADEC and EPA concur with the methods the BLM uses to perform baseline monitoring of groundwater and surface water.*

2014 Engineering Evaluation/Cost Analysis (EE/CA). Sediment sampling results from the 2014 RI indicated that mine tailings were migrating into the Kuskokwim River via Red Devil Creek. The BLM planned an “early action” for 2014 that was intended to prevent tailings from continuing to erode into Red Devil Creek and migrate to the Kuskokwim River. The EE/CA presents the RI data that demonstrate the need for the early action, the regulatory framework for the early action, and four alternatives considered for the project, including an early action alternatives analysis that yielded a preferred alternative. *The BLM planned and executed the early action on Red Devil Creek to prevent tailings from migrating into the Kuskokwim River with concurrence from the ADEC and EPA.*

2014 Early Action. The BLM, working with the U.S. Army Corps of Engineers, implemented the “early action” at the site in 2014. The primary objective of the early action was to reduce the transport of contaminated tailings and waste rock from the site into the Kuskokwim River. To accomplish this goal, the early action involved re-grading tailings to reduce erosion in steeply sloped areas of the Main Processing Area, stabilizing the creek channel sidewalls with rock-filled baskets (gabions), and installing a sediment trap downstream of the realigned portion of the creek channel. This action was not intended to clean up the creek, but rather to construct structures that would prevent additional erosion and transport of tailings before the final remedial action is implemented. This work was completed in July 2014.

2016 FS. Following completion of the 2014 RI, the BLM conducted an FS to address contaminated tailings/waste rock, soil, and Red Devil Creek sediments. It did not address remedies for groundwater or Kuskokwim River sediments because the need for, and extent of, cleanup of site groundwater and sediments in the Kuskokwim River had not yet been completely assessed. The FS report contains analysis of a variety of technologies to address contaminated tailings/waste rock, soil, and Red Devil Creek sediments documented in the RI, and assembles the technologies into four cleanup alternatives. *The EPA concurred with this document. The ADEC did not concur with this document at the time, however, its concerns have been subsequently resolved with the BLM.*

2018 RI Supplement and Human Health and Ecological Risk Assessment Supplement. An RI Supplement was conducted to address data gaps associated with soil, groundwater, and Kuskokwim River sediments that were identified as part of the development of site-wide remedial alternatives during the preparation of the FS. The RI Supplement also addressed changes in the groundwater and surface water monitoring network, and possible changes to the groundwater and surface water conditions at the Red Devil Mine stemming from implementation of the non-time-critical removal action performed by the BLM at the Red Devil Mine during the summer of 2014. In 2015, baseline monitoring was performed in conjunction with additional groundwater characterization conducted as part of the RI Supplement. Results of the 2015 baseline monitoring are presented in the RI Supplement report.

As part of the RI Supplement, a Human Health Risk Assessment (HHRA) Supplement was performed to address data gaps associated with Kuskokwim River sediments that were not addressed as part of the 2014 RI effort—specifically, to assess the risks and hazards from potential exposure to contaminants of potential concern through direct contact and incidental ingestion of sediment, and consumption of fish from the Middle Kuskokwim River region. In addition, a Baseline Ecological Risk Assessment (ERA) Supplement was performed to assess potential risks to aquatic-dependent receptors that use the Kuskokwim River near and downstream from the Red Devil Mine. *The ADEC approved this document, and the EPA concurred with this document.*

2019 Final Groundwater and Surface Water Report. In 2019, BLM prepared a report to provide a compilation of data and results of groundwater and surface water characterization and baseline monitoring performed by the BLM at the Red Devil Mine as part of the RI and subsequent efforts. The report also presents results of soil and bedrock characterization pertinent to groundwater and surface water characterization. Much of the information provided in this report has been presented previously in the RI and RI Supplement reports.

Subsequent to the RI Supplement, the BLM performed additional characterization of groundwater and tailings/waste rock at the Red Devil Mine. This report presents new results of the baseline groundwater and surface water monitoring performed in 2016 through 2018, as well as results of the additional characterization of groundwater and tailings/waste rock that was performed following the 2017 Groundwater and Tailings Characterization. The additional tailings/waste rock characterization generated additional information to assist with the design efforts associated with outlining the extent of excavation for tailings/waste rock and impacted soil from the Main Processing Area. The hydrogeologic characterization included detailed analysis of the proposed repository. *The ADEC approved this document. The EPA divested itself from the Red Devil CERCLA project before the 2019 FS Supplement was complete.*

2019 FS Supplement. In 2019, following the completion of the RI Supplement and 2017 Groundwater and Tailings Characterization, the BLM prepared an FS Supplement focused on groundwater and sediment in the Kuskokwim River. Selected results of the RI, RI Supplement, and additional characterization and baseline monitoring were used to support the development of the FS Supplement. The FS Supplement report contains analysis of a variety of technologies to address contaminated tailings/waste rock, soil, and Red Devil Creek sediments documented in the RI, and assembles the technologies into four cleanup alternatives. *The ADEC approved this document. The EPA divested itself from the Red Devil CERCLA project before the 2019 FS Supplement was complete; however, the EPA provided technical input on the overall concepts and draft versions of the document.*

2019 Refined Repository Hydrologic Analysis Technical Memo. In 2016, as a part of the FS and FS Supplement, the BLM prepared a hydrologic analysis of Remedial Alternatives 3a through 3d, which include construction of an on-site repository to consolidate tailings/waste rock and contaminated soil and sediments that would be excavated from the site. All four versions of Alternative 3 include an impermeable geomembrane cover system for the repository. The repository under Alternatives 3a and 3c does not include a bottom liner system. Under Alternatives 3a and 3c, it is assumed that a bottom liner for the repository would not be necessary because the cover system would be designed to provide adequate protection from water infiltration. The hydrologic analysis was performed in 2016 to evaluate the potential for infiltration and migration of leachate for a repository without a bottom liner. The hydrologic analysis was summarized in the Hydrologic Analysis, Red Devil Mine Site report, provided as Appendix A of the 2016 FS. Results indicated that concentrations of the primary contaminants of concern (COCs) in leachate would reach negligible levels at a depth in the unsaturated zone well above the water table.

Following the 2016 FS, the BLM collected additional data to support development of a more detailed understanding of the geologic and hydrogeologic conditions in the area of the proposed repository. The 2019 Refined Hydrologic Analysis Technical Memo incorporates appropriate results of additional post-FS characterization and is based on assumptions and model input parameters believed to be representative of a reasonably plausible future hydrologic scenario. The results of the refined analysis show that for all COCs, the concentrations in leachate decrease from the initial leachate concentrations to levels below State of Alaska drinking water criteria within the unsaturated zone at depths of less than 4 feet below the base of the repository. *The ADEC agreed with the analysis provided in this document. The EPA divested itself from the Red Devil CERCLA project before this document was complete; however, the EPA provided technical input on the overall concepts and draft versions of the document.*

Site Characteristics

The Red Devil Mine is located in the valley formed by Red Devil Creek, a tributary of the Kuskokwim River. The site is accessed from the nearby Red Devil village by an unpaved road. No buildings currently exist on the site.

The majority of the tailings and waste rock are situated in the approximately 12-acre Main Processing Area, located approximately 1,000 feet from the Kuskokwim River. Red Devil Creek flows through the middle of the Main Processing Area to the Kuskokwim River (see Figure 1). Red Devil Creek is a relatively small stream with flows ranging from less than 1 cubic feet per second (cfs) to approximately 16 cfs, depending on season and location. While it is classified by the Alaska Department of Fish and Game as an anadromous fish stream, Red Devil Creek does not support permanent populations of game or subsistence fish.

Tailings and waste rock extend from the Main Processing Area down the channel of Red Devil Creek and have formed a delta at the mouth of the creek on the shore of the Kuskokwim River. A total of approximately 220,000 cubic yards of tailings and waste rock are estimated to be present at the site, predominantly in the Main Processing Area. It is likely that some of these tailings and waste rock are commingled with petroleum-related contaminants from the former above ground fuel storage tanks and associated pipelines. In addition, underlying contaminated native soils and creek sediment are present.

To the northwest of the Main Processing Area is the area known as the Surface Mined Area, where surface exploration and mining and underground mining occurred. This area, currently heavily vegetated, contains exposed ore-bearing bedrock, old mine shafts (now closed), and several “sluiced” areas where water was used to remove unconsolidated overburden to expose bedrock for surface exploration and mining. Investigation results do not indicate that tailings are present in the Surface Mined Area.

Groundwater in the Main Processing Area contains COCs above State of Alaska cleanup levels. Groundwater in the Main Processing Area is impacted primarily by leaching of COCs from tailings and waste rock. Hydrogeologic investigations in the Surface Mined Area and other areas outside of the Main Processing Area suggest that naturally occurring mineralization substantially contributes to the elevated concentrations of COCs in groundwater throughout the site area.

Kuskokwim River sediments near the mouth of Red Devil Creek and in nearby downstream locations contain eroded tailings/waste rock materials that have migrated through Red Devil Creek into the river. The tailings particles that have settled in the river sediments have created localized areas of elevated COCs, mainly near the Red Devil Creek delta. Kuskokwim River sediment investigations determined, in general, that COC concentrations decrease with distance away from the river bank near the site and downstream of the delta.

WHAT ARE THE “CONTAMINANTS OF CONCERN” THAT POSE A RISK TO HUMAN HEALTH AND THE ENVIRONMENT?

COCs were identified as part of the risk assessments. The main risk drivers include antimony, arsenic, and mercury. In addition, it is likely that these CERCLA hazardous substances are locally commingled with petroleum fuels in the Main Processing Area. The BLM has identified arsenic as the contaminant that poses the greatest potential risk to human health and the environment at the Red Devil Mine site. Arsenic is a naturally occurring element, but through the mining and extraction process can become greatly concentrated. Inorganic arsenic, the most toxic form to people, was detected on site at concentrations up to 9,880 milligrams per kilogram (mg/kg) (0.98%) in soil and approximately 3,610 mg/kg (0.36%) in sediment. Arsenic has been shown to cause cancer. Because arsenic poses higher risks than other contaminants, and the extent of arsenic contamination encompasses the areas where other COCs exist, arsenic is the primary COC used for remedial planning purposes. The remedial alternatives being considered to address arsenic will also be effective in addressing the other COCs.

Scope and Role of the Response Action at the Red Devil Mine

The response actions presented in this Proposed Plan represent the plan for site-wide remediation at Red Devil Mine. By focusing active remedial work on the tailings and waste rock, the sediment bed of Red Devil Creek, and nearshore sediments in the Kuskokwim River, the BLM is prioritizing actions based on where the largest volume and highest concentration of contamination exists. These actions reduce exposure of humans and wildlife to antimony, arsenic, and mercury, as well as reducing the potential transport of contaminated materials into and through the Kuskokwim River.

Summary of Site Risks

As part of RI/FS activities at the site, the BLM completed assessments of human health and ecological risk based on the levels of contamination at the Red Devil Mine. A wide range of potential contaminants were included in initial studies of the

site. This list of potential contaminants was then narrowed through a screening process to determine the COCs. The COCs identified as part of the risk assessments include antimony, arsenic, mercury, and other metals. A series of other metals were identified as COCs, but antimony, arsenic, and mercury are of the greatest concern.

Human health and ecological risk assessments estimate the health risks to people and the environment from exposure to contaminants either now or in the future. “Risk” is the possible harm to people or wildlife from exposure to chemicals. Two types of health risks for people are evaluated: the risks that can cause cancer and the risks that can cause other health effects. Consistent with EPA guidance, the BLM evaluates only noncancer risks to wildlife.

The BLM uses the results of a risk assessment to determine whether the contamination at a site poses an unacceptable risk to human health or the environment under CERCLA. The CERCLA regulations give us a range of risk numbers to use in deciding if federal cleanup is necessary. EPA guidance establishes an “acceptable” extra cancer risk range, from 1 in 10,000 (1×10^{-4}) to 1 in 1,000,000 (1×10^{-6}) of developing cancer from exposure to site contaminants at a site over a person’s lifetime. ADEC guidance establishes a risk threshold of 1 in 100,000 (1×10^{-5}).

For noncancer health effects, a hazard quotient or hazard index for both humans and wildlife is calculated. A hazard index is the sum of the hazard quotient for several chemicals that have the same or similar effects. The noncancer hazard index has a threshold below which the BLM does not expect any noncancer health effects. If the hazard quotient or hazard index is 1 or higher, then exposure to site contaminants could be a risk to humans or wildlife’s health.

Human Health Risk Assessment

The HHRA used multiple types of information to help estimate human health risks related to the potential for exposure to COCs under a variety of scenarios for both adults and children at the Red Devil Mine site. This

information included estimates of risk using standard HHRA methods and modeling of risk, modeling of contaminant levels in wild foods, and bioavailability of arsenic in soil (the percentage of arsenic that could be absorbed by the body and affect health). The HHRA was conducted in accordance with EPA and Alaska State guidance.

To assess the potential risks to human health associated with COCs, the HHRA estimated potential risks under several exposure scenarios, based on land use in the vicinity of the Red Devil Mine site. These exposure scenarios include:

- Hypothetical future residents (both adult and child).
- Current/future recreational or subsistence users (both adult and child) that could visit the site.
- Future mine workers (adult).

It was assumed that all users participate in some form of subsistence activity, including fishing, hunting, and gathering wild foods near the Red Devil Mine site. It was assumed that potential users of the site would come in contact with surface water from Red Devil Creek, sediments from Red Devil Creek and the Kuskokwim River, and soil from around the site. It was also expected they would eat wild foods and breathe air potentially impacted from volatile compounds. Although groundwater is not currently used at the site, it was assumed that if residents or mine workers used the site in the future, they could use the groundwater for drinking.

Currently, no one lives at the Red Devil Mine site, so some assumptions were made about where people might put residences in the future, even though residential development is prohibited as long as BLM manages the land. Potential risks were estimated for both the Main Processing Area and the Surface Mined Area. These general areas are shown in Figures 1 and 2.

Overall, an unacceptable level of risk was estimated for each area. The overall excess lifetime cancer risks and non-carcinogenic hazards for important receptors at the site are summarized in Table 1.

Exposure Media	Receptors	Cancer Risk¹	Toxic Hazard²
Tailings/Waste Rock and Soil	Potential Human Residents	Yes	Yes
	Plants	N/A	Yes
	Terrestrial Wildlife	N/A	Yes
	Aquatic Wildlife	N/A	Yes
Red Devil Creek Sediment	Potential Human Residents	Yes	Yes
Groundwater	Potential Human Residents	Yes ³	Yes ³
Kuskokwim River Sediment	Potential Human Residents	Yes	Yes
Air (dust)	Potential Human Residents	Yes	Yes
Consumption of Fish, Mammals, Birds, and Plants/Berries	Potential Human Residents	Yes	Yes

Notes:

¹ Cancer risk represents greater than a range of 1 in 10,000 to 1 in 1,000,000 probability of getting cancer over a lifetime from exposure to antimony, arsenic, and mercury. This probability range is used by the EPA to determine unacceptable levels of risk.

² Toxic hazard represents the likelihood that lifetime exposure to antimony, arsenic, and mercury could result in adverse non-cancer health effects.

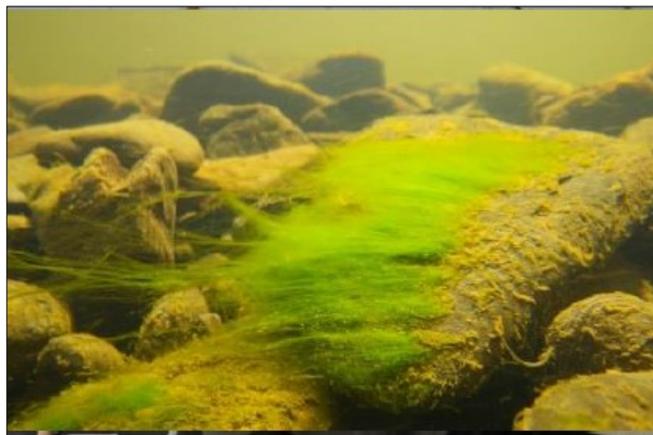
³ Groundwater risk in the Main Processing Area.

Key:

N/A = Not applicable

In the baseline risk assessment, most of the predicted risk to humans is from exposure to COCs by consuming fish or plants/berries, followed by ingestion and contact with soil. In this baseline assessment, groundwater ingestion and ingestion of fish from the Kuskokwim River contributed significantly to the overall predicted risk at the site. In order to be cautious while estimating this risk, the concentration of COCs in fish were modeled from sculpin collected in Red Devil Creek, where the COC levels in fish are higher than those of fish collected from the area of the Kuskokwim River nearest to the Red Devil Mine, where fishing would most likely occur. However, because sculpin are not edible game fish, the modeled assumptions were initial, conservative assessments of risks to humans through consumption of the larger fish found in the Kuskokwim River.

The HHRA Supplement evaluated new sediment data and fishery information collected from the Kuskokwim River. Several studies gathered area-wide river sediment samples for COCs, and did a regional analysis of subsistence fish spawning and movement trends. These studies indicate that Red Devil Mine is currently not a significant contributor of mercury or other heavy metals to pike, whitefish, and other species in the Kuskokwim River, and the Red Devil Creek delta area is not attractive habitat for these species. These conclusions indicate that the predicted risks to human health in the baseline assessment over-estimated the true risks posed by site-related COCs from the site, particularly for ingestion of fish.



The bed of the Kuskokwim River near Red Devil Mine is composed of large cobbles and rocks—pike, whitefish, and other fish species prefer softer river bed conditions for spawning, rearing, and feeding.

Ecological Risk Assessment

An ERA, completed as part of the 2014 RI, evaluated potential risks to plants, soil invertebrates, wildlife, and aquatic organisms in Red Devil Creek, including fish and sediment-dwelling bugs (Table 1). The ERA was conducted in accordance with EPA and Alaska State guidance. All of these groups were predicted to be at risk from site-related contaminants, with the greatest potential risks posed by antimony, arsenic, and mercury. The greatest arsenic risks were to plants, followed by soil invertebrates and two wildlife species, the masked shrew and common snipe. For these two wildlife species, the majority of their arsenic risk is from incidental ingestion of soil or sediment while feeding. Potential ecological risks from antimony and mercury followed a similar pattern to that for arsenic. The Main Processing Area, where contaminant levels in soil and sediment are greatest, contributed the most to the potential ecological risks from antimony, arsenic, and mercury at the Red Devil Mine site.

The ERA Supplement focused on aquatic species in the Kuskokwim River. The assessment relied mainly on studies of the health of invertebrate residing in river sediment. The results of these studies suggest that there is currently a marginal risk to some aquatic-dependent wildlife receptors from river sediments near the mine. Risks posed to fish species were evaluated in the HHRA.

Basis for Remedial Action

Based on the findings of the human health and ecological risk assessments, the BLM has determined that action is necessary to protect human health and the environment from potential risks associated with exposure to actual and threatened releases of antimony, arsenic, mercury, and other metals at the site.

Remedial Action Objectives

The remedial action proposed for the Red Devil Mine is intended to protect human health and the environment from risks associated with exposure to elevated levels of site-related contaminants in tailings and waste rock, contaminated soil, groundwater, sediments in Red Devil Creek, and nearshore sediments in the Kuskokwim River.

Remedial Action Objectives (RAOs) are goals for protecting human health and the environment that address specific exposure routes and receptors. Achieving the RAOs should reduce risks to levels acceptable to the ADEC and EPA. Human receptors evaluated included potential future residents, recreational site visitors, and potential future on-site workers. Ecological receptors evaluated included a range of terrestrial and aquatic wildlife species known to be present at or near the site, and vegetation.

Specific RAOs have been developed for the Red Devil Mine site. The RAOs listed below were developed in close coordination with the ADEC and EPA. All parties concur with these objectives. They include:

- Prevent or reduce human exposure (through ingestion or dermal contact) to COCs in tailings and waste rock, soils in the Main Processing Area, Red Devil Creek sediment, and Kuskokwim River sediment at concentrations above cleanup levels.
- Prevent or reduce human exposure (through inhalation) to COCs in dust from tailings and waste rock and soil.
- Prevent or reduce human exposure (through ingestion) to COCs in fish in Red Devil Creek, and mammals and birds that may inhabit the Main Processing Area.
- Prevent or reduce exposures to plants, fauna, terrestrial wildlife in the Main Processing Area; aquatic-dependent wildlife that feed in or near Red Devil Creek; fish in Red Devil Creek; and sediment dwelling organisms to COCs in tailings and waste rock; soil in the Main Processing Area; Red Devil Creek sediment; and Kuskokwim River sediment.
- Prevent or reduce migration of COCs to surface water from erosion of tailings/waste rock.
- Prevent or reduce leaching of COCs from tailings/waste rock to groundwater.
- Prevent or reduce human exposure (through ingestion) to COCs in groundwater.
- Prevent or reduce human exposure (through dermal contact) to nearshore sediments adjacent to the Kuskokwim River at Red Devil Creek.
- Measure remedial action results.

Target cleanup levels, also known as remedial goals, are established by calculating what levels would not pose an unacceptably high risk of health impacts, or by calculating the “background concentration”—the levels that naturally occur in and around the site. For carcinogenic compounds, the cleanup level is typically set at a range of one in 10,000 (1×10^{-4}) to one in 1,000,000 (1×10^{-6}) for excess cancer risk. Many of the metals at Red Devil Mine occur naturally and, in some cases, background concentrations of these metals are higher than risk-based cleanup levels. It is not practical to clean up below naturally occurring levels.

The BLM determined that for tailings, waste rock, soil, and Red Devil Creek sediments at the Red Devil Mine, cleanup to background would be the most appropriate target for antimony, arsenic, and mercury. For COCs in Red Devil Creek sediments, the target cleanup levels are based on the soil target cleanup levels because the sediment matrix in the creek bed is primarily composed of tailings, waste rock, and eroded soil from upland portions of the site.

For Kuskokwim River sediments, the arsenic target cleanup level is based on a site-specific, risk-based cleanup level calculation.

Groundwater COC concentrations in the area near Red Devil Creek are strongly influenced by the presence of tailings and waste rock. Under the action alternatives described below, tailings and waste rock would be excavated. Actual concentrations of antimony, arsenic, and mercury in groundwater after excavation cannot presently be predicted with confidence. However, it is reasonable to assume that concentrations of COCs in groundwater after excavation would be similar to those observed in bedrock in the upper elevations of the watershed. Groundwater monitoring data from wells installed uphill from the tailings indicate that concentrations are elevated due to the presence of natural mineralization of bedrock. Therefore, remedial goals established for groundwater reflect the expected influence of natural mineralization of bedrock on groundwater in the area where tailings are currently found. The BLM will develop long-term groundwater quality objectives based on post-remediation conditions and background water quality data.

A summary of the target cleanup levels for antimony, arsenic, and mercury in site media is presented in Table 2.

Contaminant	Soil Remedial Goal (mg/kg)¹	Kuskokwim River Sediment Remedial Goal (mg/kg)	Groundwater Remedial Goal (µg/L)
Antimony	52.2	N/A ²	12.99
Arsenic	28.58	69.1	444.1
Mercury	3.92	N/A ²	1.628

Notes:

¹ The soil remedial goals also apply to tailings, waste rock, and Red Devil Creek sediments.

² Kuskokwim River sediment remedial goals for antimony and mercury are not established because these COCs do not present unacceptable risk to site receptors.

Key:

mg/kg = milligrams per kilogram

Summary of Remedial Alternatives

The 2016 FS developed and analyzed four remedial alternatives to address contaminated tailings/waste rock, Red Devil Creek sediment, and waste contained in existing monofills at the site. Because separate alternatives were developed for groundwater and river sediment, the four remediation alternatives developed in the 2016 FS to address tailings/waste rock, soil, and Red Devil Creek sediment will be referred to as “mine site alternatives.”

Mine Site Alternatives

- **Alternative 1: No Further Action.**
- **Alternative 2: Institutional and Access Controls through Fencing and Signs.** Under Alternative 2, contaminated tailings, soil, and Red Devil Creek and Kuskokwim River sediments would be left in place, and active remediation would be limited to erecting exclusion fencing to reduce the potential for potential receptors to gain access to the site and become exposed to on-site COCs. Land use restrictions would be established at the site to restrict future human exposure by limiting activity, use, and access to the property.
- **Alternative 3: Excavation of Solid Materials and On-Site Consolidation.** Under Alternative 3, the tailings/waste rock, soil, and Red Devil Creek sediment in the Main Processing Area, and areas of Kuskokwim sediment would be excavated and consolidated in an on-site repository. The final configuration of the repository would be one of four options. In all four options, the on-site repository would be capped with a low permeability cover. The four options are:
 - a) The repository would have no bottom liner and Monofill #2 would be closed in place with a low permeability cover like that placed over the larger repository.
 - b) The repository would have a bottom liner and leachate collection system, and Monofill #2 would be closed in place with a low permeability cover like that placed over the larger repository.
 - c) The repository would have no bottom liner, and Monofill #2 would be deconstructed and the associated tailings would be moved into the larger repository. The rest of Monofill #2 contents and the hypalon liner would be disposed of at an offsite location.
 - d) The repository would have a bottom liner and leachate collection system. Monofill #2 would be deconstructed and the associated tailings would be moved into the larger repository. The rest of Monofill #2 contents and the hypalon liner would be disposed of at an offsite location.
- **Alternative 4: Excavation of Solid Materials and Off-Site Disposal.** Under Alternative 4, the tailings/waste rock, soil, and Red Devil Creek sediment in the Main Processing Area, and areas of Kuskokwim sediment would be excavated as in Alternative 3. However, the contents of Monofills #1, #2, and #3 would also be excavated and all excavated material would be transported offsite for disposal.

The 2019 FS Supplement developed and analyzed remedial alternatives to address contaminated groundwater and sediment in the Kuskokwim River. The 2019 FS Supplement alternatives included:

Groundwater (GW) Alternatives

- **Alternative GW1: No Action.**
- **Alternative GW2: Institutional and Access Controls.** Under Alternative GW2, a Notice of Activity and Use Limitation would be established and warning signs would be installed along the perimeter at intervals of approximately 100 yards. Land use restrictions would be established at the site to restrict future human exposure by limiting activity, use, and access to the property. Alternative GW2 is similar to Alternative 2 established for the mine site.

Kuskokwim River Sediment (KR) Alternatives

- **Alternative KR1: No Action.**
- **Alternative KR2: Institutional Controls.** Under Alternative KR2, contaminated sediments and materials within the lower delta would be left in place, and active remediation would be limited to erecting warning signs to reduce the potential for human receptors to become exposed to on-site COCs. A Notice of Activity and Use Limitation would be developed and signage would be erected. Alternative KR2 is similar in scope and RAO conformance to mine site Alternative 2.
- **Alternative KR3: Monitored Natural Attenuation.** Under Alternative KR3, contaminated sediments and materials within the lower delta would be left undisturbed in place. Naturally occurring processes in the Kuskokwim River and Red Devil Creek delta are expected to reduce the COC concentrations over time. A Notice of Environmental Contamination and signage would be erected and river sediment would be monitored periodically to confirm that concentrations are decreasing over time.
- **Alternative KR4: Limited Dredging.** Alternative KR4 involves dredging approximately 18,000 cubic yards of material along the front of the delta at the mouth of Red Devil Creek. The dredged material would be consolidated in the on-site repository under Alternative KR4A, and sent to an offsite disposal facility under Alternative KR4B. Alternative KR4A is similar in scope and RAO conformance to mine site Alternative 3. Alternative KR4B is similar in scope and RAO conformance to mine site Alternative 4.
- **Alternative KR5: Nearshore Sediment Removal.** Under Alternative KR5, approximately 18,000 cubic yards of material along the front of the delta at Red Devil Creek would be dredged. In addition, approximately 300 cubic yards of nearshore Kuskokwim River sediments located downriver of the delta would be dredged. Under Alternative KR5A, the dredged material would be consolidated in the on-site repository. Under Alternative KR5B, the dredged material would be sent to an offsite disposal facility. Alternative KR5A is similar in scope and RAO conformance to mine site Alternative 3. Alternative KR5B is similar in scope and RAO conformance to mine site Alternative 4.

Site-Wide Remedy (SW) Alternatives

For this Proposed Plan, the BLM is combining the mine site alternatives evaluated in both the 2016 FS and the 2019 FS Supplement for site-wide remedy alternatives. The site-wide remedy alternatives represent a logical grouping of the 2016 FS and 2019 FS Supplement alternatives because they combine response actions of similar scope and RAO conformance. The site-wide alternatives are identified as follows:

- **Alternative SW1: No Further Action.** Incorporates 2016 FS Alternative 1, and 2019 FS Supplement Alternatives GW1 and KR1. This site-wide alternative groups the no action alternatives for the mine site (Alternative 1), groundwater (Alternative GW1) and Kuskokwim River sediment (Alternative KR1).
- **Alternative SW2: Institutional Controls.** Incorporates 2016 FS mine site Alternative 2, and 2019 FS Supplement Alternatives GW2 and KR2.
- **Alternative SW3: Excavation of Solid Materials and On-Site Consolidation, Monitored Natural Attenuation of Groundwater, and Nearshore Removal of Kuskokwim River Sediments.** Incorporates the 2016 FS mine site Alternative 3 and its four options involving on-site repository

design and excavation or enhancement of Monofill #2. This alternative also incorporates the 2019 FS Supplement Alternatives GW2 and KR3, and the nearshore dredging component of Alternative KR4A.

- **Alternative SW4: Excavation of Solid Materials and Off-Site Disposal, Monitored Natural Attenuation of Groundwater, and Limited Dredging of Kuskokwim River Sediments.** Incorporates the 2016 FS mine site Alternative 4 and 2019 FS Supplement Alternatives GW2 and KR5B.

These site-wide remedy alternatives are described more fully below.

Alternative SW1 – No Further Action

Interim cleanup actions have already been undertaken at the Red Devil Mine. These actions include demolition of mining structures and equipment, removal of hazardous materials to off-site disposal locations, consolidation of contaminated materials into the lined Monofill #2, stabilization of a portion of the on-site tailings and installation of erosion control structures in Red Devil Creek, and installation of warning signs and a gate at the entrance to the mine. Since these actions have already been completed at the site, they are considered to be part of the No Further Action alternative. The No Further Action alternative represents a baseline against which other alternatives for the Red Devil Mine can be compared.

Under this alternative, the tailings, waste rock, contaminated soil, creek sediment, and Kuskokwim River sediment would remain in their current locations, and groundwater contamination would not be actively monitored. The gate and warning signs that have been installed as part of previous response actions would remain in place, but would not be maintained.

Alternative SW2 – Institutional and Access Controls

Alternative SW2 is intended to reduce exposure of both humans and ecological receptors to contaminated material using enhanced site access restrictions, future land use restrictions (i.e., Notices of Activity and Use Limitation), and long-term monitoring of site contaminant behavior. Existing site features and areas of contamination would remain in their current locations. All tasks included in Alternative SW2 could be completed in a single construction season. The primary elements of Alternative SW2 are:

- Installation and maintenance of approximately 5,000 linear feet of fence and warning signs previously installed at the mine entrance and new signs installed along the fence perimeter.
- Implementation and enforcement of permanent land use restrictions that would limit how the site is developed in the future.
- Performance of a five-year review to assess the protectiveness of the alternative by evaluating if exposure assumptions are still valid or if new data has become available that could alter the effectiveness of the remedy.

Alternative SW3 – Excavation of Tailings, Waste Rock, Soils, and Sediments; Solidification; On-site Consolidation; and Capping

Alternative SW3 involves site-wide excavation of tailings/waste rock, removal of sediments from Red Devil Creek and in the nearshore areas of the Kuskokwim River at the mouth of Red Devil Creek. These actions would constitute removal of the primary sources of COCs that could migrate off-site or pose risk to human health and the environment. Monitoring of on-site groundwater and sediments in the Kuskokwim River would be conducted to measure the success of on-site cleanup actions.

Alternative SW3 includes four options as described previously for mine site Alternative 3. These sub-alternatives are summarized in Table 3 and described separately below.

Remedy Features	SW3A	SW3B	SW3C	SW3D
On-site Repository	Yes	Yes	Yes	Yes
Liner Under Repository	No	Yes	No	Yes
Excavate Monofill #2 and Place in Repository	No	No	Yes	Yes

Each of the options for Alternative SW3 involves the construction of an on-site repository for excavated waste materials. Figure 3 illustrates the conceptual location and dimensions of the repository.

All the options have the following components in common:

- Implement institutional and access controls (fencing and signs) as described under Alternative SW2.
- Excavate tailings and waste rock, contaminated soil, and surficial delta material that contain COCs above the cleanup levels.
- Excavate sediment that contains COCs above the cleanup levels located in Red Devil Creek.
- Excavate sediment that contains COCs above the cleanup levels located adjacent to the Kuskokwim River at the mouth of Red Devil Creek.
- Conduct solidification of excavated tailings that fail the Toxicity Characteristic Leaching Procedure test for arsenic.
- Consolidate all excavated and solidified materials in an on-site repository with a cap consisting of a geomembrane cover, a geocomposite drainage layer, rock cover layer, and run-on and run-off surface water controls.
- Re-grade exposed highly mineralized soil/bedrock in the Surface Mined Area, cap with locally obtained soil (loess), and construct run-on and run-off surface water controls.
- Conduct periodic maintenance and monitoring to evaluate remedy performance and effectiveness.
- Perform periodic monitoring of on-site groundwater quality.
- Perform periodic sediment quality monitoring in the Kuskokwim River.

The quantities of material to be excavated are similar for all of the Alternative SW3 options; however, Alternatives SW3C and SW3D would involve approximately 1.3% more excavated material than Alternatives SW3A and SW3B due to the removal of Monofill #2. The time necessary to implement each of the Alternative SW3 options is expected to be approximately 1 to 2 construction seasons.

Alternative SW3A – Unlined Repository and Monofill #2 Covered In-Place

The primary elements specific to Alternative SW3A are:

- Close Monofill #2 in place by enhancing the existing cap and capping highly mineralized bedrock in the Surface Mined Area that was exposed during the last phase of mine operation.
- Install a cover system for Monofill #2 using a geomembrane to prevent direct exposure to contaminated soil and tailings on the structure, and to inhibit leaching of contaminants to groundwater.

Alternative SW3B – Lined Repository and Monofill #2 Covered In-Place

The primary elements specific to Alternative SW3B are:

- Install a cover system for Monofill #2 using a geomembrane to prevent direct exposure to contaminated soil and tailings on the structure, and to inhibit leaching of contaminants to groundwater.
- Install a high-density polyethylene bottom liner, drainage layer, and perforated leachate collection piping beneath the consolidated waste beneath the repository.
- Collect leachate via a sump and pump the leachate from the repository to an underground storage tank.
- Periodically transport collected leachate from the site via barge to an off-site treatment or disposal facility.

Alternative SW3C – Unlined Repository and Monofill #2 Excavated

The primary elements specific to Alternative SW3C are:

- Excavate 940 cubic yards of materials presently contained within Monofill #2 and approximately 1,700 cubic yards of tailings used as cover material on the monofill.
- Segregate contents presently contained within Monofill #2 that are not suitable for consolidation in the repository and transport these materials to an off-site disposal facility.
- Consolidate the contents and tailings cover of Monofill #2, in the on-site repository.

Figure 3
Alternative SW3 Excavation
Area and Repository Location

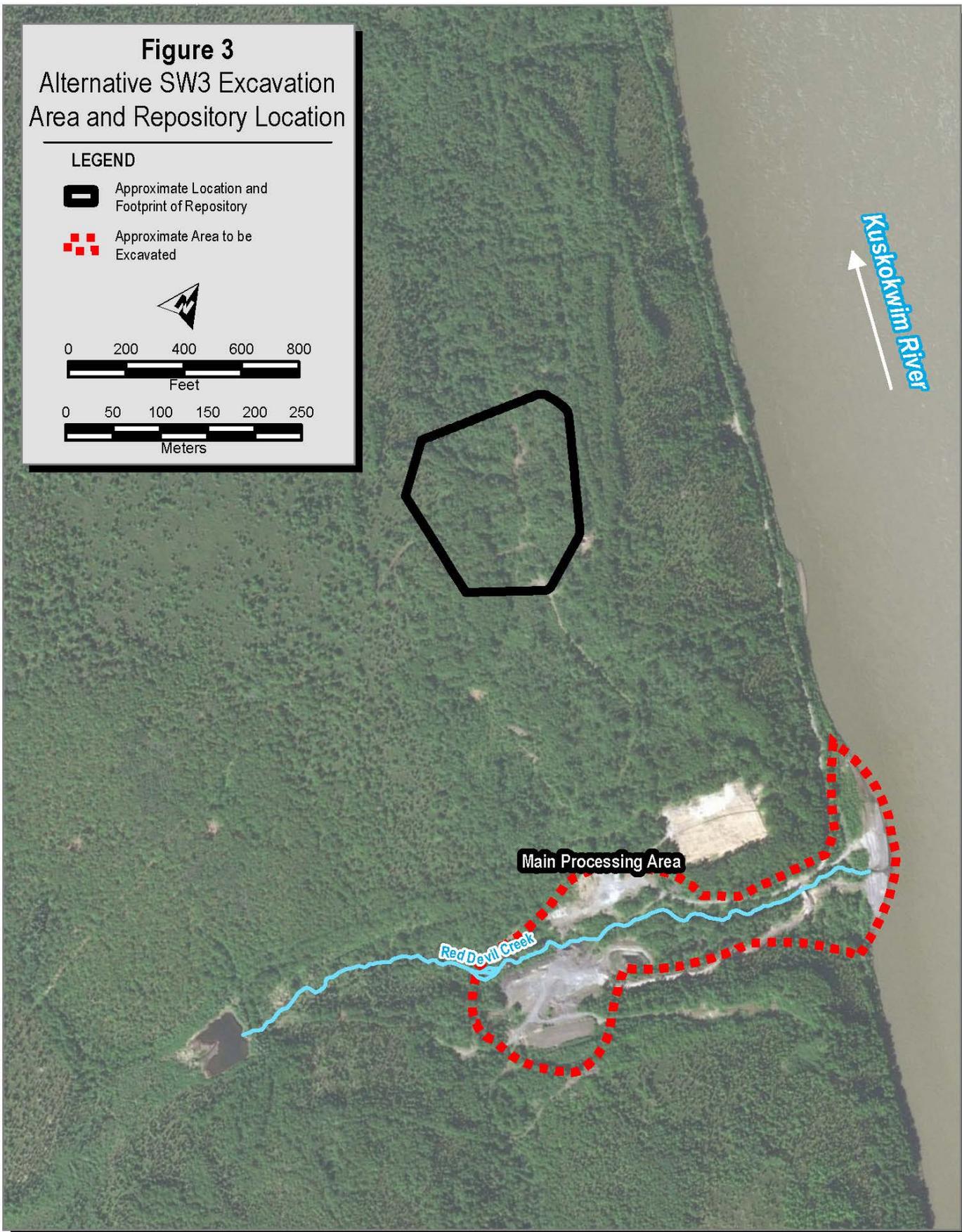
LEGEND

-  Approximate Location and Footprint of Repository
-  Approximate Area to be Excavated



0 200 400 600 800
Feet

0 50 100 150 200 250
Meters



Alternative SW3D – Lined Repository and Monofill #2 Excavated

Alternative SW3D combines the key elements of Alternatives SW3B and SW3C.

The primary elements specific to Alternative SW3D are:

- Excavate 940 cubic yards of materials presently contained within Monofill #2 and approximately 1,700 cubic yards of tailings used as cover material on the monofill.
- Segregate contents presently contained within Monofill #2 that are not suitable for consolidation in the repository and transport these materials to an off-site disposal facility.
- Consolidate the contents and tailings cover of Monofill #2, in the on-site repository.
- Install a high-density polyethylene bottom liner, drainage layer, and perforated leachate collection piping beneath the consolidated waste in the repository.
- Collect leachate via a sump and pump the leachate from the repository to an underground storage tank.
- Periodically transport collected leachate from the site via barge to an off-site treatment or disposal facility.

Alternative SW4 – Excavation of Tailings, Waste Rock, Soils, and Sediments; Off-site Disposal; Capping; Monitored Natural Attenuation of Groundwater

Similar to the options described under Alternative SW3, Alternative SW4 would involve excavation of tailings and waste rock, contaminated soil, and removal of sediment in Red Devil Creek and in the nearshore area of the Kuskokwim River at the mouth of Red Devil Creek. All three monofills would also be excavated. All excavated material would be transported off-site by barge via the Kuskokwim River for disposal in a licensed disposal facility outside of Alaska. This alternative includes capping of exposed highly mineralized bedrock in the Surface Mined Area.

The quantity of material to be excavated under Alternative SW4 is the same for Alternatives SW3C and SW3D. The time necessary to implement Alternative SW4 is expected to be approximately one to two construction seasons.

The primary elements of Alternative SW4 are:

- Excavate tailings and waste rock, contaminated soil, and surficial delta material that contain COCs above the cleanup levels.
- Excavate contaminated sediment that contains COCs above the cleanup levels located in Red Devil Creek.
- Excavate the contents of the three monofills and backfill the open excavation.
- Re-grade exposed highly mineralized soil/bedrock in the Surface Mined Area, cap with locally obtained soil (loess), and construct run-on and run-off surface water controls.
- Transport excavated materials via barge on the Kuskokwim River and dispose of the materials at a licensed disposal facility in the contiguous 48 states.
- Conduct periodic maintenance and monitoring.
- Perform periodic monitoring of on-site groundwater quality.
- Perform periodic sediment quality monitoring in the Kuskokwim River.

Evaluation of Alternatives

The NCP identifies nine criteria (summarized in Table 4) that are used to evaluate the different remediation alternatives individually, and against each other, in order to select a remedy. This section of the Proposed Plan profiles the relative performance of each alternative against the nine criteria, describing how it compares to the other options under consideration. Note that the evaluation summarized in this section was performed only on the site-wide alternatives described in the preceding section.

Table 4 Evaluation Criteria for Remedial Alternatives	
THRESHOLD CRITERIA	
1. Overall Protection of Human Health and the Environment	determines whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.
2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)	evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that pertain to the site, or whether a waiver is justified.
PRIMARY BALANCING CRITERIA	
3. Long-term Effectiveness and Permanence	considers the ability of an alternative to maintain protection of human health and the environment over time.
4. Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment	evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
5. Short-term Effectiveness	considers the length of time needed to implement an alternative and the risks the alternative poses to workers, residents, and the environment during implementation.
6. Implementability	considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
7. Cost	includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30%.
MODIFYING CRITERIA	
8. EPA, State, and Support Agencies' Acceptance	considers whether the EPA and/or the State of Alaska agrees with the BLM's analyses and recommendations, as described in the RI/FS and Proposed Plan.
9. Community Acceptance	considers whether the local community agrees with BLM's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

The nine criteria fall into three groups: threshold criteria, primary balancing criteria, and modifying criteria. The three groups have the following purposes:

- Threshold Criteria - requirements that each alternative must meet in order to be eligible for selection.
- Primary Balancing Criteria - used to weigh major trade-offs among alternatives.
- Modifying Criteria - may be considered to the extent that information is available during the FS but can be fully considered only after public comment is received on the Proposed Plan.

The nine evaluation criteria are categorized and discussed below. The “Detailed Analysis of Alternatives” can be found in the 2016 FS and the 2019 FS Supplement, which can be found in the Administrative Record.

1. Overall Protection of Human Health and the Environment

Alternatives SW3A, SW3B, SW3C, SW3D, and SW4 would achieve this primary objective by reducing the potential for human and wildlife exposure to elevated levels of contamination through inhalation or ingestion of tailings, waste rock, soil, and sediment. Alternatives SW3A, SW3B, SW3C, SW3D, and SW4 would also reduce the potential for future migration of contaminated tailings, waste rock, and soil, and would provide increased protection of groundwater. By removing Monofill #2, Alternatives SW3C, SW3D, and SW4 would provide additional protection of groundwater in the area of Monofill #2. Alternatives SW3A, SW3B, SW3C, SW3D, and SW4 also integrate ongoing monitoring to measure protection to humans and the environment. Alternative SW2 would reduce direct exposure through inhalation or ingestion but would not reduce the potential for contaminants to migrate or provide protection of groundwater. Alternative SW1, the No Further Action alternative, would be the least protective of human health and the environment. Both Alternatives SW1 and SW2 do not fully provide protection of human health and the environment.

2. Compliance with Other Regulations (ARARs)

CERCLA includes a process that is defined in federal regulations for investigating and cleaning up sites like Red Devil Mine. The CERCLA process recognizes that other state and location regulations may apply and must be considered in evaluating cleanup alternatives. The state and local regulations considered under the CERCLA process are referred to as regulations that may be applicable or relevant and appropriate. The BLM, acting as lead agency, evaluated a number of federal regulations found in the Code of Federal Regulations and

the U.S. Code, and a number of regulations found in the Alaska Administrative Code (AAC). The majority of the state regulations considered by the BLM are included in Chapter 75 and relate to oil and hazardous substance pollution control. The BLM also reviewed regulations in Chapter 60 that relate to solid waste management. The majority of the state regulations included in BLM's review were accepted as applicable to Red Devil Mine. In a letter dated September 17, 2019, ADEC documented its assertion that several state regulations are applicable or relevant and appropriate; according to its review, the BLM did not agree with these assertions. Alternatives SW3C, SW3D, and SW4 would comply with all associated regulatory requirements. Alternatives SW3A and SW3B would leave contaminated soil in place beneath Monofill #2 and would not fully comply with AAC Chapter 75. Alternatives SW1 and SW2 would also not fully comply with all identified ARARs because contamination would be left in place.

3. Long-term Effectiveness and Permanence

Alternatives SW3A, SW3B, SW3C, SW3D, and SW4 would provide long-term, effective stabilization of contaminated materials. Mine site Alternative 4 slightly better meets the Long-Term Effectiveness criterion than the other alternatives because all contamination in the Main Processing Area would be removed from the site and transported to a commercial disposal facility designed for the treatment and storage of this material. Alternatives SW3C and SW3D next best meet this criterion since they both involve the excavation, treatment of materials contained in Monofill #2. Alternatives SW1 and SW2 would provide no additional long-term protection beyond protections achieved through previous interim actions.

4. Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment

Alternatives SW3A, SW3B, SW3C, SW3D, and SW4 would reduce the mobility of contaminants, and the Alternative SW3 options would achieve this reduction partially through on-site treatment (solidification of the most contaminated tailings). Alternatives SW1 and SW2 have no treatment or consolidation component, and thus would not reduce the toxicity, mobility, or volume of contaminants.

5. Short-term Effectiveness

Alternatives SW3A, SW3B, SW3C, SW3D, and SW4 would involve the relocation of significant volumes of contaminated soil and tailings and sediments, and would thus present a potential for short-term exposure, primarily through windblown soil transport. The use of proven dust control measures during the remedial action would limit the amount of materials that may migrate. Short-term risk to workers involved in the remedial action would be minimized through appropriate controls and adherence to proper health and safety protocols. Alternative SW4 involves handling large volumes of waste and shipping the waste long distances. This increases workers' risk to physical hazards and exposure to contaminated material. Also, transporting site waste materials long distances in the Kuskokwim River and through marine waters increases the chance of a spill of this contaminated material. Thus, Alternative SW4 does not meet this criterion as well as Alternatives SW3A, SW3B, SW3C, and SW3D. Alternatives SW1 and SW2 would result in minor short-term risk to workers installing fencing and signage.

6. Implementability

All of the alternatives rely on proven technologies that can be readily implemented. Alternatives SW3A, SW3B, SW3C, SW3D, and SW4 would be more difficult to implement than Alternative SW2 because of the need for substantial heavy construction equipment to be mobilized to the site, and the need to identify a nearby source for low permeability cover soil. Alternatives SW3B and SW3D would present significant long-term operational challenges related to leachate collection, storage, and management.

7. Cost

The estimated capital cost and the present worth (includes capital and long-term operational and maintenance costs) for each alternative is listed in Table 5.

Table 5 Estimated Capital and Present Worth Costs of the Alternatives		
Alternative	Capital Cost	Present Worth Cost
Alternative SW1	\$0	\$0
Alternative SW2	\$816,000	\$1,700,000
Alternative SW3A	\$26,438,000	\$29,860,000
Alternative SW3B	\$30,998,000	\$58,210,000
Alternative SW3C	\$27,788,000	\$30,710,000
Alternative SW3D	\$32,728,000	\$59,890,000
Alternative SW4	\$198,710,000	\$199,900,000

8. State/Support Agency Acceptance

The BLM has provided the State of Alaska and EPA with the opportunity to review the RI/FS reports and this Proposed Plan. State and EPA acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the Record of Decision (ROD) for the site. Figure 4 provides a summary of the evaluation of the remedial alternatives.

Figure 4 Comparison of Alternatives with Feasibility Study Evaluation Criteria

Feasibility Study Evaluation Criteria	Alternative SW1	Alternative SW2	Alternative SW3A	Alternative SW3B	Alternative SW3C	Alternative SW3D	Alternative SW4
Overall Protection	No	No	Yes	Yes	Yes	Yes	Yes
Compliance with ARARs	No	No	No	No	Yes	Yes	Yes
Long-Term Effectiveness	○	○	◐	◑	◒	◓	◔
Reduce Toxicity, Mobility, Volume	○	○	◐	◑	◒	◓	◔
Short-Term Effectiveness	◓	◒	◑	◐	◑	◒	○
Implementability	◓	◒	◑	○	◑	○	◑
Cost	◓	◒	◑	◑	◑	◑	○
State Agency Acceptance	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Community Acceptance	TBD	TBD	TBD	TBD	TBD	TBD	TBD

Key:

Yes = Alternative achieves threshold criterion.

No = Alternative does not achieve threshold criterion.

◓ = Alternative is most favorable for balancing criterion.

◑ = Alternative is moderately favorable for balancing criterion.

○ = Alternative is least favorable for balancing criterion.

TBD = To Be Determined

9. Community Acceptance

Community acceptance of the preferred alternative will be evaluated after the public comment period ends and will be described in the ROD for the site.

Summary of the Preferred Alternative

The preferred alternative for the Red Devil Mine is Alternative SW3C. This alternative includes the following elements:

- Excavation of contaminated materials at the site, including Monofill #2.
- Excavation of nearshore sediments located downstream of the Red Devil Creek delta.
- Solidification of tailings/waste rock in the Main Processing Area that fail the toxicity characteristic leaching procedure test for arsenic.
- Consolidation of the excavated materials into an engineered repository.
- Capping exposed highly mineralized areas in the Surface Mined Area.
- Long-term monitoring of groundwater in the Red Devil Creek watershed.
- Alternative SW3C also includes the primary provisions of Alternative SW2, including exclusion fencing to protect wildlife, and restrictions on public access and future use of the site area.

The preferred alternative was selected over other alternatives because it is expected to reduce overall risk to acceptable levels by meeting the following criteria:

- It is protective of human health and the environment because it eliminates the direct exposure of site waste materials to humans, fish, and wildlife.
- It is protective of groundwater because waste materials would be adequately isolated in an engineered containment structure.
- It meets all ARARs.
- It reduces toxicity and mobility of the highest concentration tailings through treatment.
- It is constructable and more readily implemented than other alternatives given the site location and setting.
- The on-site repository that is central to this alternative is easily inspected and maintained and does not require developing on-site facilities needed to collect, store, and possibly treat high concentration fluids.
- It does not involve transportation of large volumes of contaminated materials on the Kuskokwim River or through marine waters.
- It includes monitoring and maintenance of the on-site repository and monitoring of groundwater and Kuskokwim River sediments to verify remedy effectiveness.

Based on information currently available, the BLM believes that Alternative SW3C, augmented by FS Supplement Alternative KR3 and components of Alternative KR5A, meets the threshold criteria and provides the most reasonable approach among the alternatives with respect to the balancing criteria. The modifying criteria will be evaluated following the Proposed Plan's public comment period, and the results of this evaluation will be documented in the ROD. The BLM expects Alternative SW3C to satisfy the following statutory requirements of CERCLA §121(b): (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost-effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the preference for treatment as a principal element of the remedy.

The preferred alternative's performance will be formally evaluated at 5-year intervals by the BLM. If the RAOs are not being achieved by the preferred alternative during these 5-year reviews, the BLM will re-evaluate the selected remedy in consultation with the ADEC.

Community Participation

The BLM has provided information regarding the cleanup of the Red Devil Mine to the public through community meetings, periodic newsletters, the Administrative Record file, tribal consultation, and announcements published in *The Delta Discovery* and broadcast over KYUK public radio (Bethel). The BLM encourages the public to review this Proposed Plan and provide comments so they can participate in the final selection process.

**For further information on the Red Devil Mine,
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