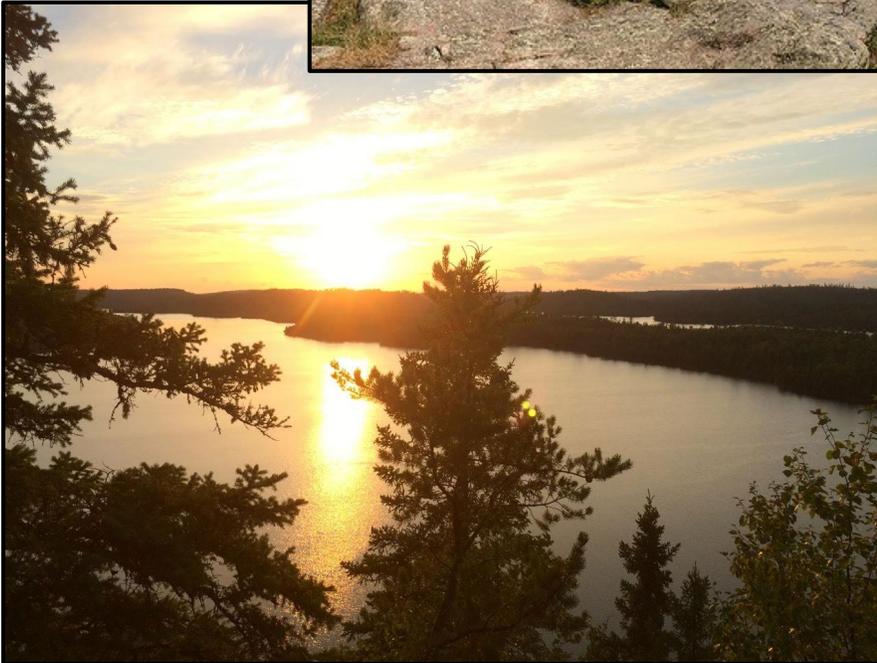




United States Department of Agriculture

Rainy River Withdrawal

Case Studies Report



June 2022

Forest Service
Superior National Forest
Duluth, Minnesota

Prepared By: Copperhead Environmental Consulting, Inc.

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INTRODUCTION

The United States Department of Agriculture - Forest Service (Forest Service) is requesting a withdrawal of approximately 225,504 acres of National Forest System lands (the Rainy River Withdrawal Application Area) in the Rainy River Watershed in northern Minnesota from disposition under U.S. mineral and geothermal leasing laws. A recommendation regarding withdrawal of the area from mineral and geothermal leasing — for a 20-year term, subject to valid existing rights — will be made to the U.S. Secretary of the Interior.

The purpose of the withdrawal request is to protect and preserve natural and cultural resources in the Rainy River watershed, including the Boundary Waters Canoe Wilderness Area, the Boundary Waters Canoe Wilderness Area Mining Protection Area, and the 1854 Ceded Territory, from the known and potential adverse environmental impacts arising from exploration and development of Federally-owned minerals. The requested withdrawal is needed because the Forest Service and the Bureau of Land Management have seen and can reasonably anticipate increasing interest within the private sector for developing the copper-nickel ore minerals in the Duluth Complex that may adversely impact the Rainy River watershed.

The Forest Service contracted Copperhead Environmental Consulting, Inc. (Copperhead) to review the environmental performance of mining operations with characteristics similar to those of mines that could occur within the proposed Rainy River Withdrawal Application Area. This report describes and compares predicted effects (e.g., in environmental review documents and permit applications) with real-life impacts of operations.

Each case study includes a summary discussing any similarities between the site in the report and the Rainy River Withdrawal Application Area. Each case study also identifies the type of mining operation, its age, pertinent environmental reviews and regulatory requirements, impacts, and noncompliance actions that affect the environment.

METHODOLOGY

The Forest Service provided a list of candidate mines for case studies that had been suggested by the public. In addition, Copperhead conducted a search in April 2022 for other relevant mining operations that could be evaluated in the report. Copperhead drew upon professional knowledge of similar mines and an online search of mines in the U.S. and Canada.

Each candidate mine was evaluated against a set of criteria to determine its suitability for inclusion as a case study in this report. The criteria included mining methods, mineralogy, ecological setting, and date when mining operations began.

The selection process focused on hard-rock mines. Mineralogy similar to that of the Rainy River Withdrawal Application Area was determined to include deposits of copper, nickel, gold, silver, lead, zinc, and other elements typically extracted from ores with sulfide mineralization. Similar ecological settings included forested landscapes and/or the presence of nearby surface water features such as rivers, lakes, and other large bodies of water. Finally, modern mines were ranked higher, as they were more likely to be subject to permitting, engineering, and environmental review standards similar to those required of any future projects in the Rainy River Withdrawal Application Area. Metal sulfide mines in a similar ecological

setting and put into operation after 1990 were selected as case studies. In addition, several candidate mines that satisfied some, but not all, criteria were included in this report because of an abundance of publicly available online information that could provide instructive insight into real-life impacts that could occur within the Rainy River Withdrawal Application Area.

For each case study, environmental analysis, monitoring reports, government reports, and other public online data sources were reviewed to better understand operational and restoration performance.

SUMMARY OF FINDINGS

This report contains 20 case studies reviewing a total of 24 mines and one mining district with characteristics similar to those that could occur within the proposed Rainy River Withdrawal Application Area. Information was gathered in April 2022 from publicly available online sources. The search identified environmental impacts at all 20 case studies, including impacts on air quality, health and safety, water quality, and indigenous communities. For 14 case studies, these impacts were considered informal or formal violations of federal, state, or environmental laws. Violations varied from administrative recordkeeping to warnings regarding noncompliance with permits to formal violations of federal or state water, air, or waste management laws.

In summary, the amount of available information pertaining to each mine was greatly variable. This could be due to several factors, including the age of each mine, the type of environmental review that was required, and the completeness of online sources by country, state, or province. In general, information on predicted impacts and environmental reviews of older mines was more difficult to obtain, probably because those documents have not been digitized or the mines in their original configuration predate some modern environmental regulations. Similarly, some Canadian mines were not required to undergo an environmental review similar to those required under the National Environmental Policy Act (NEPA) in the United States. In addition, the availability of online information from state or provincial regulators varied; some states or provinces such as Montana or British Columbia provide an easily accessible database of mine records, while others do not. Finally, a lack of information about some mines might also indicate that there have been no noncompliance actions involving the mine. This is more likely to be true of newer mines (post-2000), for which records are more often digitized and available online.

Environmental Effects of Relevant Mining Activities

The most common environmental impacts identified during review of the case study mines concerned water quality and air quality. Water-quality impacts were typically related to tailings management, including tailing dam management and dam failures. Those impacts were the result of large-scale events (e.g., a dam failure) and smaller incidents that did not trigger regulatory action (e.g., overflow or inadvertent releases).

Air-quality impacts were also identified for multiple case studies. Those impacts included fugitive dust, commonly caused by vehicle traffic on unsurfaced access roads, and sulfuric acid and acid rain. Vehicle traffic includes employees accessing the mine each day, deliveries, and transportation of mined materials to off-site processing or shipping facilities. Sulfuric acid impacts arose from historical mining practices in the Sudbury District in Ontario.

Accuracy of Predicted Impacts

Copperhead searched public online sources to identify environmental review documentation pertaining to each case study mine. Whenever possible, environmental review documents were examined to identify predicted impacts, which were then compared against the real-world environmental track record of that mine.

Environmental review documentation pertaining to many of the older (pre-2000) mines in the United States was not available online. In the case of some mines, Copperhead located NEPA documentation for proposed mine expansion facilities, although those documents typically did not address all potential impacts arising from a proposed mine or expansion. In addition, Canada's Impact Assessment Agency does not always require that an environmental impact assessment of a mine be conducted. When predicted impacts were identified, there seemed to be few corresponding real-world violations related to mine construction or operation. The lack of correlation may be due to chance, as the sample is small.

External literature suggests that environmental reviews have a mixed track record when predicting environmental effects. For example, Kuipers et al. (2006) reviewed 25 environmental impact statements (EIS) associated with major hard-rock mines in the U.S. since 1975, mostly in the western U.S. He found that 19 of these mines later exceeded their water quality standards for surface or ground water. The EISs for 8 of these mines predicted low potential for water contamination; for 8 others moderate contamination was predicted; the EISs for the remaining 3 predicted high contaminant leaching. The frequency and magnitude of exceedances varied by mine.

Noncompliance Actions

Noncompliance actions — including violations, fines, or litigation due to environmental impacts — were identified concerning 16 of the 20 case studies in this report. The number, type, and severity of noncompliance actions varied widely, from informal enforcement actions and warning letters to the Mount Polley Mine tailing dam failure in British Columbia, Canada. In addition to actions that triggered a regulatory response, several case studies identified smaller-scale releases or spills. Older mines or districts that largely predate modern environmental laws sometimes had an accompanying record of toxic releases that did not result in regulatory action. This was seen in historical releases of sulfuric acid in the Sudbury District in Canada that did not appear to result in formal violations or fines.

Noncompliance actions pertaining to closed mines were also difficult to identify, as the U.S. Environmental Protection Agency's (USEPA's) Enforcement and Compliance History Online (ECHO) database does not contain historical violation records. Further research might identify historical noncompliance actions.

Effectiveness of Corrective Measures

Documentation of corrective measures and their effectiveness was difficult to ascertain via search of publicly available online information. Generally, information pertaining to larger scale events was readily found. Such events include the Mount Polley Mine tailings dam failure in Canada or Superfund cleanup efforts in the U.S. Corrective measures for smaller-scale events were more difficult to track. For this reason, if the online record did not indicate repeated noncompliance actions for the same issue at a mine, Copperhead assumed the corrective measures were effective. In contrast, Copperhead's research pertaining to four mines in Missouri indicated a cycle of noncompliance actions and corrective measures addressing

violations of the Clean Air Act and the Clean Water Act, among other statutes. The apparent ineffectiveness of long-term corrective measures at the four mines might be due in part to their age; they have been in operation for many decades, and their original design was not subject to modern engineering or environmental standards. Finally, many corrective measures designed to address large-scale problems, such as Superfund cleanup efforts at the Gilt Edge Mine in South Dakota or at the Zortman and Landusky mines in Montana, might take multiple years and sometimes decades before their long-term effectiveness is fully understood.

Copperhead's investigation identified corrective measures that resulted in changes to the broader industry. When the Beal Mountain Mine owner declared bankruptcy in 1998, leaving taxpayers to pay for reclamation efforts, the Montana State Legislature passed laws strengthening bond requirements and preventing bad actors from mining in the state. The aforementioned Mount Polley Mine tailings dam failure was one of several mining disasters throughout the world that prompted the United Nations to create global standards (albeit voluntary) for tailings management.

INDIVIDUAL CASE STUDIES

Beal Mountain Mine

Silver Bow County, Montana, United States

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level 1 Ecoregion</i>
Two open-pit gold and silver mines	Began operations in 1988	Closed (mining stopped in 1997)	Northwestern Forested Mountains

Location

The former Beal Mountain Mine is located in Silver Bow County, Montana, within the Pioneer Mountains at the headwaters of German Gulch. It is approximately 16 miles west-southwest of the City of Butte and 10 miles south-southwest of Fairmont Hot Springs. The mine is primarily within the Beaverhead-Deerlodge National Forest, which is in the USEPA Level II Western Cordillera ecoregion.

Both Beal Mountain deposits (South Beal and Beal Mountain) reside at the headwaters of German Gulch. The primary deposit occurs on the southern flank of a ridge between German Gulch and Minnesota Gulch, both of which are tributaries of Silver Bow Creek and the Clark Fork. Mine elevations range from approximately 6,500 feet at German Gulch to 7,863 feet at the top of Beal Mountain; the deposits themselves being between 6,930 and 7,560 feet. The topography of the area consists of sloping ridge-tops and V-shaped valleys. The ridge tops and south-facing slopes are generally open while north-facing slopes are typically forested (Maxim Technologies, 2004).

The climate of the area is continental and is considerably altered by the mountainous terrain of the surrounding land. Annual precipitation averages 25 inches per year.

The mine is located within the Northern Cordilleran overthrust belt. The belt consists of Cretaceous rocks that have been folded, faulted, and thrust faulted into imbricated layers of complex structure, and also include intrusive rocks from the Idaho and Boulder batholiths. These intrusive bodies have produced contact metamorphism and locally mineralized zones, such as those found at the Beal Mountain Mine, within adjacent sedimentary rocks. The Beal Mountain Mine area is located in a contact zone between the 72-million-year-old (Cretaceous age) Boulder Batholith intrusive igneous rock of granodiorite to diorite composition and sedimentary rocks. Contact metamorphic and metasomatic processes associated with the batholith intrusive are principally responsible for alteration of the host rocks and formation of the Beal Mountain ore deposits. The ore deposit is hosted in Cretaceous-age clastic sedimentary rocks of the Vaughn Member of the Blackleaf formation. These clastic rocks are non-marine and have been metamorphosed to quartzite, hornfelses and metaconglomerates. The mining site itself can be found along a regional northeast-southwest trending contact zone within the intrusive and sedimentary rock (Maxim Technologies, 2004).

Comparison to Rainy River Withdrawal Application Area

Similarities with the Rainy River Withdrawal Application Area include proximity to surface water features and a continental climate.

Mining methods in the two areas differ, as the open pit and heap and vat cyanide leach processing mining practices conducted at Beal Mountain Mine have been banned in Montana since 1998 (Montana Standard, 2021). The geology of the Rainy River Withdrawal Application Area and Beal Mountain Mine are also different. Geology in the Beal Mountain Mine area consist of non-marine sedimentary rocks of an age younger than 145-million years ago, that have been intruded by 72-million-year-old igneous batholiths of intermediate composition (between mafic and felsic composition). Rocks within the withdrawal area consist of the 1.1-billion-year-old mafic intrusions of the Duluth Complex, and the older 2.7-billion-year-old greenstone formation comprised of marine volcanogenic rocks, along with slightly younger granitic batholiths that intrude the greenstone formation.

Site Design

The Beal Mountain Mine began production in 1988, with two open-pit, gold and silver deposits, Beal Mountain and South Beal. Conventional open-pit methods were used, including: topsoil and waste rock stripping; stockpiling; and mining ore by means of drilling, blasting, loading, and hauling. Once mined, the ore was then crushed, agglomerated, and sent to a leach pad to be leached of its gold and silver using a diluted cyanide solution. The main facilities at the site were, "...two open-pit mines; a waste rock disposal area; a leach pad with a large containment dike or embankment along its southeast flank and a smaller containment dike along the north flank; ore stockpile and crushing /agglomeration facility area; processing plant area (for recovery, assaying and refining of gold and silver); a water treatment plant; an onsite maintenance shop/warehouse and fuel storage area; and an offsite office/warehouse complex" (Maxim Technologies, 2004). Final mining operations and gold recovery from the pad were completed in 1997 and 1999, respectively. In 1998, the mine's owner filed for bankruptcy, leaving the Forest Service and Montana Department of Environmental Quality responsible for the final closure and post-closure activities (Maxim Technologies, 2004).

Environmental Review Process

In 1988, an Environmental Assessment (EA) was prepared which included a water quality impact analysis. Geochemical characterization tests were conducted and later indicated that the waste rock would not generate acidic waters or become a significant source of metal. It was also determined that a leachate developed under acidic conditions would not cause adverse impacts. Mitigation measures proposed in the EA included diverting storm water and collection pit water for process use, lining leach pad and solution ponds and providing them with either a blanket drain or leak detection system, establishing a backfilled, free-draining pit to prevent the occurrence of a pit lake, and rinsing the leach pad to confront any residual cyanide. Overall, the EA concluded that there would be minor but unpredictable impacts on water quality from the leach pad (Stratus Consulting et al., Undated).

Impacts to the Environment

In 1993, the Forest Service prepared an EIS addressing a proposed water treatment process at the Beal Mountain Mine. After geochemical characterization testing, it was determined that nitrate, sulfate, cyanide,

and increased amounts of sediment were of concern, as well as the presence of pyrite, pyrrhotite, and iron disulfides potentially causing acid production. The testing of both deposits concluded that while there was a low potential for acid formation, it was still possible that sulfates and metals could be release into the surface water as well these substances potentially mobilizing regardless of the production of acid (Stratus Consulting et al., Undated).

A 2004 Existing Conditions Report prepared for the Forest Service outlined several concerns at the mine facilities. These included the existence of two active slides within the Beal Mountain pit area, geotechnical instability within the leach pad's dike, and a large accumulation of waste rock that posed a risk for acid generation and acid rock drainage. The mine has also caused adverse impacts on water quality. Within German Gulch, the potential long-term effects have been excessive amounts of selenium, cyanide, and some copper. Fish within the sub watershed of the creek were exposed to concentrated amounts of selenium (Maxim Technologies, 2004).

In 2019, a Water Resources Report issued by Tetra Tech identified stream water at the site as at or below the water quality standards for Total Suspended Solids (TSS), ammonia, cyanide, and selenium for June and September of that year (Tetra Tech, 2019). The report issued the following year (2020) identified similar results (Tetra Tech, 2020)

Non-Compliance and/or Litigation

As of April 2022, the USEPA ECHO database shows no violations within the past 5 years and the mine is not listed in the most recent Toxic Release Inventory.

The State of Montana filed and later dropped a “bad actor” case against the mine owner’s former executive. The case sought to prevent this individual from mining in Montana due to numerous past bankruptcies that left the public to pay for reclamation. The Montana Legislature passed the Metal Mine Reclamation Act in 1989 and expanded it in 2001 to prevent mining executives who have not reimbursed the state for past cleanup efforts from receiving new mining permits. In addition, state laws governing bonds have become stricter, partly in response to the Beal Mountain Mine bankruptcy and reclamation costs (Montana Standard, 2021).

Mitigation Measures / Corrective Actions and Their Effectiveness

Reclamation under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) is ongoing. Due to the public ending up paying for reclamation costs, mine bonding requirements were increased.

Caribou Mine

Northwest New Brunswick, Canada

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level 1 Ecoregion</i>
Two former open-pit lead, zinc, and silver mines and one underground zinc, lead, and silver mine s	Began operations in 1969	Currently Closed	Eastern Temperate Forests

Location

The Caribou Mine is located approximately 30 miles southwest of Bathurst, New Brunswick, Canada, which sits at the mouth of the Nepisiguit River and the Chaleur Bay. The mine is located within the USEPA Level II Mixed Wood Plains ecoregion, which is characterized by flat lake plains, rolling till plains, hummocky stagnation moraines, hills, and some low mountains. Land cover is a mix of agriculture, forest, wetlands, and glacial lakes.

The Caribou Mine is located within the Miramichi Highlands physiographic unit of the Appalachian Uplands physiographic region. The highlands in New Brunswick include Cambrian shale, sandstone, conglomerate, and quartzite; Ordovician - Mississippian volcanic and granitic rocks; Silurian - Devonian sedimentary, tuffs and intrusive rocks with minor volcanic rocks; and Precambrian formations of sedimentary, volcanic, and undifferentiated igneous rocks (Fahmy, Hann, and Jiao, 2010). Ore from the Caribou Mine is a volcanic sediment-hosted sulfide deposit within the Spruce Lake Formation. The Spruce Lake Formation consists of the host sedimentary rocks and associated felsic volcanic rock.

Comparison to Rainy River Withdrawal Application Area

The Rainy River Withdrawal Application Area and the Caribou Mine are located in the USEPA level II Mixed Wood Shield ecoregion of the USEPA level I Northern Forests ecoregion. And although the Rainy River Withdrawal Application Area is approximately 1,185 miles directly west of the Caribou Mine, they have similar topography and latitude. The geology in the area is somewhat similar to the greenstone formation in the Rainy River Withdrawal Application Area. Like the rocks in the greenstone formation, bedrock in the Caribou Mine area generally consists of volcanic and volcanoclastic (volcanic-derived sediment) rocks. However, the Caribou Mine bedrock at an age of 440 to 470 million-years-ago, is much younger than the 2.7-billion-year-old greenstone formation.

Site Design

Currently, the Caribou Mine consists of an underground lead, zinc, and silver mine, and two former open-pit lead, zinc, and silver mines. The underground mine is accessed by the zero-level portal and the main portal, with ramps used to access and transport the ore to the surface. Waste rock from the mine is used as backfill.

Infrastructure at the Caribou Mine site includes: the primary crusher and conveyor; main concentrator building containing unit operations for milling, floatation, and concentrate production; large staff/administration office and mine dry facility; core shack; assay laboratory; warehouse; maintenance shop; cold storage facility; compressor room; electrical substation; reclaim pumphouse; hoist room (not currently in use); head frame (not currently in use); mine water treatment plant and associated treatment ponds; crusher ore pad; Restigouche raise ore/waste rock storage pad; and west open-pit ore/waste rock storage pad (Stantec 2018).

The site also contains the South Tributary Tailings Pond, a fire pond, and the historical “Anaconda” tailings storage area which contains several unlined ponds. The 2018 Stantec Environmental Impact Assessment (EIA) and the 2018 Roscoe Postle Associates Technical Report also evaluate the addition of the North Tributary Tailings Pond which included the construction of a new tailings management facility pond and basin, polishing pond and dam, and water treatment facilities.

Environmental Review Process

In 2018, Stantec conducted an EIA for proposed construction and operation of a new tailing management facility, a polishing pond, a water treatment facility and supporting permanent and non-permanent ancillary facilities. The EIA found that the Caribou Mine would comply with standards outlined in applicable regulations and guidelines with regard to waste, emissions, and discharges. The mine owner, Trevali Mining Ltd., committed to industry best practices and best management practices as well as mitigation planning as specified by their site-specific environmental management plan (Stantec, 2018).

Impacts to the Environment

In January 2013, Trevali Mining Ltd. entered into a Limited Environmental Liability Agreement with the province of New Brunswick whereby the province would accept environmental liability associated with the Anaconda Canada Exploration Ltd. historical liabilities (Roscoe Postle Associates 2018). Well and surface water monitoring data show a direct correlation between historical mining activity at the Anaconda Tailings Ponds and elevated metal concentrations and low pH values in portions of the North and South Branch Forty Mile Brook. Water quality at the polishing pond discharge is sampled five days a week for metals, pH, and total suspended solids. Toxicity testing is also conducted once per month and sublethal testing is conducted twice yearly (Roscoe Postle Associates, 2018).

Non-Compliance and/or Litigation

During an April 2022 search, Caribou Mine was not listed on the Canadian Environmental Offenders Registry or on the enforcement notification database.

A 2008 press release from the Government of New Brunswick describes a guilty plea by the mine’s then-owner for violating the Clean Environment Act when it released a contaminant without permission. The article states that lead concentrate was inadvertently released into a ditch which allowed it to flow into the Fire Pond and an impounded area of Forty Mile Brook (Government of New Brunswick, 2008).

Mitigation Measures / Corrective Actions and Their Effectiveness

As described above, Trevali has entered upon a Limited Environmental Liability Agreement with the province of New Brunswick regarding historic environmental liabilities. Groundwater and surface water

are regularly tested as part of permit and agreements with applicable laws and regulations. This effort is ongoing.

As part of the proposed construction of the North Tributary Tailings Pond, Trevali was to permanently inundate the remaining Anaconda tailings area, surface waste rock acid rock drainage stockpiles, the G-pond, and the underground mine workings to enhance reclamation at the end of the life of the Caribou Mine (Stantec, 2018). The efficacy of these measures could not be identified during an April 2022 search of publicly available online searches and may take years or decades to fully understand.

Cortez Mine

Central Nevada, United States

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level 1 Ecoregion</i>
Surface Pit and Underground Gold Mine	Began operations in 1969	Currently Active – Mine Life until 2031	North American Deserts

Location

The Cortez Mine is located southwest of Elko, Nevada, and is associated with three other mine complexes (Pipeline, Gold Acres, and Cortez Hills). The region is arid with unforested basins, alluvial fans, plateaus, buttes, and scattered mountains. It is almost completely surrounded by higher, wetter, more rugged, forested mountain ranges. Perennial streams are rare and those that occur typically originate outside the region in the bordering mountainous ecoregions. The few small perennial streams that originate in the higher mountain ranges within the region commonly disappear when they reach lower elevations. Vegetation is sparse and varies from sagebrush, invasive cheatgrass, juniper, and pinyon pine. Valleys are mostly Quaternary alluvial, playa, and marsh deposits. During the Pleistocene, this are contained pluvial lakes. The hilly areas are Tertiary silicic ash-flow tuffs and tuffaceous rocks. Historic gold, silver, and mercury mining have occurred in the region. Currently there are active sand, gravel, and gold mines. Mine de-watering has occurred since the 1990s. Some streams have been designated for protection as priority or critical cold water fishery habitat. Higher elevation streams associated with the Quinn River drainage support populations of the federally threatened Lahontan cutthroat trout (USEPA, Wiken et al., 2011).

The Cortez Mine ore is a disseminated gold deposit mainly hosted in a sedimentary rock consisting of carbonate bedrock of Silurian-Devonian age (i.e., 255 to 440 million years ago). The host rocks are commonly thinly bedded silty or argillaceous carbonaceous limestone or dolomite, commonly with carbonaceous shale. To a much lesser extent, gold that reaches economic value can be hosted in non-carbonate siliciclastic (clastic rocks consisting largely of silica or silicates) and rare felsic metavolcanic rocks.

The Cortez Mine is located within the traditional homeland of the Western Shoshone. Three areas of cultural and religious importance to the tribe are nearby (Mt. Tenabo, the White Cliffs, and Horse Canyon).

Comparison to Rainy River Withdrawal Application Area

Unlike the Rainy River Withdrawal Application Area, the Cortez Mine area is arid and mountainous, and the geology consists of relatively young sedimentary, and to a lesser degree, felsic volcanics that are less than 440 million years old, compared to the 1.1- to 2.7-billion-year-old bedrock in the withdrawal area. One similarity between the two areas is that both underground and open-pit mining operations occur at the Cortez Mine site, and these types of operations would also be expected to occur in the Rainy River Withdrawal Application Area. Also, there are tribal concerns with past and ongoing projects in both areas.

Site Design

The site consists of open-pit mining, underground mining, waste rock storage facilities, conventional cyanide heap leach pads, carbon columns, carbon-in-leach mill, tailings impoundments, refractory ore roaster, groundwater remediation pumpback system, and various support facilities (BLM, 2008).

In 2008 the Cortez Hills Expansion Project expanded the footprint by 57,058 acres, of which 53,790 acres are on Bureau of Land Management (BLM) administered land and 3,268 acres are privately owned (BLM ROD 2008). The Deep South Project added another 3,846 acres (2,779 acres of BLM-administered land) to the entire mine area (BLM, 2019).

Environmental Review Process

Two EISs and one Supplemental EIS have been prepared for mine expansion projects in the past twenty years. In 2008, the BLM published a Record of Decision (ROD) for the Cortez Hills Expansion Project EIS that sparked a lawsuit by several Western Shoshone tribes and non-profit organizations. In 2010, a supplemental EIS for the Cortez Hills Expansion Project was published in which the USEPA reviewed and determined there was insufficient information describing the adequacy of mitigation for losses of surface water flows and riparian/wetland vegetation. The USEPA also requested additional information on financial assurance and air emissions modeling.

An EIS was completed for the Deep South Expansion Project in 2019.

Impacts to the Environment

As described above, USEPA's review of the 2010 supplemental EIS identified concerns with proposed mitigation for losses of surface water flows and riparian/wetland vegetation. The BLM's ROD for the Cortez Hills Expansion Project Supplemental EIS describes potential impacts on water resources and mitigation measures to reduce those impacts. Mitigation was aimed at protecting seeps and springs. In addition, surface disturbance impacts associated with implementation of site-specific mitigation were anticipated to be reclaimed within 2-3 years. Air quality impacts included an increase in PM_{2.5}, but were not expected to result in exceedances of NAAQS, and would result in "very low" cumulative impacts (BLM, 2011)

The BLM's Deep South Expansion Project EIS identified potential impacts on aquatic habitat and water resources from mine-related groundwater drawdown, negligible impacts on wildlife from post-mining pit lakes, low potential for a spill into aquatic habitat, and other potential environmental impacts. The EIS also considered applicant-committed environmental protection measures meant to minimize impacts on wildlife species, livestock grazing, groundwater, and other resources. Significant impacts were forecasted for floodplains, wetland vegetation, some aquatic wildlife habitat, bats. Mitigation measures were identified to reduce these impacts to a less-than-significant level (BLM, 2019).

Non-Compliance and/or Litigation

Violations reported in the USEPA ECHO database for the Cortez Mine within the last 5 years are Clean Air Act violations that were resolved.

The Te-Moak Tribe of Western Shoshone, the Western Shoshone Defense Project, and Great Basin Mine Watch filed a lawsuit against the BLM and Cortez Gold Mines (respondent-intervenor) in 2008 to revoke

the mining permit. The plaintiffs argued that the Project will cause permanent and irreparable harm to the environment, Mt. Tenabo and the Western Shoshone. They allege that the Project will substantially harm their right to engage in prayer and religious activities in the area. The plaintiffs claimed that the Project would dump toxic mine waste onto their land, and they further claimed that the amount of groundwater needed by the mine will cause a loss of surface waters and springs in the area. The district judge rejected the application for preliminary injunction in January 2009 (Business and Human Rights Resource Centre, 2022).

In February of 2009, the plaintiffs filed an appeal with the Ninth Circuit Court. In December 2009 the Ninth Circuit Court of Appeals granted a preliminary injunction to stop the expansion at the Cortez Gold Mine. The injunction was granted on the basis that the plaintiffs showed a likelihood on their claims regarding environmental violations under NEPA. By January 2012, the court lifted the injunction finding the deficiencies and was in compliance with NEPA (Business and Human Rights Resource Centre, 2022).

Mitigation Measures / Corrective Actions and Their Effectiveness

No mitigation measures or corrective actions due to litigation or violations were found during an April 2022 search of publicly available online information.

Doe Run Mines – Sweetwater, Buick, Brushy Creek, Fletcher

Southeast Missouri, United States

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level 1 Ecoregion</i>
Underground lead, copper, and zinc mines	Began operations in 1960s	Currently Active	Eastern Temperate Forests

Location

The Doe Run Mines are in southeastern Missouri in the USEPA Level II Ozark, Ouachita-Appalachian Forests ecoregion. This ecoregion is discontinuous and comprises most of the unglaciated, forested low mountains, and upland plateaus in the central and eastern United States. The region has a more irregular physiography and is generally more forested than adjacent regions, except for the Boston Mountains. Soils are mostly derived from cherty carbonate rocks, with chert stone comprising about 20% to 60% of the soil mass. Cambrian and Ordovician dolomite and sandstone comprise the dominant bedrock in the interior of the region with Mississippian limestone underlying the western outer regions. Shale, chert, and Precambrian igneous rocks are also present. Topography varies from steep slopes near the large streams to moderate relief hills on the broad plateaus or inter-stream areas. Karst features, including caves, springs, and spring-fed streams are found throughout most of the region. High-gradient, clear-flowing streams in entrenched valley meanders are also common. More than 60% of the total area is open forest or woodland, although in the more rugged sections the forest covers nearly all of the upland. Oak is the predominant forest type, but mixed stands of oak and pine are also common, with pine concentrations greatest to the southeast. Cultivated land is mainly confined to small tracts in the numerous valleys and small creek bottoms. Cleared upland is used for pasture and livestock (USEPA, 2000; Wiken et al., 2011).

The four mines are underground mines within the Viburnum Trend. The Viburnum Trend consist chiefly of lead ore deposits that also contain recoverable zinc, copper, nickel and cobalt minerals. The metals exist as sulfide mineral deposits in carbonate sedimentary bedrock. It is generally accepted the mineral deposits in the Viburnum Trend are a disseminated replacement of sulfide minerals in a carbonate host rock. The process generally involves the dissolution and precipitation of minerals out of fluids that migrated through the carbonate bedrock.

The Buick, Brushy Creek, and Fletcher Mines are in the Mark Twain National Forest (MTNF). The Sweetwater Mine borders the MTNF.

Comparison to Rainy River Withdrawal Application Area

The area encompassing the Doe Run Mines is similar to the Rainy River Withdrawal Application Area in that both locations are heavily forested and on or near National Forest System lands. The Doe Run Mines, however, are sited on karst terrain with fewer nearby large surface water bodies. Most water resources in southeast Missouri are spring-fed streams. The geology in the two areas is also dissimilar in that southeast Missouri host rock of the Viburnum Trend is a carbonate sedimentary rock of an age between 500 to 525

million years ago, versus the host rocks within the Rainy River Withdrawal Application Area that are igneous and metamorphic bedrock with ages that span beyond 525 million years ago.

Site Design

The underground mines have a room-and-pillar design. From a review of aerial images, the mine sites include tailings ponds, mine facilities, and access roads. The Doe Run Company states that 25 miles of underground roadways connect four of their mines – Casteel, Buick, Brushy Creek and Fletcher.

Environmental Review Process

NEPA documents for the current Doe Run Mines were not located online.

In 2001, Doe Run applied for seven prospecting permits for lead, copper, and zinc in the MTNF. The Forest Service prepared an EA that evaluated alternatives on 8,756 acres of National Forest System lands near Viburnum and Bunker, Missouri. A Finding of No Significant Impact was issued in 2002. The EA took into consideration the environmental effects on cultural resources, water quality, soil productivity, visual resources, wildlife, recreation resources, vegetation, and biodiversity. The primary concern was the effects of drilling on water quality. Potential impacts included those from drilling into a cavern, drilling lubricants, aquifers, and drill hole plugging and abandonment. If done correctly, the EA concluded that the potential for effluent to reach surface water was low. In the cumulative effects section, there were no known evidence of past drilling projects affecting water quality in the proposed drilling areas. Another issue of concern were the effects of drilling on other Forest resources from the creating openings for drill sites and access roads. Soil productivity would be impacted by the construction of temporary roads from the clearing of trees. With the application of Forest Service standards and guidelines, it was predicted that these activities would have no significant effects on soil productivity (US Forest Service, 2001, 2002).

Impacts to the Environment

An April 2022 search of publicly available information identified impacts to air and water resources. Details are provided in the following section.

Non-Compliance and/or Litigation

In 2011, the USEPA filed a Judicial Civil Enforcement Case for alleged violations against the Resource Conservation and Recovery Act (RCRA), RCRA – Solid Waste, the CWA, the CAA, CERLCA, the Missouri Hazardous Waste Management Law, the Missouri Air Conservation Law, the Missouri Clean Water Law. The case also alleged that Doe Run created an unlawful public nuisance at the Doe Run facilities in Southeast Missouri (Buick Resource Recycling Facility, Glover Facility, Herculaneum Lead Smelter Facility, Brushy Creek Mine/Mill Facility, Buick Mine/Mill Facility, Fletcher Mine/Mill Facility, Sweetwater Mine/Mill Facility, Viburnum Mine #35 Casteel Facility, West Fork Unit Facility. After a ruling in USEPA’s favor, a \$7 million penalty was levied against Doe Run, to be paid to the state and federal government.

As of April 2022, the USEPA ECHO database identified the Buick, Brushy Creek, and Fletcher Mines as being in violation of the CWA and CAA.

Mitigation Measures / Corrective Actions and Their Effectiveness

The 2011 Consent Decree ordered;

To address the CAA violations, Doe Run will:

- Shut down the acid plant and sintering machine and stop shipping lead concentrate to the Herculaneum facility by December 31, 2013.
- Comply with a production limit of 130,000 tons per year (tpy) of finished primary lead on a 12-month rolling average across its facilities until the shutdown in 2013.
- Comply with the following rates and caps:
 - Sinter production shall not exceed a 12-month rolling tonnage of 326,370 tons. Blast furnace sinter consumption shall not exceed a 12-month rolling tonnage of 326,370 tons.
 - Emissions of lead shall comply with the 1.0 pound per ton of lead limit set forth in 40 C.F.R. § 63.1543.
- Continuously operate certified emission rate monitors (CERMS) for sulfur dioxide (SO₂) at the smelter.
- Obtain federally enforceable state-issued permits and update its Title V permits to reflect the injunctive relief requirements of the consent decree.

To address the CWA violations, Doe Run will:

- Ensure continuing compliance with its current and future *National Pollutant Discharge Elimination System* (NPDES) permits:
 - Participate in an expedited process for resolving permit appeals it has filed relating to recently issued NPDES permits for its facilities in southeast Missouri. New NPDES permit limits at Doe Run's facilities contain more stringent water quality-based limits. Doe Run may ultimately need to install major controls in order to comply with them.
 - Conduct informal negotiation with the Missouri Department of Natural Resources (MDNR) and the use of a court-appointed dispute-resolver to determine any remaining permit issues.
 - Abide by the dispute-resolver's decision and waive further appeal rights under state law.
- Collect surface and underground water data to evaluate water quality and potential for pollutant load reductions at ten of its facilities. Using this data, Doe Run will:
 - Establish underground water management plans at each facility designed to assess procedures and methodologies to reduce metals loadings in mine water and underground process water.
 - At each facility, establish surface water management plans to manage process wastewater and stormwater (including mine water pumped to the surface) in compliance with all NPDES permits.
- Complete several site-specific measures at the following facilities:
 - Herculaneum facility
 - Install and continuously operate a second lime slurry tank to address pH consistency.
 - Assess the characteristics of water entering the slag water collection system and investigate potential for treatment.
 - Install a truck wash recycling system to recycle wash water and reduce hydraulic loading to the wastewater treatment plant.
 - Glover facility
 - Evaluate the effectiveness of chemical reagents used at the wastewater treatment plant and implement any recommended changes in the use of these chemicals.

- Evaluate the use of sodium sulfide to reduce thallium in the wastewater treatment system and implement any recommendations provided through this evaluation.
- Remove any slag washed out of the slag storage area and stabilize the containment berm around the slag storage area.
- Buick Resource Recycling Facility
 - Continuously operate an additional sand vertical gravity filter at the wastewater treatment plant.
 - Install equipment for recycling non-contact cooling water in the battery desulfurization and crystallization areas and install return pumps for the blast furnace cooling water to allow reuse of the non-contact cooling water.
- West Fork Facility
 - Remove and replace the substrate in the north biocell of the wastewater treatment plant and eliminate the discharge from the domestic wastewater treatment unit

To address the RCRA violations, Doe Run will

- Take various measures to correct RCRA violations identified at the Brushy Creek, Buick Resource Recycling, and Herculaneum Lead Smelter facilities during prior inspections, comply with permits, and improve general RCRA compliance.
- Investigate and clean up the Herculaneum facility to health-based cleanup levels appropriate for the designated future use of the property after shutdown of the Herculaneum smelter.
- Provide initial financial assurance of \$8.14 million in the form of a trust fund to be completely funded over the next three years for the cleanup work at Herculaneum. The trust fund will be used in the event the company is unable to perform the cleanup action.
- Expand its financial assurance and remediation accordingly should additional engineering controls or greater monitoring be required as a result of the site-investigation.
- Provide financial assurance for the cleanup of its six active or former mine and mill facilities including Brushy Creek, Buick, Fletcher, Sweetwater, Viburnum, and West Fork. The total cost of this financial assurance is currently estimated by Doe Run to be \$20-25 million in 2010 dollars.

Transportation and Yard Contamination Injunctive Relief

- USEPA and Doe Run have agreed on a modification of a 2007 administrative order on consent (Modified AOC) that requires:
 - Improved washing and inspection of trucks hauling lead-bearing materials.
 - Independent auditing of the washing and inspection activities.
 - Additional sampling of residential properties along the truck routes used for hauling lead-bearing materials.
 - An assessment to implement improvements to its transportation and handling operations.
- In order to address contamination revealed in Herculaneum residential yards, Doe Run is entering into a RCRA AOC (Yard AOC) requiring:
 - Annual sampling of all residential properties, vacant lots, and high child impact areas (e.g., schools, day care centers, churches) within 1.5 miles of its smelter facility.
 - Cleanup of all properties with lead soil concentrations above a 400 parts per million (ppm) action level within 18 months.
- Once the smelter operation is shut down at the end of 2013 and the smelter property is cleaned up, Doe Run will sample all residential properties, vacant lots, and high child impact areas one final time and clean up any additional properties with lead soil concentrations above 400 ppm.

Additional Injunctive Relief

This settlement will require Doe Run to expend no less than \$17.5 million to implement the following additional injunctive relief measures:

- Enclosure of lead concentrate handling, loading, and storage areas under negative pressure with emissions routed to a baghouse at four facilities over the next five years (and any future facility at the time of opening) at an estimated cost of \$10-12 million.
- Stream mitigation activities on 8.5 miles of Bee Fork Creek (near Fletcher Mine/Mill) at an estimated cost of \$5.8 million.
- Mitigation projects in the affected communities over the next four year at an estimated cost of \$2 million, including a minimum of
 - \$300,000 for clean diesel retrofits
 - \$200,000 for school laboratory clean-outs
 - \$300,000 in school energy efficiency projects
 - \$300,000 in ground source heat pump projects

Pollutant Reductions

As a result of the settlement, Doe Run was instructed to reduce air and water pollutants to specific amounts.

Table 1. Doe Run Mines Air and Water Pollutants Thresholds Established in 2011 Settlement Agreement.

Air Pollutants	Tons per Year (tpy)	Water Pollutants	Tons per Year (tpy)
Carbon Dioxide (CO ₂)	101,000 tpy	Oil & Grease	140.5 tpy
Sulfur Dioxide (SO ₂)	42,000 tpy	Zinc	41.8 tpy
Lead (Pb)	162 tpy	Nitrate	16.4 tpy
Particulate Matter (PM ₁₀)	23 tpy	Total Suspended Solids	6.4 tpy
Carbon Monoxide (CO)	22 tpy	Chemical Oxygen Demand	5.4 tpy
Nitrous Oxides (NO _x)	13.5 tpy	Lead	3.5 tpy
Volatile Organic Chemicals (VOCs)	2.5 tpy	Cadmium	0.95 tpy
--	--	Biochemical Oxygen Demand	0.89 tpy
--	--	Arsenic	0.13 tpy
--	--	Copper	0.08 tpy

In 2012, a consent decree filed by the State addressed a 450-acre waste pile at Sweetwater. Doe Run agreed to implement a wind erosion plan to keep material from blowing off-site. Once mining ends at the site, the company agreed to cover the mine waste with dirt and native plants in order to prevent future erosion.

The settlement also required Doe Run to:

- upgrade a sewage lagoon;
- implement a cleanup of soil contamination;
- assess pollution in Sweetwater Creek;
- develop a program to improve compliance and staff training;
- pay the state about \$45,000 for litigation costs and oversight of work at the Sweetwater mine;
- fund \$35,000 in environmental education projects for K-12 students.

Efficacy of the corrective actions is questionable because as of April 2022, the USEPA ECHO database lists three of the four mines as having been in violation of the CWA and CAA during the past three years.

Some of the violations may be unrelated to the settlement or due to utilization of older mining methods that would not be permitted under current regulations.

Eagle Mine

Upper Peninsula, Michigan, United States

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level 1 Ecoregion</i>
Underground nickel and copper mine	Began operations in 2014	Currently Active	Northern Forests

Location

The Eagle Mine is approximately 10 miles south of Lake Superior in the Upper Peninsula of Michigan. The associated Humboldt Mill where mines metals are processed is 17 miles south of the mine in Champion, Michigan. Both facilities are in the USEPA Level II Mixed Wood Shield ecoregion. Moderate to low gradient perennial streams are typical and wetlands are widespread. The numerous glacial lakes are clearer and less productive than those in ecoregions further south. Nearby surface waterbodies include the Salmon-Trout River, Yellow Dog River, and Lake Superior. The Mixed Wood Shield is largely devoid of agriculture because of its thin, nutrient-poor soils and short growing season. Variable depths of acidic, sandy soils over bedrock determine vegetation patterns. White pine, red oak, red pine, and aspen grew on exposed bedrock with little or no soil. Balsam fir and white spruce occurred on thin soils over bedrock. Any areas with greater depths of well-drained soil and a silty loess cap supported northern hardwoods forest minus beech, which grew only in more moderate lakeshore areas. Better water retaining soils supported hemlock and yellow birch (USEPA, 2000).

The region is rich in wildlife, with moose, black bear, gray wolf, white-tailed deer, lynx, snowshoe hare, ruffed grouse, bald eagle, brook trout, and muskellunge. Main economic activities for this border region include forestry, recreation, tourism, hunting and fishing, and iron ore mining. Parts of the ecoregion contain some public national, state, and provincial parks or forestlands. The closest major cities are Marquette and Duluth (Wiken et al., 2011).

The Michigamme Highland is an outcrop of complex Precambrian bedrock, including sandstone, slate, shale, gneiss, quartzite, and iron formations. There are several bedrock lake basins; the lakes are mostly acidic and low in nutrients. The Eagle Mine is part of an ultramafic intrusive system and hosts high grade primary magmatic nickel/copper sulfide mineralization; it is the only mine in the United States that extracts nickel as primary base metal. The intrusions are related to the feeder system for the Keweenawan flood basalts, a large igneous provenance created from mantle-tapping extension during the 1.1-billion-year-old Midcontinent Rift. Economic mineralization include semi-massive and massive sulfides (Clow et al., 2017).

Comparison to Rainy River Withdrawal Application Area

The Eagle Mine is approximately 200 miles southeast of the Rainy River Withdrawal Application Area. The Rainy River Withdrawal Application Area and the Eagle Mine are both located within the Level II Mixed Wood Shield ecoregion of the Level I Northern Forests ecoregion. Landscapes in both areas include large amounts of surface water and proximity to large bodies of freshwater. The geology of the Eagle Mine deposit is similar to the Duluth Complex deposits in the Rainy River Withdrawal Application Area. Both deposits are associated with the Midcontinent Rift system, and rocks from both areas are igneous intrusions of upper mantle material.

Site Design

The Eagle Mine covers 150 acres and includes several buildings for mine services, truck washing, storage of ore, underground mobile equipment, powerhouse, cold storage, and water treatment plants. There is also a temporary development rock storage area, contact water basins, and a treated water infiltration system.

The Humboldt Mill is about 17 miles south of the mine and uses conventional crushing, grinding, and floatation methods to produce separate nickel and copper concentrates.

In 2019, another section of underground mine, Eagle East, was permitted.

Environmental Review Process

In 2004, Michigan passed the Non-Ferrous Metallic Mining Law to review proposed new mines. Consistent with this law, a feasibility study was completed in 2007 and Eagle Mine was permitted by the Michigan DEQ. The permit includes conditions to minimize environmental impacts. These conditions measures include limits to water infiltration and oxidation of the development rock, a composite liner system, geomembrane, specifications for the leachate collection piping, contact water extraction system, and many others (MDEQ, 2007).

Eagle Mine has been part of the Community Environmental Monitoring Program (CEMP) since 2012 and will continue in the program through the life of the mine (estimated to be 2025). The program is implemented by the Superior Watershed Partnership in cooperation with the Keweenaw Bay Indian Community and the Community Foundation of Marquette County, Michigan. The CEMP monitors environmental impacts that may result from operations at Eagle Mine, Humboldt Mill, and along the designated transportation route.

Impacts to the Environment

In 2015, Eagle Mine reported groundwater parameters that were outside of the established benchmarks under their mine permit for 2 or more consecutive sampling events at nine of their monitoring well locations. They concluded that the exceedances posed no risk to the environment but would continue tracking changes in groundwater (Superior Watershed Partnership 2015). In 2020, exceedances in groundwater were still being reported, but have not been definitively attributed to mine operations (Eagle Mine, 2021).

The rivers/streams in the HUC surrounding the Humboldt Mill, including Bell Creek and Middle Branch Escanaba River are listed as impaired by Polychlorinated Biphenyls (PCBs) for fish consumption. The probable sources contributing to this impairment are listed as “Atmospheric Deposition – Toxics.” A

statewide restoration plan was created in 2017 (USEPA, 2020). Because the industrial use of PCBs was banned in 1979, the primary sources of PCBs to water are likely historic (LimnoTech, 2013).

Non-Compliance and/or Litigation

As of an April 2022 query, the Eagle Mine has had no violations in the past 3 years according to the USEPA ECHO database. The Humboldt Mill, where materials are processed from the Eagle Mine, has been in violation of the CWA for 9 of the past 12 quarters. The noncompliance violations include effluent gross amounts of chlorine, cyanide, manganese, nickel, and toxicity. The USEPA ECHO database reports that in April 2019 the mill was issued a letter of violation/warning letter from the State of Michigan for an NPDES enforcement/compliance activity.

CEMP states that neither site has had any state permit violations (CEMP, 2022).

Mitigation Measures / Corrective Actions and Their Effectiveness

No mitigation measures other than standard requirements for their permits were found during an online search in April 2022.

Flambeau Mine

Northwest Wisconsin, United States

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level 1 Ecoregion</i>
Open-Pit Copper-Gold Mine	Began operations in 1993	Closed in 1999 – Fully Reclaimed	Northern Forests

Location

The reclaimed Flambeau Mine is adjacent to the Flambeau River in Ladysmith, Wisconsin, in the USEPA Level II Mixed Wood Shield ecoregion. Moderate to low gradient perennial streams are typical and wetlands are widespread in this ecoregion. The numerous glacial lakes are clearer and less productive than those in ecoregions further south. The Mixed Wood Shield is largely devoid of agriculture because of its thin, nutrient-poor soils and short growing season. Forest types are mostly coniferous and northern hardwood forests, with sugar maple, yellow birch, hemlock, white pine, and red pine. Cooler and wetter sites have black spruce and northern white cedar.

The region is rich in wildlife, with moose, black bear, gray wolf, white-tailed deer, lynx, snowshoe hare, ruffed grouse, bald eagle, brook trout, and muskellunge. Main economic activities for this border region include forestry, recreation, tourism, hunting and fishing, and iron ore mining. Parts of the ecoregion contain some public national, state, and provincial parks or forestlands. There is also some farming with hay, grain crops, and dairy cattle (Wiken et al., 2011). The closest major city is Duluth, about 136 miles northwest.

The geology of the Flambeau Mine area consists of a thick cover of glacially derived soils overlying Precambrian bedrock consisting mainly of metamorphosed volcanic, granitic and sedimentary rocks. The Precambrian rocks occur as steeply dipping east-northeast trending belts. The Flambeau deposit is a massive sulfide deposit situated in one of these belts that extends from the Pembine area in Florence County to Ladysmith. Other mineral deposits, including the Crandon (Exxon) and Pelican River (Noranda) deposits, have been discovered in this region. The bedrock in the Flambeau area started out as volcanic extrusions of lava and exhalative deposits that occurred about 2 billion years ago, followed by volcanogenic sediment depositions and granitic intrusions. The region then underwent dynamic mountain building more than 1.8 billion years ago which tilted the rocks to their current near-vertical orientation (Wisconsin DNR, 1990).

Comparison to Rainy River Withdrawal Application Area

The Flambeau Mine is approximately 160 miles northwest of the Rainy River Withdrawal Application Area. The Rainy River Withdrawal Application Area and the Flambeau Mine are both located within the Level II Mixed Wood Shield ecoregion of the Level I Northern Forests ecoregion. Landscapes in both areas include large amounts of surface water and proximity to large bodies of freshwater.

However, the region encompassing the Flambeau Mine area has a thick cover of glacial soil deposits, whereas within the Rainy River Withdrawal Application Area these deposits are in comparison sparse resulting in many bedrock exposures in the area. The Rainy River Withdrawal Application Area is within the Canadian Shield, whereas the Flambeau Mine area is not. Although similar to the greenstone formations, the volcanic rocks of the Flambeau Mine site are younger at about 2 billion years old, versus 2.7 billion years for the greenstone volcanics.

Site Design

Prior to mining, the 181-acre site was a mix of agriculture, pasture, and forest with several intermittent tributaries to the Flambeau River. There were also approximately eight acres of wetlands within the project area (Wisconsin DNR, 1990). The mining operation consisted of a 35-acre open pit, various stockpiles, mine operations buildings, and wastewater treatment facility. Waste material removed from the pit was directed to one of several stockpiles on the site. A separate stockpile was created for the glacial overburden, sandstone, weathered bedrock, and low-sulfur waste rock containing less than 1 percent sulfur. These materials were stored in an unlined 40-acre facility just north of the open pit. High-sulfur waste rock and other material containing greater than 1 percent sulfur, which could generate acidic drainage, was stored in a lined 27-acre stockpile area south of the pit. The high-sulfur stockpile was underlain with a plastic membrane liner and leachate collection system to prevent migration of potentially contaminated water from entering the groundwater system (Wisconsin DNR, 2022).

Groundwater entering the open pit was collected in sumps and pumped to lined holding ponds. Runoff from the stockpiles as well as leachate from the high-sulfur waste rock storage facility was also directed to the holding ponds. This water was then sent to the wastewater treatment facility and discharged to the Flambeau River. The water treatment facility used filtration, lime neutralization, sulfide precipitation to treat the discharged water. Ore was crushed on-site and sent to Canada for concentrating and smelting (Wisconsin DNR, 2022).

Environmental Review Process

Acquisition of mining permits for the 181-acre site began in 1974, with plans to have an 11-year open-pit phase followed by an 11-year underground mine. An Environmental Impact Report was submitted to Wisconsin DNR after which they prepared an EIS for the project. In 1976 local officials indicated they would not grant zoning approvals, so the mine permitting process was stopped. In 1986, the project was reevaluated and redesigned on a smaller scale. DNR issued a FEIS in 1990 and all permits were issued in 1991.

The 1990 EIS predicted that private wells north of the mine could be adversely affected by drawdown of groundwater. The EIS also stated that Flambeau Mining Company (FMC) would replace any water supplies impacted by the project. No impacts to threatened or endangered species, water quality, or aquatic

life were predicted to occur. Waste rock was acknowledged to have the potential to leach contaminants to ground and surface waters, but proposed segregation, lining, and backfilling measures would prevent “widespread adverse impacts” to groundwater. The EIS concluded that the proposed wastewater treatment system appeared adequate to meet regulatory limits for water quality; unanticipated effects would be managed via monitoring, testing, and prompt implementation of corrective actions. With dust suppression measures, no air quality violations were anticipated (Wisconsin DNR, 1990).

One stream in the project area would be removed causing minor impacts to stream and river flows. The primary air pollutant would be caused by dust emitted from the project, but if dust suppression measures were used the total dust emissions would remain below air quality violation standards. Short term adverse visual impacts would occur along a state highway and Flambeau River.

Impacts to the Environment

After mine reclamation, and during regular surface water monitoring and site inspections, elevated levels of copper were found in sediment in the biofilter pond associated with the former mine buildings that were later used by the City of Ladysmith.

Post-mining monitoring found that concentrations of copper and zinc in one stream frequently exceeded acute toxicity criteria, although the results of a bioassay test and the presence of a fish and macroinvertebrate community in this stream suggest that any potential toxicity is not severe (Roesler, 2012). The affected stream was not monitored prior to mining, so a comparison to baseline data is not possible. However, pre- and post-mining monitoring in the Flambeau River and several intermittent streams did not show any significant changes in copper and zinc concentrations, suggesting that local background concentrations of copper and zinc are generally low (Roesler, 2012). In 2015, FMC completed additional soil excavation, improvement of drainageways, modification of the drainage system, and installation of permanent erosion control features in select areas. Currently, the stream still exceeds the water quality standards for copper and has been designated as an "impaired water" in accordance with Section 303(d) of the Clean Water Act (Wisconsin DNR, 2022).

Non-Compliance and/or Litigation

A search of the USEPA ECHO database found no violations for the former mine. Wisconsin DNR stated that throughout the life of the project, there were no exceedances of any effluent limits during the period of discharge. The Flambeau River similarly did not show any impacts from the effluent discharge. Anomalous results from some bioassay tests were reported, but in each case the company responded promptly and appropriately. Air monitoring indicated exceedances of suspended particulate limits, only one of which was attributed to activities on the mining site: dust from a delivery of an uncovered load of crushed limestone (Wisconsin DNR, 2022).

Mitigation Measures / Corrective Actions and Their Effectiveness

In 1997, reclamation of the open pit began. The reclamation plan stipulated that the pit would be backfilled with original rock and soil materials that were removed during site preparation and mining operations. High-sulfur waste rock was blended with limestone for neutralization before entering the pit. The high-sulfur waste rock was overlain by low-sulfur waste rock, weathered bedrock, sandstone and glacial till. The

site was graded to the approximate pre-mining condition and long-term surface water drainage features were established. Topsoil was reapplied to the site and revegetation and wetland restoration efforts began.

The Reclamation Plan goal was to create diverse habitats by reestablishing forested areas, various native grasslands, and wetlands. The majority of revegetation activities at the site took place in 1998 and 1999. Grassland areas were seeded with a mixture of cover crop, native grasses, and wildflowers. Woodland areas were planted with tree and shrub seedlings along with some larger trees. An 8.5-acre wetland area was constructed using wetland soils that were salvaged and stockpiled during site construction. During reclamation, plants and bare rootstock of typical wetland species were planted. Drainageways and biofilters were also planted with live tree stakes of alder, willow and dogwood species. A trail system through the reclaimed site was also developed for public use. Reclamation was complete in 1998.

In 2007, FMC granted a Certificate of Completion for 149 acres of the mine site. The remaining 32 acres of “Industrial Outlot” required further environmental testing for no less than three years. In November of 2021, FMC submitted its petition for Certificate of Completion (DeWitt, 2021).

Gilt Edge Mine

Western South Dakota, United States

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level 1 Ecoregion</i>
Open-pit heap leach gold mine	Began historical operations in 1876	Inactive since July 1999	Northern Forests

Location

The former Gilt Edge Mine is located 6.5 miles East of Lead, South Dakota in the USEPA Level II Middle Rockies ecoregion. Characterized by steep, high elevation mountain ranges, the site is within the Black Hills sub-region of the Middle Rockies. Forests in the area are dominated by stands of white spruce, quaking aspen, and paper birch.

The geology of the region encompassing the Gilt Edge Mine is mixed with portions of the limestone plateau, areas of schists, slates, quartzites, and large areas of granitic rock intrusions. At the Gilt Edge Mine, gold is hosted in highly-fractured and brecciated Tertiary felsic igneous rocks at an age about 60 million years ago. The igneous rock consists of a quartz monzonite stock that has been intruded by rhyolite dikes. Mineralization of gold and sulfides occurs in the fractured quartz monzonite and the extensively altered rhyolite dikes. Mining has increased in recent year within the region due to improved precious metal prices and improvements in mining technology.

Comparison to Rainy River Withdrawal Application Area

The Gilt Edge Mine area shares a similar forested vegetation composition to the Rainy River Withdrawal Application Area. The geology of the areas is not similar. The mineralized deposit of the Gilt Edge Mine consists of felsic igneous rock at an age of around 60 million years ago. Conversely, the rocks of the withdrawal area are either mafic igneous intrusives or metamorphosed volcanogenic rocks.

Site Design

The site consists of a 360-acre area containing several retention ponds, a large open-pit mine, heap leach processing pad, and some historic underground exploratory structures beneath the current retention ponds.

Environmental Review Process

An EIS was issued in 1997 for the proposed Anchor Hill Project, which would expand the existing open-pit gold to 37 acres. Approval was rescinded in 1998 after appeals from the mine owner. The EIS could not be located online.

Impacts to the Environment

The mine has several large, exposed rock faces generating acid rock drainage: there have been multiple NPDES violations for discharges with elevated levels of cyanide from leaks in the heap leach process, and

additional discharges of metals into the nearby Strawberry Creek (USEPA, 2008). Additional impacts are described in the following section.

Non-Compliance and/or Litigation

In 1982, the mine was found to be discharging cyanide solutions into Strawberry Creek via overflow of the heap leach ponds during heavy rain. The owner was fined \$99,800 in 1991 by the USEPA for an NPDES violation, and in 1994 the owner removed the tailings from the creek drainage. From 1994 to 2000 the mine was cited for multiple additional NPDES Permit limit violations, specifically citing aluminum, cadmium, copper, lead, and zinc discharges into Strawberry Creek (USEPA, 2008). In 1998 the site owner reported their intent to abandon the site and related water treatment operations, and the state filed an injunction to prevent site abandonment. After the parent company of the site owners filed for bankruptcy in 1998, South Dakota DENR took control of the site and related water treatment responsibilities (USEPA, 2008). In 2016, several previous owners of the site were sued by the USEPA for a combined \$10.3 million to pay for remediation and cleanup of the site (Department of Justice, 2016).

Mitigation Measures / Corrective Actions and Their Effectiveness

The USEPA has been in control of the site since December 2000, and the area has been declared a Superfund site under CERCLA. Ongoing remedial and cleanup actions focus on mitigating the effects of acid mine drainage from the exposed rock and waste rock piles and reducing the amount of metal contamination within the watershed. Cyanide levels within the surface soils and water from heap leach ore processing have been reduced to trace amounts (USEPA, 2017).

Greens Creek Mine

Juneau, Alaska, United States

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level I Ecoregion</i>
Underground silver, zinc, lead, and gold mine	Began operations in 1989	Currently Active	Marine West Coast Forest

Location

The Greens Creek Mine is located on Admiralty Island, within the Tongass National Forest. A portion of the mine is also located within Admiralty Island National Monument. The mine resides at an elevation of 1,500 feet along the southern portion of the Greens Creek. It is approximately 17 miles southwest of Juneau and approximately 7 miles southwest of the Gulf of Alaska. It is within the USEPA Level II Marine West Coast Forest ecoregion.

Old-growth rainforests primarily consisting of Sitka spruce (*Picea sitchensis*) and western hemlock (*Tsuga heterophylla*) can be found at the lower elevations of Admiralty Island, while both alpine tundra and subalpine forests appear above 2,000 feet. Muskeg bogs, avalanche slopes containing deciduous shrubs, as well as wetlands with an abundance of *Carex* sedge communities can be found throughout the island (Schoen, 1988). Regarding wildlife, the island is known to contain a high-density brown bear and nesting bald eagle populations. Harbor seals, porpoises, and sea lions can be found within bays, while multiple species of pacific salmon are found within multiple rivers and streams (Travel Alaska, 2022)

The Greens Creek deposit is a series of massive sulfide bodies that lie along the contact between altered mafic-ultramafic igneous rocks and stratigraphically overlying Upper Triassic argillite sediments. The deposit itself is a polymetallic, stratiform, massive sulfide deposit in a host rock containing mostly marine sedimentary, and mafic to ultramafic volcanic and plutonic rocks. Discontinuous mineralization happens between a structural hanging wall of quartz-mica-carbonate-phyllite, and a structural footwall of black graphitic and calcareous Greens Creek argillite (Mindat.org, 2001).

Comparison to Rainy River Withdrawal Application Area

The Greens Creek Mine and the Rainy River Withdrawal Application Area are within or in close proximity to environmentally sensitive and protected areas (Hecla Greens Creek, 2019). In addition, both areas are heavily forested and have extensive surface water features including rivers, streams, and open water. The geologies are dissimilar in that the Greens Creek deposits are of a younger age of 200 to 225 million years old, and are associated with a non-volcanic sedimentary deposit. In contrast, the Rainy River Withdrawal Application Area occurs within 1.1-billion old layered mafic igneous intrusions of the Duluth Complex and 2.7-billion-year-old low-grade metamorphic volcanic-derived igneous and sedimentary rock of a greenstone formation.

Site Design

The Greens Creek Mine is an underground silver, lead, zinc, and gold mine. It generates approximately 2,200 tons of ore each day, is estimated to have 10 years' worth of ore reserves, and occupies 320 acres (US Forest Service, 2012). The primary mining methods used are cut-and-fill and longhole stoping. The mining process can be categorized into three phases: tunneling, extraction, and replacement. During the tunneling phase, miners bore 15 feet high by 15 feet wide tunnels to access the targeted mining zones. The extraction phase varies upon which types of ore are being sought, smaller orebodies being extracted by tunneling while greater ones may be subjected to large scale extracting methods. Lastly, within the replacement phase, pits are backfilled by filling in the excavated holes with mill waste and cement, thus stabilizing that portion allowing excavation to occur around the backfilled area (Hecla Mining Company, 2022). Ore processing at the Greens Creek Mine utilizes a floatation process. This involves adding compounds like copper sulfate into the ore before separating it from its valuable materials. The mine tailings are later disposed of as backfill (Ground Truth Trekking, 2016).

Environmental Review Process

In 1983, the U.S. Forest Service published an EIS and ROD for the proposed development of the mine. The Final EIS predicted a “low threat” to fish habitat, “low disruption” to subsistence activities, “moderate loss” of brown bear habitat, and a “low potential” of chemical and heavy metal accumulations affecting marine resources for the project as designed at the time (US Forest Service, 1983).

The General Plan of Operations (GPO) was approved in 1984. The GPO stipulated underground mining, and for the ore to be crushed and concentrated by floatation in a mill close to the mine. However, mine ownership of changed in 1986 and the new owner requested changes to the GPO regarding tailing disposal. To address this and other proposed changes, in 1988 the Forest Service issued the EA for Proposed Changes to the General Plan of Operations of the Greens Creek Mine (a copy of which could not be located online). As full-scale mine development began in 1987, workers found large volumes of porous soil that had to be removed. Because this soil had been placed in the designated waste rock disposal site, unanticipated volumes of waste rock were disposed of at the Tailings Disposal Facility (TDF), therefore decreasing the mine's future capacity for tailings. To address this unanticipated situation, the Forest Service issued the EA for Additional Waste Rock Disposal Capacity at the Greens Creek Mine (a copy of which could not be located online).

The mine and concentrator facility began operation in 1989 but was suspended in 1993 due to low metal prices. After three years of modernization and redevelopment, operations continued in 1996 (Mindat.org, 2001). Due to the need for more surface tailings disposal, a proposal was submitted to the Forest Service in January 2001 to modify the GPO to include an expansion of the TDF capacity. In November 2003, the Forest Service published the Greens Creek Tailings Disposal Final EIS (US Forest Service, 2003). The Final EIS predicted the Proposed Action would result in negligible impacts on groundwater, surface water, marine waters, air quality, most terrestrial animals, subsistence, and recreation (US Forest Service, 2003). The resulting ROD approved 3.3 million cubic yards of additional tailings disposal capacity (US Forest Service, 2013).

In 2013, an EIS and ROD were issued, authorizing the Greens Creek Mine to expand further south on Admiralty Island by approximately 18 acres, allowing for an additional 2.1 million cubic yards of storage (US Forest Service, 2013). Based on water quality monitoring data collected from the TDF during the

previous 20 years of operations, the ROD for this EIS predicted that contact water will not meet water quality standards after closure, and that the water will require treatment in post-closure for hundreds of years, perhaps into perpetuity. An engineered cover will be constructed on the pile at closure, predicted to minimize development of acid drainage (US Forest Service, 2013). Fugitive dust and air quality emissions were predicted to increase due to dust and windblown erosion at the TDF and truck traffic on unpaved roads. As a result, additional air quality minimization measures are required in the FEIS and ROD. These include additional sampling for fugitive dust; implementation of a mitigation plan and control measures if fugitive dust emissions related to TDF activities are the source of elevated concentrations of lead, zinc and other metals; ongoing dust abatement; and spraying roads with water if notable dust is observed (US Forest Service, 2013).

As recently as 2021, the Forest Service is preparing a supplemental EIS addressing the mine's request to expand its TDF by 14 acres. It is predicted that the 66-acre TDF will be filled by 2031, and the mine will end operations soon after (Brehmer, 2021).

Impacts to the Environment

The mine's initial EIS (US Forest Service, 1983) predicted minimal potential for acid mine drainage production. The non-profit Ground Truth Trekking reports that, in 2001 and 2002, increased metal leaching was found around the site, and the Alaska Department of Conservation (ADEC) documented acid mine drainage in 2003 (Ground Truth Trekking, 2016). The most recent ADEC Active Tailings and Production Rock Report (2019) states:

“Greens Creek Mine tailings contain pyritic sulfur, which through weathering processes can lead to acid generation. However, the tailings also contain significant carbonate, which neutralizes acid. Previous studies have shown that the lag time to acid generation of exposed tailings is on the order of decades. ... Waste rock from the mine generally consists of two varieties, argillite and phyllite. Characterization of Greens Creek Mine argillite and phyllite ... indicates that argillite is clearly not acid generating and that most samples of phyllite are potentially acid generating” (ADEC, 2019).

To manage the potential for acid generation, the mine implements a sampling and monitoring protocol, the results of which are included in the annual ADEC reports.

Earthwork's Alaska Metal Mines Report (Gestring, 2020) reports that an audit in 2018 found that fugitive dust emissions from the TDF are a concern for surface water quality; a copy of the audit could not be found during the April 2022 review of information. Fugitive dust monitoring is a requirement of the Waste Management Permit and is monitored through atmospheric deposition container monitoring, real-time monitoring, and visual monitoring (Hecla Greens Creek, 2020).

As described in the previous section, fugitive dust has been identified as an environmental concern at Greens Creek. As a result, the Forest Service has required additional minimization measures to minimize dust-related impacts on air quality, water quality, and other resources (Forest Service, 2013).

Non-Compliance and/or Litigation

According to a report published by Earthworks (Gestring, 2020), Greens Creek was cited for multiple violations of the Clean Water Act and the Safe Drinking Water Act from 2016-2019. ACEC also issued water quality violations in 2002 and 2006. Violations include diesel oil spills, stormwater discharge outfalls,

mine drainage discharges due to failure in a pipeline, mud discharges, and an onsite spill of zinc concentrate (Gestring, 2020). An April 2022 query of USEPA ECHO database records for the past 3 years appears to corroborate Gestring's findings: ECHO identified 9 quarters with RCRA violations, 4 quarters with CAA violations, 11 quarters with CWA violations, and 5 quarters with SWDA violations.

In 2018, a Notice of Violations was issued regarding violations of, "...Title 46, Chapters 15 and 17 of the Alaska Statutes (*Water Use Act and Supervision of Safety of Dams and Reservoirs*) and violations of Title 11, Chapter 93 of the Alaska Administrative Code (*Water Management*)" (ADNR, 2018). The Notice alleged these violations occurred due to the expansion of the Tailings Storage Facility (TSF) and subsequent unauthorized modification of the Pond 7 dam, the unauthorized construction and operation of the Pond 10 and Sand Pit dams, and the unauthorized diversion of water within the Pond 7, Pond 10, and Sand Pit dams (ADNR, 2018). A summary of the required corrective measures are detailed below.

Mitigation Measures / Corrective Actions and Their Effectiveness

Due to the violations listed above, the Hecla Greens Creek Mine was required by the Alaska Department of Natural Resources (ADNR) to implement a number of corrective measures, including: paying a civil damages fee, providing proof of financial ability to cover costs, conducting a geophysical investigation of groundwater, conducting an independent technical evaluation of pertinent aspects of integrated water management systems, submitting a final operations and maintenance program with ongoing data collection, inspections and reporting, and demonstrating adequate measures and processes to ensure future compliance (Alaska DNR, 2018). Implementation of some of these measures is ongoing and their efficacy cannot be conclusively determined.

Kensington Mine

Southeast Alaska, United States

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level 1 Ecoregion</i>
Underground gold mine	Began operations in 2010	Currently Active	Marine West Coast Forest

Location

The Kensington Mine is an underground gold mine on the east side of Lynn Canal, 45 miles north of Juneau, Alaska. The mine is accessible by either a combination of road vehicles and boat or by helicopter, floatplane, or boat from Juneau (Coeur Mining, 2022).

The Kensington Mine lies within the USEPA Level I Marine West Coast Forest ecoregion. The Commission for Environmental Cooperation describes this ecoregion as extending along the Pacific coast from southern Alaska to northern California. The topography is mountainous bordered by coastal plains and contains all the temperate rain forests in North America. Igneous and sedimentary rocks underlie most of the area with leached, nutrient-poor forest soils. The Pacific Ocean moderates the climate with high levels of precipitation, long growing seasons, and moderate temperatures. Variations in altitude create contrasting ecological zones from temperate coastal rain forests to cool boreal forest. Temperate forest has a mixture of western red cedar, yellow cedar, western hemlock, Douglas fir while more subalpine regions have mountain hemlock and Pacific Silver fir. Alpine regions are dominated by shrubs, herbs, mosses, and lichens. Landcover around the mine is mostly evergreen forest with mixed forest and shrubs lands dotted around the greater area. The mine is located on the west side of a mountain along a stream that drains directly into the Gulf of Alaska. To the east, the Lace River creates a delta and subsequently Berners Bay to the south of the mine.

The Kensington Mine is in the Berners Bay Mining District, which lies on the northern end of the Juneau Gold Belt, a 120 mile-long, 10-mile-wide structural zone containing numerous mesothermal gold deposits. The district is flanked by Triassic-age mafic metavolcanic rocks to the east-northeast and Cretaceous-age pelitic sediments to the west-southwest. The contact between these two units has been intruded by the northwest-trending, Cretaceous-age Jualin Diorite stock, measuring approximately five miles long by three miles wide. Regional deformation and shearing within and adjacent to the Jualin Diorite resulted in emplacement of numerous gold-bearing, mesothermal quartz-carbonate vein deposits. The deposits with economic significance consist of high-grade shear-hosted veins of limited strike and dip length, within a narrow halo of locally auriferous quartz-veined diorite, and vein packages comprised of extensional vein arrays, sheeted extensional veins, and stacked en-echelon shear veins (Coeur Alaska, 2018).

The deposit at the Kensington Mine consists of a quartz vein in the Jualin Diorite. The vein has been traced for 1,500 feet along strike and 3,200 feet vertically, and averages 43 feet in thickness. The vein is bounded on the north by metavolcanic rocks and to the south, the limit of ore is defined by declining metal values (Echo Bay Mines, 1993).

Comparison to Rainy River Withdrawal Application Area

The Kensington Mine area and Rainy River Withdrawal Application Area are both close to large water bodies and heavily forested. The Kensington Mine is located in a very mountainous region while the Rainy River Withdrawal Application Area is relatively flat in comparison. The geology between the two areas is dissimilar. The geology of the Kensington Mine area is much younger within the Mesozoic Period (65 to 225 million years ago), whereas the geologic age of the withdrawal area is 1.1 to 2.7 billion years old, within the Precambrian time period. Gold mineralization at the Kensington Mine site occurs within fault-filled veins in an igneous diorite intrusive of intermediate composition (between mafic and felsic composition). Mineralization within the Rainy River Withdrawal Application Area occurs within older layered mafic igneous intrusions of the Duluth Complex and even older low-grade metamorphic volcanic-derived igneous and sedimentary rock of a greenstone formation.

Site Design

The 2021 Final Supplemental Environmental Impact Statement (FSEIS) Plan of Operations Amendment 1 for the Kensington Mine describes the 239-acre processing facility as a conventional milling gold froth flotation recovery circuit. The major components include crushing, grinding, gravity separation, flotation, thickening, and filtering. Gold flotation concentrates are transported offsite while mined ore is transported to the surface and stockpiled by the Kensington Portal. Most waste rock is hauled to the surface and stored there, but approximately 10 percent of waste rock remains underground and is placed as backfill in mined-out areas. Around 40 percent of the 1,200 tons of tailings milled per day are placed underground into the stopes as paste backfill; the remainder are deposited in the tailings treatment facility. The tailings and water are held in place by a dam constructed in three stages in 2010, 2012, and 2018 with a current capacity of 4.5 million tons of tailings solids covering roughly 60 acres (US Forest Service, 2021).

Environmental Review Process

The Tongass National Forest approved Plan of Operations Amendment 1 in February 2022. The 2005 Plan of Operations allows for sufficient tailings and waste rock storage through 2023, but additional waste rock storage is needed to continue operations. The mine is now permitted to construct a new Stage 4 tailings dam, expand waste rock storage at Comet, Kensington, and Pit #4, and build a new waste rock storage facility along Pipeline Road. Amendment 1 approval will allow the mine to operate for an additional 10 years (until 2033). Based on public input, the Final Supplemental EIS for the amendment analyzed the following significant issue “Expansion of tailings and waste rock areas, increased production of tailings, construction, and the consequences of dam failure due to increased water and tailings behind the dam may adversely affect aquatic resources; specifically, water quality, fish habitat, streams, wetlands, and other Waters of the U.S.” The EIS predicted that exceedances of effluent limitations could occur, but impacts would be localized, minor, and temporary. A significant earthquake could destabilize the tailing dam, resulting in loss of tailings, but the chance of tailings and water volume reaching Berners Bay to be “extremely unlikely.” The predicted loss of stream habitat associated with the mine’s expanded footprint may reduce some stream fish production, but enhancements and lake expansion may increase overall Dolly Varden char production in the affected area (US Forest Service, 2021).

In 2005, Coeur Alaska, Inc. received U.S. Army Corps of Engineers permits to dispose of 4.5 million tons of waste into nearby Lower Slade Lake effectively killing most aquatic life (New York Times, 2009). The Corps found that this was less environmentally damaging than other options which could affect wetlands

in the area. Environmental advocacy organizations sued arguing the waste should be regulated by the Clean Water Act which is much more stringent (New York Times, 2009). In 2009, the United States Supreme Court ruled that Coeur was able to discharge the waste into the lake (Coeur Alaska, Inc. v. Southeast Alaska Conservation Council Et Al.).

Impacts to the Environment

The previously mentioned release of 4.5 million tons of mining waste into Lower Slate Lake has altered the entire aquatic biotic community of the lake. Coeur plans to return the fish population and habitat back to baseline conditions after mining has discontinued (US Forest Service, 2021). According to the Aquatic Studies at Kensington Mine conducted from 2014-2016, water quality in Slade Creek, Johnson Creek, and Sherman Creek have all been negatively affected by mining discharge, mainly due to high concentrations of metals; however, these reports present monitoring data with little interpretations of what the data means to the scale, magnitude, or duration of environmental impacts (Kanouse, 2014; Brewster, 2015; Kanouse and Zutz, 2016).

Non-Compliance and/or Litigation

According an Earthworks report (Gestring, 2020), Kensington Mine has been cited multiple times from 2005-2019 by the EPA and ADEC for violations of the Clean Water Act and exceedances of or unpermitted discharges. This finding appears to be corroborated by an April 2022 review of the USEPA ECHO database, which shows two quarters of non-compliance of the CAA within the past three years and two informal enforcement actions in the past five years. The mine has also been in non-compliance with the CWA consistently for the past three years, has had six informal enforcement actions, three formal enforcement actions, and has paid \$450,000 in fines in the past five years. Additionally, the mine's owner was sued by the USEPA for \$84,500 for violating the Emergency Planning and Community Right-to-Know Act.

CAA violations included federally reported violations of exceedances of nitrogen oxides in 2020 and an unknown pollutant in 2019. CWA violations included exceedances of zinc, cadmium, copper, and total dissolved solids. Other violations of the CWA included multiple unauthorized discharges, effluent violations failure to maintain records, improper operations and maintenance, failure to monitor for non-toxicity requirements, improper analysis or lab error, improper/incorrect reporting, and failure to submit required reporting.

Formal enforcement actions occurred in 2019. One formal action was in response to failing to develop a complete Stormwater Pollution Protection Plan (SWPPP) along with failure to conduct required monitoring and inspections, resulting in a \$210,000 fine. Another formal action was in regard to discharged pollutants in excess of permit limits resulting in a \$240,000 fine. The third formal action was in response to improperly discharging acid rock discharge, resulting in no fine. Additionally, the mine was fined \$84,500 for failing to report nitrate compounds manufactured by the facility from 2013 to 2017.

Mitigation Measures / Corrective Actions and Their Effectiveness

No mitigation measures or corrective actions were found online other than those stipulated in the FSEIS regarding future reclamation.

Lac des Iles Mine

Southern Ontario, Canada

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level 1 Ecoregion</i>
Open-Pit and Underground Mine	Began operations in 1993	Currently Active	Northern Forests

Location

The Lac des Iles Mine is currently an open-pit and underground palladium, gold, platinum, copper, and nickel operation located approximately 55 miles northwest of Thunder Bay, Ontario, Canada which is located on the boundary of Lake Superior. Other large bodies of surface water surrounding the Lac des Iles Mine are the Lac des Iles located directly north of the mine, Dog Lake located approximately 20 miles south and Lake Nipigon located approximately 40 miles northeast. Water typically flows into three local catchments to Lac des Iles, Camp Lake, and Hasson Lake which all eventually flow into Lake Superior.

Lac des Iles Mine is located within the USEPA Level II Softwood Shield ecoregion of the Level I Northern Forests ecoregion. Otherwise known as the boreal shield ecozone of Canada, this region is the largest ecozone in Canada and is primarily comprised of boreal forests of Taiga and coniferous forests with numerous surface water features.

Lac des Iles Mine is located within the physiographic Superior Province of the Canadian Shield. Regional geology of the Lac des Iles area is primarily composed of mafic to ultramafic rocks of the Archean Lac Des Iles Intrusive Complex (LDI-IC). The LDI-IC includes, specifically two discrete intrusive complexes, called, the North LDI Complex and the South LDI Complex, that are encompassed by the LDI mine properties. The LDI-IC is a 2.7-billion-year-old layered mafic-ultramafic rock that has intruded into approximately 3.0-billion-year-old granites and greenstone of the Superior Province. The complex is located just to the west of the Nipigon Embayment of the Mid-Continent Rift system. These ultramafic to mafic rocks within the LDI-IC Complex host economic concentrations of Cu, Ni, and PGM ore base and precious metals in the form of magmatic sulfide deposits which can occur in intrusion or lava flows (NAP Alladium, 2018).

Comparison to Rainy River Withdrawal Application Area

The Lac des Iles Mine is located in Ontario, Canada, approximately 130 miles northeast of Ely, Minnesota. The Lac des Iles Mine and Rainy River Withdrawal Application Area are located in similar vegetative communities, with similar climates, and in relatively close proximity to Lake Superior and smaller surface water features.

The layered mafic to ultramafic geology of the Lac des Iles Mine area is similar to that of the Duluth Complex within the Rainy River Withdrawal Application Area, but much older. The Duluth Complex is associated with the 1.1-billion-year-old Mid-Continent Rift system, whereas the LDI-IC has been dated at

an age of 2.7-billion years old, which is of similar age to the greenstone formation and granitic batholiths within the Rainy River Withdrawal Application Area.

Site Design

Lac des Iles began operations in 1993 using open-pit mining methods, and in 2005-2006 developed an underground mine beneath the Roby Pit. The underground component of the Lac des Iles Mine uses a long hole stoping mining method with an unconsolidated fill approach. Other existing supporting infrastructure includes a gravel access road to site from Provincial Highway 527; several buildings and facilities associated with administration, maintenance, offices, and security operations; accommodations for 324 people including dining and recreation; a potable water treatment plant; an exploration office building and core storage area; a building used for cold storage and information technology; a maintenance facility and warehouse; two major propane tank stations; No. 1 shaft, hoist house and compressor building; the underground ore handling system which consists of two ore passes, grizzlies, rock breakers, a crusher and a loading pocket; the mill complex; a Tailings Management Facility (TMF) and water treatment plant; surface explosive storage buildings; the pump house which draws fresh water from Lac Des Isle Lake; an electrical station; the East waste rock pile; the low grade stockpile which is used as supplemental mill feed; and the South Fill Raise and Dump. (Buss, Roney, Peck, et al. 2017).

Environmental Review Process

No federal EAs or reviews addressing construction of the Lac des Iles Mine could be found online in a review of publicly available sources in April 2022.

In accordance with federal and provincial regulatory requirements as well as applicable permits, Lac des Iles is required to complete several environmental monitoring studies. Environmental elements monitored include surface and groundwater quality, sediment quality, benthic invertebrate community monitoring, fish population monitoring, and air quality monitoring (Decharte, Hofton, Marrs, et al., 2018).

Impacts to the Environment

According to Mining Watch Canada (2001), a non-profit organization, the Lac des Iles Mine failed to meet water quality standards for toxicity in 1997 and phosphorus in 1998. These statements could not be verified during an April 2022 search of publicly available online government records.

In 2015, the Ministry of the Environment allowed the mine to discharge tailings into the local watershed due to a water balance issue and heavy rains threatened the stability of the dam at the TMF. Chief Wilfred King of the Gull Bay First Nation reported that more than 200 gallons of water with suspended soils, iron, and aluminum were released (CBC News, 2015). Clarity tests after the incident ranged from 5-7 out of an allowable 10 Nephelometric Turbidity Units. After the failure, the mine conducted assessments on dam safety and stability (Thompson, 2015); the ministry order Lac des Iles to implement long-term monitoring and remediation plan (TBnewswatch, 2015)

Non-Compliance and/or Litigation

Lac des Iles, nor Impala, North American Palladium, or Lac Des Iles Mine Ltd., were not listed on the Canada Environmental Offenders Registry in an April 2022 query. However, several health and safety violations were found in relation to the Lac des Iles Mine, including a 2006 incident in which Lahti

Construction and Design Inc. was fined \$80,000 for a violation of the Canadian Occupational Health and Safety Act that resulted in injuries to five employees at the Lac des Iles Mine (Ontario Newsroom, 2006). In 2007, Lac Des Iles Mines Ltd. plead guilty and was fined \$110,000 for a violation under the Occupational Health and Safety Act (Northern Ontario Business Staff, 2010). In 2016 Lac Des Iles Mines Ltd. was fined \$365,000 for health and safety violations in which one worker was injured and another one was killed (CBC, 2016). And in 2020 a mining contractor died as a result of underground mining activities (AMSJ, 2020).

Mitigation Measures / Corrective Actions and Their Effectiveness

Several mitigation measures have been implemented based on risks identified in the 2018 Feasibility Study. No environmental issues were identified which would affect the ability of Lac Des Iles Mine Ltd. to mine at the site (Decharte, Hofton, Marrs, et al., 2018). Additional environmental mitigation measures as a result of the feasibility study include additional measures implemented should void propagation occur sooner than expected and reducing the reliance on upstream dam raises in the TMF through the use of hybrid raise methodologies.

As described above, after the 2015 discharge Lac des Iles Mine conducted assessments on dam safety and stability (Thompson, 2015); the ministry order Lac des Iles to implement long-term monitoring and remediation plan (TBnewswatch, 2015). The mine has operation plans in place for each dam, spillway, structure, reclaimed cell and all constructions associated with the TMF (Thompson 2015). No subsequent TMF violations were identified in an April 2022 online search.

Lalor and 777 Mines

Western Manitoba, Canada

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level I Ecoregion</i>
Underground copper, zinc, gold, and silver mine	The 777 mine began operations in 2001; Lalor in 2012	Currently Active	Northern Forests

Location

Hudbay Minerals' Lalor and 777 mines are located in central west Manitoba, Canada approximately 620 miles northeast of the Rainy River Withdrawal Application Area. The 777 Mine borders the Manitoba-Saskatchewan border in Flin Flon, Manitoba; and the Lalor Mine is located approximately 75 miles east near Snow Lake, Manitoba. Portions of the ores from the Lalor Mine are transported and processed in the Flin Flon Concentrator, and all of the ore from the 777 Mine is processed in Flin Flon. Both mines are located in the immediate vicinity of large bodies of surface water including Snow Lake and are located northwest of Lake Winnipeg.

The Flin Flon area is located within the USEPA Softwood Shield Ecosystem Level II Ecoregion. The softwood shield ecosystem is comprised of permafrost terrain with wetlands and numerous small lakes and ponds present throughout. Tree species are primarily made up of black spruce and jack pines with shrubs, mosses, and lichens in the understory. Land in the region is mainly used for hunting, trapping, fishing, mining, and tourism.

Geology of the Flin Flon area is greenstone formation called the Flin Flon greenstone belt. The Flin Flon greenstone belt is comprised of metamorphosed volcanic, plutonic, and sedimentary rocks. It is part of the Paleoproterozoic Trans-Hudson Orogen (Lazzarotto 2020). The Flin Flon greenstone belt is known for its volcanogenic massive sulfide deposits which are what supports the production of copper and zinc in local mines (Simard 2006).

Comparison to Rainy River Withdrawal Application Area

Both the Rainy River Withdrawal Application Area and the Lalor and 777 Mines are located within the Northern Forests USEPA Level I Ecoregion. Also, as with the Lalor and 777 Mines, the northern portion of the Rainy River Withdrawal Application Area is within a greenstone formation.

Site Design

The 777 Mine is an underground mine designed to produce approximately 4,300 tons of ore per day, with access to the mine via a production shaft and a secondary ramp access. The primary mining method used to extract ore from the 777 Mine is longhole open stope, as well as retreat longhole open stope, and cut and fill. After ore is brought to the surface via the production shaft, it is milled at the Flin Flon Concentrator. Copper concentrate from the Flin Flon mill is filtered and transferred to bedding bins and sold to third party smelters. Zinc concentrates are transported from the mill to the Hudbay zinc metallurgical plant in Flin Flon

which has the capacity of 115,000 tpy of refined zinc. Tailings are sent to either the Paste Backfill Plant located in the lower levels of the Flin Flon Plant or the Flin Flon Tailings Impoundment System. Other existing infrastructure used by the 777 Mine includes provincial roads, privately owned rail lines, 115kV Manitoba Hydro grid power, and Manitoba Telecom Services land line and cellular phone service (Hudbay 2012; Hudbay 2019). The 777 Mine is approaching the end of its mine life and is anticipated to close in 2022.

The Lalor Mine is also an underground mine designed to produce 4,500 tons per day of base metal, gold, and copper-gold ore that primarily uses variations of cut and fill mining methods as well as longhold open stoping. Ores from the Lalor Mine are sent to either the concentrator in Flin Flon or to the Stall mill located approximately 16 km from Lalor. Zinc concentrates are sent by truck to the Hudbay zinc metallurgical plant in Flin Flon, and the copper concentrates are sold to the market. Tailings from the Stall mill are deposited in the Anderson Tailings Impoundment Area, or the Lalor paste plant; and tailings from the Flin Flon concentrator are deposited at the Flin Flon tailings facility or used at the paste plant in Flin Flon.

Environmental Review Process

In 2012, AECOM completed the Lalor Mine Environment Act Proposal Report to evaluate the environmental impacts of the conversion of from exploration to production of the Lalor Advanced Exploration Project and Lalor Ramp projects. The report found that, overall, the adverse residual effects of the proposed Lalor Mine would be considered negligible to minor in magnitude and mitigable with the measures implemented as detailed in the report (AECOM 2012).

Impacts to the Environment

In 2006, tests by Manitoba Conservation found soil concentrations of arsenic, mercury, cadmium, lead, and copper elevated to levels above national environmental guidelines in test areas in Flin Flon. The results of this study prompted the creation of the Flin Flon Soil Study, which was conducted by Intrinsic Environmental Services, retained by Hudbay, as well as other groups, agencies, and individuals. The study found that the risk of adverse health effects residents in the Flin Flon area were negligible to low; however low level of risk of some metals were found. A 2009 study found that some children in the area had measured blood lead levels above the Canadian Blood Lead Intervention Level. A follow-up study in 2012 found that blood lead levels in children decreased significantly following the closure of the smelter in 2010 (AECOM 2013).

Non-Compliance and/or Litigation

During an April 2022 search, neither the 777 Mine nor the Lalor Mine were listed on the Canadian Environmental Offenders Registry or the enforcement notification database.

Media have reported protests and litigation against Hudbay from indigenous peoples at other Hudbay mines, including the Mathias Colomb Cree Nation located northwest of Snow Lake, whom argued that they never gave consent to mine on their land (CBS 2013).

Mitigation Measures / Corrective Actions and Their Effectiveness

According to Hudbay's 2020 Sustainability Report, Hudbay is updating the Flin Flon Impoundment System which currently holds around 100 million tons of tailings. The impoundment project incorporates higher industry standards and takes into account other tailings dams failures to improve the safety of the structure.

Langlois Mine

West Quebec, Canada

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level 1 Ecoregion</i>
Underground zinc, copper, and silver mine	Began operations in 2007	Currently on Care and Maintenance	Northern Forests

Location

The Langlois Mine is located in western Quebec, Canada, approximately 20 miles northeast of City of Lebel-sur-Quévillon. The mine is located near several large bodies of surface water including Lake Mirbeau, Puskitamika Lake, and the Chensagi Lake as well as the Ruisseau Cameron stream.

Langlois Mine is located within the USEPA Level II Softwood Shield ecoregion of the Level I Northern Forest Ecoregion. The softwood shield ecosystem is comprised of permafrost terrain with wetlands and numerous small lakes and ponds present throughout. Tree species are primarily made up of black spruce and jack pines with shrubs, mosses, and lichens in the understory. Land in the region is mainly used for hunting, trapping, fishing, mining, and tourism.

The Langlois Mine is located in the Abitibi Sub-province of the Superior Province. The Abitibi Sub-province is one of the most extensive Achaean volcano-sedimentary greenstone belts in the world which has led to the rich deposits of gold, copper, zinc, and silver deposits throughout it (Government of Quebec, 2012). The Langlois deposit contains mainly zinc, along with lesser values of copper, silver and gold. The deposit occurs in narrow, tabular volcanogenic massive sulfide bodies with near vertical dips (Mining Weekly, 2013).

Comparison to Rainy River Withdrawal Application Area

The Rainy River Withdrawal Application Area is located approximately 700 miles west of the Langlois Mine, but both are located in the USEPA Level I Northern Forests ecoregion. Additionally, both are located in sparsely populated areas with extensive surface water at similar latitudes. Both areas are within the Canadian Shield and have similar bedrock geologies of greenstone formation.

Site Design

The Langlois Mine is a currently closed underground mine. Infrastructure at the site includes a head frame, hoisting plant, paste backfill plant, mechanical and electrical shops, a service building, a zinc and copper concentrator, and a tailings pond. When the mine was operational, the concentrator was capable of processing 2,500 tons per day of zinc and copper concentrates (Nystar, 2017).

Environmental Review Process

A review of public information available online conducted in April 2022 did not locate any relevant environmental review documentation for the Langlois Mine.

Impacts to the Environment

In February of 2018, a 500-liter spill of flocculent resulted in a discharge of acutely lethal effluent into the Wedding River. The discharge of acutely lethal effluent into water frequented by fish is a violation of subsection 36(3) of the Fisheries Act. As described below, the company was fined \$350,000 CAD. (Environment and Climate Change Canada, 2020). Online news articles did not identify any required corrective measures.

Non-Compliance and/or Litigation

In October 2020, Breakwater Resources Limited, a subsidiary of the mine owner Nyrstar, pleaded guilty to one count of violating the Fisheries Act. Breakwater was fined \$350,000 and is now listed under the Canada Environmental Offenders Registry.

Mitigation Measures / Corrective Actions and Their Effectiveness

A review of public information available online conducted in April 2022 did not identify any mitigation measures or corrective actions for the Langlois Mine.

Mount Polley Mine

South Central British Columbia, Canada

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level 1 Ecoregion</i>
Open-pit copper and gold mine with an underground component	Began operations in 1997	Currently on Care and Maintenance	Northwestern Forested Mountains

Location

The Mount Polley Mine is located in south-central British Columbia, Canada, approximately 1,350 miles northwest of the Rainy River Withdrawal Application Area. The mine is located within the USEPA Level II Western Cordillera Ecosystem of the Level I Northwestern Forested Mountains ecoregion. The Western Cordillera Ecosystem is characterized by high, rugged, and forest mountains with wide open valleys. Typical forest cover consists of red cedar, Douglas fir, sub-alpine fir, lesser black cottonwood, trembling aspen, and paper birch (Brown et al., 2016). The Mount Polley Mine is situated between Bootjack Lake to the west and Polley Lake to the east, with Quesnel Lake approximately 2.5 miles east of the site. Drainage at the mine is divided into two sub-watersheds within the Quesnel Lake watershed via Morehead Creek, Hazeltine Creek, and Edney Creek.

The Mount Polley Mine is located in the Fraser Plateau physiographic sub-division and is part of the Quesnellia accreted terrane in the Intermontane Belt of the Canadian Cordillera. Quesnellia geology is characterized by Triassic to Jurassic volcanic, sedimentary, and mafic to intermediate intrusive rocks that developed west of the continental margin of ancestral North America (Brown et al., 2016). The Mount Polley Mine is within the Mount Polley Intrusive Complex (MPIC) situated in the Central Quesnel Belt, a region within the Quesnellia. The MPIC hosts the Mount Polley copper-gold porphyry deposit. It is a Late Triassic magmatic center consisting of alkalic, marginally silica-undersaturated intrusions, and magmatic-hydrothermal breccias. The age of the deposit is approximately 205-million-year-old. Mineralization occurs in almost all constituent rock types of the MPIC, with nearly all economic mineralization in breccias, or in mineralized stockwork veins in adjacent wall rock intrusion.

Comparison to Rainy River Withdrawal Application Area

The Rainy River Withdrawal Application Area and the Mount Polley Mine are located in different geographical and environmental regions of North America. However, both areas have large quantities of surface water and glacial lakes and extensive forests.

The geologies of the Mount Polley Mine area and Rainy River Withdrawal Application Area are dissimilar. The rocks in the Mount Polley Mine area consist of igneous rock of intermediate composition (between mafic and felsic) and are at a younger age of 205 million years old. Rocks within the withdrawal area consist of the 1.1-billion-year-old mafic intrusions of the Duluth Complex, and the older 2.7-billion year old greenstone formation comprised of marine volcanogenic rocks, along with slightly younger granitic batholiths that intrude the greenstone formation.

Site Design

The Mount Polley Mine is an open-pit copper and gold mine with an underground component that is owned by Mount Polley Mining Corporation, a subsidiary of Imperial Metals Corporation. The mine has the capacity to process 17,800 to 22,000 tons per day. Infrastructure at the mine site includes the crusher and stockpile facilities, mill, concentrator, electrical substation, maintenance shops, warehouse, offices, laboratory, fuel storage facilities, potable water systems, and exploration geology buildings and core shacks. In addition, Craigmont Industries Ltd. operates a magnetite recovery plant on the mill site of the mine (Brown et al., 2016).

Environmental Review Process

Several EAs have been completed on the Mount Polley Mine, primarily related to the tailings breach as described below. No environmental reports were found in a search of publicly available websites with regard to the predicted impacts of mining at the Mount Polley site before the development and construction of the mine.

Impacts to the Environment

On August 4, 2014, the failure of a glacial lacustrine layer beneath the TSF at the Mount Polley Mine caused a breach of the embankment and resulted in the release of 17.1 million cubic meters of supernatant and tailings pore water and 7.9 million cubic meters of tailings and construction material from the TSF to Polley Lake, Hazeltine Creek and Quesnel Lake (Golder Associates, 2016). In response to the breach, the British Columbia Ministry of Environment issued a Pollution Abatement Order (PAO) and Mount Polley Mining Corporation conducted or contracted two Post Event Environmental Impact Assessment reports in 2015 and 2016, a Human Health Risk Assessment in 2017, an Ecological Risk Assessment in 2017, and a remediation plan in 2019.

Results of both the Post Event Environmental Impact Assessments concluded that the breach resulted in physical impacts to Polley Lake, Hazeltine Creek and valley, the mouth of Edney Creek, the benthic environment in the West Basin of Quesnel Lake, and their associated communities in these environments (Golder Associates, 2016). Potential chemical and biological impacts were also observed in soil, sediment, and water quality data as well as benthic invertebrate and fish communities. The Human Health Risk Assessment (Golder Associates, 2017a) found that the estimated risks for evaluated receptors were considered acceptable and human health risks associated with the breach are considered very low. The Ecological Risk Assessment (Golder Associates, 2017b) found that risks associated with the metals in the materials released by the breach were acceptable and were of low magnitude relative to the physical effects, and that conditions in both the terrestrial and aquatic environments were considered to be stable or improving.

The PAO was lifted on September 12, 2019.

Non-Compliance and/or Litigation

As a result of the aforementioned TSF breach, the British Columbia Ministry of Environment issued a PAO with the requirement to initiate monitoring along with producing a Post-Event Environmental Impact Assessment. To satisfy the requirements of the PAO, Mount Polley Mining Corporation developed a Rehabilitation and Remediation Strategy for rehabilitation of terrestrial and aquatic environments.

Mitigation Measures / Corrective Actions and Their Effectiveness

Mount Polley Mining Corporation has spent approximately \$70 million on rehabilitation and remediation efforts from the TSF breach. Efforts have included gathering woody debris from Quesnel Lake and Hazeltine Creek valley, removing tailings from along Hazeltine and lower Edney creeks, rebuilding Hazeltine Creek and the mouth of Edney Creek, repairing the impacted Quesnel Lake shoreline, annual seed gathering and spreading, planting over 600,000 native shrubs and trees in riparian and uplands areas, installing new fish spawning and rearing habitat in Hazeltine Creek and at the mouth of Edney Creek, and building a rainbow trout hatchery on-site in 2018 to raise more rainbow trout for Polley Lake (Imperial Metals, 2022). Implementation of reclamation actions is ongoing.

Pogo Mine

Southeast of Fairbanks, Alaska, United States

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level I Ecoregion</i>
Underground gold mine	Began operations in 2006	Currently Active	Taiga

Location

The Pogo Mine is located along the Goodpaster river approximately 86 miles Southeast of Fairbanks, Alaska, and 38 miles northeast of Delta Junction, Alaska, on land owned by the State of Alaska (ADNR, 2022). Access to the mine is via a 49-mile all-season road from the Richardson Highway (ADNR, 2022). Northern Star, owner and operator of the Pogo Mine since 2018, controls 17,080 hectares of mining and exploration leases (Northern Star, 2022).

The Pogo Mine is within the USEPA Level I Taiga ecoregion and Level II Alaskan Boreal Interior ecoregion. This area is flat to nearly flat bottomlands along large rivers of interior Alaska. The bottomlands are dotted with thaw and oxbow lakes with poorly draining and shallow soil usually over permafrost. The vegetation of the region is dominated by spruce and hardwood forests, tall shrub thickets, and wetlands.

The mine lies within the geological Big Delta quadrangle. The bedrock in the area is generally high-grade gneiss intruded by granitic bodies, the whole of which is cut by high-angle faults. The USGS characterizes the immediate surrounding area as primarily gneiss, schist, and quartzite of Mississippian, Devonian, and older age. Bedrock near the site include orthogneiss and amphibolite of igneous origin, and granitic intrusions (USGS, 2022). Northern Star describes the Pogo gold deposit as numerous veins of massive auriferous (gold bearing) quartz +/-sulfide hosted in amphibolite-grade gneiss of Proterozoic to mid-Paleozoic age. Mid-Cretaceous age granitic plutons and dikes intrude the gneisses, which in turn, are cut by the gold-bearing veins. The age of the gold mineralization is approximately 104 million years (Cretaceous) and is controlled by the fault structures in the rock, which are interpreted as the fluid conduits for mineral hydrothermal fluids. The Proterozoic gneiss and Cretaceous granitoid sequence are part of the Yukon-Tanana terrain, a gold belt extending from Fairbanks into the historic gold mining areas of the Yukon Territory (Northern Star, 2022).

Comparison to Rainy River Withdrawal Application Area

The Pogo Mine and Rainy River Withdrawal Application Area are both located in regions of abundant wetlands and lakes, and extensive forests. Additionally, both regions are remote and relatively environmentally sensitive. The geology of both areas is dissimilar. The geology of the Pogo Mine area is younger where mineralization occurs within fault-filled veins that cut through high-grade metamorphic rock. Mineralization within the withdrawal area occurs within older layered mafic igneous intrusions of the Duluth Complex and even older low-grade metamorphic volcanic-derived igneous and sedimentary rock of the greenstone formation.

Site Design

The Pogo Mine EIS prepared by the USEPA characterizes the design of the facility as a mill and camp complex, a dry-stack tailings pile and recycle (water) tailings pond, an airstrip, gravel pits, laydown and fuel storage areas, and a local network of roads. Gold would be recovered by gravity separation, flotation concentration, and cyanide vat leaching. Approximately half of the tailings would be returned underground as a paste backfill (USEPA, 2003).

The ADNR, Division of Mining, Land and Water describes the facility as an underground cut-and-fill operation using gravity, flotation, and cyanide leaching processes to recover gold. In addition to the underground mine workings, major facilities include surface mill, dry stack tailings facility, water management systems, administrative facilities, 250-person upper camp and 203-person lower camp.

Northern Star describes the Pogo Mine facilities as four portals which provide access to the various underground mining block areas. Mining methods at the Pogo Mine vary due to variability in vein thickness, dip, grade and continuity, and the selection of method is driven by the geometry of the structure during the initial planning stage of the mine design (Northern Star, 2022).

Environmental Review Process

In 2003, the USEPA prepared an EIS with the State of Alaska as a cooperating agency. The Final EIS analyzed 17 different resources. It predicted localized impacts to surface water hydrology in Liese Creek, “very small” impacts on the Goodpaster River; overall “very low” impacts on groundwater flow in the Goodpaster River Valley; localized, low, and minimal impacts on water quality with implementation of best practices; and short-term, localized impacts on soils, vegetation, and visibility in the immediate mine area as a result of fugitive dust (USEPA, 2003). The State of Alaska has stated they have used the EIS to assist in decision making for its authorizations (ADNR, 2022).

The ADNR website has a list of permits and approvals, a 2016 environmental audit, annual reports, and other supporting documents (ADNR, 2022). The permits and approvals are from multiple agencies including the Department of Natural Resources, Department of Environmental Conservation, and Department of Fish & Game. The State’s 2016 environmental audit found, “Pogo is generally in compliance with operations and reporting for all authorizations, with the exception of an outdated Quality Assurance Plan, a (potentially) long-term above ground ore stockpile, and other relatively minor observations and recommendations.” The report also states, “The reliability and integrity of information for reporting and compliance is reasonable. The Pogo staff is knowledgeable and well-trained on environmental management for mines.”

Impacts to the Environment

No major environmental impacts were found online. However, there are multiple permit stipulations from the ADNR, DEC, and ADF&G including not changing the state of water outside the use of the permit or not obstructing fish passage along streams.

Non-Compliance and/or Litigation

According to the USEPA ECHO database in April 2022, the Pogo Mine was in non-compliance with RCRA for 9 of 12 quarters and for 2 of 12 quarters for the CWA. Additionally, the mine has had 5 informal

enforcement actions within the past 5 years: two regarding the CAA (warning letters were issued); two regarding the CWA with a notice of violation, warning letter, and one requiring no further actions; and one violation of the RCRA with a written formal violation letter. According to the USEPA ECHO database, the mine has had no formal enforcement actions within the past 5 years.

A further breakdown of non-compliance actions identified in the USEPA ECHO database shows the Pogo Mine has been in violation of “40 CFR 262.A: Generators – General” since 2020 and is still in violation as of the beginning of April 2022. The mine had two quarters of violations of the CWA in the second quarter of 2020 and first quarter of 2021. One of these violations was in response to high turbidity and the other violation was a permit schedule violation. Additionally, a single event violation was recorded as the mine failed to maintain records or meet record keeping requirements regarding wastewater combined sewage outfall.

According to a report by EarthWorks, Pogo Mine has been issued violations by ADEC, the State of Alaska, and/or the EPA for effluent limit exceedances, failure to properly operate and maintain systems of treatment, monitoring and reporting issues, and failure to allow entry to the facility, as well as failing to comply with its permit limits (Gestring, 2020).

Mitigation Measures / Corrective Actions and Their Effectiveness

It is unclear what actions were taken in response to the 2016 environmental audit; however, the findings were released in early 2017 and Northern Star took ownership of the mine in 2018. It is reasonable to assume that Northern Star addressed the audit issues because they had to complete another permitting process after taking ownership of the mine. Additionally, all non-compliance violations according to the USEPA ECHO database were resolved quickly except for 262.A: Generators – General of the RCRA which the Pogo Mine is still in non-compliance as of April 2022. Only an informal written letter was sent by the USEPA to notify the mine of violation and no action has apparently taken place since.

Raglan Mine

Kativik, Quebec, Canada

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level 1 Ecoregion</i>
Underground Nickel Mine Complex	Began operations in 1997	Currently Active	Tundra

Location

The Raglan Mine is a large nickel mine complex in the Nunavik region of northern Quebec. It is part of the Tundra and is located the Northern Artic Level II Ecoregion. It is located approximately 50 miles south of Deception Bay.

Coastal ice and fog persist for long periods in the summer. The mean annual precipitation ranges 200-300 mm. Its short growing season limits vegetative growth, which is characterized by a nearly continuous cover of dwarf tundra vegetation, including dwarf birch, willow, northern Labrador tea, *Dryas spp.*, and *Vaccinium spp.* Tall dwarf birch, willow, and alder occur on warm sites; wet sites are dominated by willow and sedge. Bedrock geology consists of foliated granite and granitic gneiss. These folded strata form a series of east-west ridges and valleys with a relatively high relief in the west, but a more subdued character in the east where the summit surface of the hills merge with Larch and Sugluk plateaus. Raised beaches occur along the coast, covered by late Pleistocene marine incursions. Turbic Cryosols developed on loamy marine sediments along the coast and on thin, discontinuous glacial drift deposits inland, are the dominant soils in the ecoregion. Inclusions of Organic Cryosols and a dominant occurrence of rock outcrops are also present. Permafrost is continuous with low ice content. Characteristic wildlife includes caribou, wolverine, Arctic hare, fox, polar bear, raptors, shorebirds, and waterfowl. Marine mammals include walrus, seal, and whale. Land uses include subsistence trapping and hunting, and mineral exploration is ongoing. The main towns are Salluit and Ivujivik. The population of the ecoregion is approximately 1,500 (Environment Canada, 2022).

The Raglan Mine is in the Ungava Trough of the Canadian Shield. It sits upon one of the world's finest sulfide nickel deposits in the vast Ungava Peninsula, in Nunavik. Ni-Cu-Co-PGM mineralization is located at or near the base of subvolcanic mafic-ultramafic intrusive complexes referred to as the Raglan Formation. The Raglan Formation exists within the Cape Smith Belt which formed during the 1.8 to 1.9 billion year old crustal deformation (i.e., mountain building) that followed crustal rifting and subsequent marine basin volcanics of around 2.0-billion years ago.

Comparison to Rainy River Withdrawal Application Area

The Raglan Mine and Rainy River Withdrawal Application Area are similar in that they are both near large bodies of water. Unlike the Rainy River Withdrawal Application Area, the Raglan Mine is in the Arctic Tundra where permafrost is prevalent, and water is frozen much of the year.

Although of a different age, the geology of the ore deposit at the Raglan Mine is similar to the younger 1.1-billion year old Duluth Complex. Like the Duluth Complex, the composition of the Raglan Mine deposit is mafic-ultramafic igneous rock. And like the Duluth Complex, the emplacement of the Raglan Mine deposit was associated with an episode of crustal rifting.

Site Design

The Raglan site includes four underground mines, a concentrator, an accommodation complex, and administrative buildings. Supporting infrastructure includes a freshwater source supply, fuel tanks, a water treatment plant, and a power plant, among others. Roads connect the mining site to the Donaldson airport as well as to the Deception Bay warehouses and seaport facilities. The ore is crushed and processed onsite to produce a nickel-copper concentrate (Government of Canada, 2018).

In 2014, Raglan Mine installed a three-megawatt wind turbine that was expected to offset the mine's diesel dependence by 5 percent.

Environmental Review Process

An April 2022 search did not identify environmental documents online. Technical reports filed are in French making identification of information difficult. As a result, most of the information was gained from the mine's website and associated links.

The Raglan Project Feasibility Study was filed in 1992. The study effort included coordination with indigenous peoples to address heritage land use in the area. In 1995 the Raglan Agreement was signed which included provisions like hiring and training local people, purchasing from local businesses, and generating royalties to the local communities.

The Raglan Committee meets several times each year to discuss environmental concerns and to report on the progress of the 1995 Agreement. Inuit representatives occupy half of the committee's six seats with mining company officials holding the balance. The Committee has initiated several efforts to better characterize environmental resources, including an Arctic char monitoring program that integrates traditional knowledge into a Joint Scientific Fishing Program.

Prior to the mine's initiation, local knowledge of Arctic chars and of marine mammal migration patterns (e.g., for seals) resulted in a decision to shorten the shipping season and avoid ice-breaking from March to June in Deception Bay.

To extend its nickel concentrate production through 2040, the mine submitted documents for the Sivumut Project, a Phase II and III which would begin in 2019. Phases II and III would use existing facilities and involve expansion of the existing tailings pond, construction of new access roads, new utility lines, and a catchment system for pumping and treatment of runoff water (Glencore Canada, 2017).

Impacts to the Environment

Online sources indicate most concerns are over the economic and social impact of the mine and eventual closure/reclamation. By employing so many locals, it is possible that once the mine reclamation process is complete, those people/communities could face hardship and poverty (Monosky and Keeling, 2021).

Non-Compliance and/or Litigation

As of May 2022, Raglan Mine is not listed on the Environmental Offenders Registry and no violations were found online.

Mitigation Measures / Corrective Actions and Their Effectiveness

No sea-based shipping occurs during mid-March to mid-June to protect habitat and preserve fishing/hunting opportunities of the Inuit communities. In 2018, Raglan Mine established the Raglan Mine Closure Plan Subcommittee to address concerns the community had with tailings management and remediation.

Rainy River, New Gold Mine

Northwest Ontario, Canada

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level I Ecoregion</i>
Open-Pit and Underground gold mine	Began operations in 2017	Currently Active	Northern Forests

Location

The Rainy River Mine is located in Chapple, Ontario, Canada, in the USEPA Level II Mixed Wood Shield ecoregion. Moderate to low gradient perennial streams are typical and wetlands are widespread. The numerous glacial lakes are clearer and less productive than those in ecoregions further south. The Mixed Wood Shield is largely devoid of agriculture because of its thin, nutrient-poor soils and short growing season. Forest types are mostly coniferous and northern hardwood forests, with sugar maple, paper birch, yellow birch, aspen, white spruce, balsam fir, hemlock, jack pine, and red pine. Cooler and wetter sites have black spruce, tamarack, and northern white cedar. The region is rich in wildlife, with moose, black bear, gray wolf, white-tailed deer, lynx, snowshoe hare, ruffed grouse, bald eagle, brook trout, and muskellunge. Main economic activities for this border region include forestry, recreation, tourism, hunting and fishing, and iron ore mining. Parts of the ecoregion contain some public national, state, and provincial parks or forestlands. There is also some farming with hay, grain crops, and dairy cattle. Major cities and towns include Thunder Bay, Atikokan, Kenora, Duluth, Superior, Ashland, Rhinelander, and Marquette (Wiken et al., 2011).

The Rainy River District is found within the Superior Province of the Precambrian Shield. Geology in this region was influenced by ice of the Labradorean and Keewatin sectors of the Laurentide Ice Sheet. Remnants of glacial advances are represented by older, isolated occurrences of weathered glacial till. The Rainy River Mine is located within the 2.7 billion years (Ga) old Neoproterozoic Rainy River Greenstone Belt (RRGB). The Rainy River deposit occurs within a sequence of felsic to intermediate, calc-alkaline metavolcanic rocks which is bounded to both the north and south by a lower mafic volcanic sequence. The mine property encompasses an approximately 30 km long, north-east trending portion of the RRGB. Intermediate dacitic volcanic rocks host most of the Rainy River gold mineralization. Copper-nickel-platinum group metal mineralization has also been identified on the Rainy River Mine (AMC, 2020).

Comparison to Rainy River Withdrawal Application Area

The Rainy River Mine is approximately 125 miles northwest of the Rainy River Withdrawal Application Area, and both are located within the USEPA Level II Mixed Wood Shield ecoregion of the Level I Northern Forests ecoregion. Landscapes in both areas include very similar topographies with large amounts of surface water features. In addition to very similar environments and topographies, both areas share common geologies as they are within greenstone formation terrains.

Site Design

The Rainy River Mine site consists of an open-pit mine with associated support facilities, tailings management area and related water management infrastructure, primary crusher and process plant, and a 230-kilovolt transmission line. The underground mine is still being developed. Mining operations would be supported by development of an explosives manufacturing and storage facility. The total area covers approximately 36,762 hectares.

Environmental Review Process

Environmental review documents are available on the Impact Assessment Agency of Canada (IAA) Rainy River Project website. A voluntary EA was submitted in January 2015 and a Decision Statement was issued the later the same year. Public concerns cited in the EA included ground and surface water impacts from flow level changes and acid rock drainage. With implementation of mitigation measures and general conditions, the IAA found the project would cause no significant impacts (Ministry of the Environment, 2015).

Impacts to the Environment

Along with general conditions, the Decision Statement outlines specific ways to mitigate impacts on fish and fish habitat, migratory birds, health of aboriginal peoples, current use of lands and resources for traditional purposes, aboriginal archaeological, heritage and cultural resources, and project components that may be associated with federal authorization (Ministry of the Environment, 2015).

Non-Compliance and/or Litigation

In 2018, the IAA issued a Warning notice to the Rainy River Project because an inspection found there was no perimeter ditching around the south face of the East Mine Rock Stockpile and that water was pooling south of the stockpile with no evidence of structures or measures to collect site contact water to divert it into one of the mine's water management facilities. Additionally, the fence installed around the Tailings Management Area had gaps and the type of fence used was determined to be insufficient for excluding wildlife, as deer tracks were observed within the fence perimeter (IAA, 2018)

In 2020, the IAA issued a notice of non-compliance to the Rainy River Project. The inspection found the water level in the Stockpile Pond would not allow for water to enter the spillway and flow down the Stockpile Pond Diversion Channel. Upon reviewing past inspections and photos, the Stockpile Pond Diversion Channel was never wetted sufficiently to allow for fish passage. The letter acknowledges that New Gold Inc. was investigating whether the Stockpile Dam was leaking at the time (IAA, 2020).

Mitigation Measures / Corrective Actions and Their Effectiveness

In response to the IAA's 2018 Warning letter, New Gold committed to creating ditching to collect water and divert it to a tailings management area or water management facilities for release. New Gold also stated they would install new fencing designed specifically to exclude large and small animals (New Gold, 2018).

In response to the 2020 notice of non-compliance, New Gold Inc. developed a plan to instigate and form a path to correct the seepage issues at the Stockpile Diversion Dam. Actions to correct the issue include, completing a shovel test pit program upstream of the dam structure to determine if there are potential porous layers of Whiteshell till near bedrock outcrops at surface, a dye testing program to help determine if the

water seeping within the catchment area of the structure is related to water seepage at the toe of the Stockpile diversion dam, identify potential flow paths through the structure, and investigate potential remediation methods. They also began investigation of lowering the spillway invert from the Stockpile Diversion Pond and accompanying channel (a temporary fix). They expected to remediate the issue in spring 2021 (New Gold, 2020).

Red Dog Mine

Northwest Alaska, United States

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level 1 Ecoregion</i>
Open-Pit Zinc Mine	Began operations in 1989	Currently Active	Tundra

Location

The Red Dog Mine is located in the DeLong Mountains north of Noatak, Alaska. The mine is 82 miles north of the community of Kotzebue and approximately 55 miles inland from the Chukchi Sea. It is part of the USEPA Level I Tundra ecoregion and is located within the Alaska Tundra and Brooks Range Tundra Level II ecoregions.

At lower elevations, the region is predominantly treeless and is vegetated primarily by mesic graminoid herbaceous communities and dominated by mixed shrub-sedge tussock tundra. Willow thickets and alders occur along rivers and small drainages and *Dryas* tundra is found on ridges. Getting into the Brooks Range, vegetation is still generally sparse, limited to valleys and lower hillslopes. Dwarf scrub vegetation occurs throughout the mountains, although some valleys provide more mesic sites for graminoid herbaceous communities dominated by sedges and willows, with abundant mosses. Water resources include low to medium density drainage networks, with many braided streams and rivers. Lakes are relatively sparse, with some located in glacial areas, in floodplains, or in rock basins. Wildlife ranges from ungulates including caribou, muskox, and dall sheep to predatory species including brown bear and gray wolves. Many arctic birds including golden eagles, peregrine falcons, ptarmigans can be found here. Arctic char inhabit alpine lakes and arctic grayling can be found in groundwater fed springs and streams (Wiken et al., 2011; USEPA, 2010).

Geology in the Red Dog area is stratified Paleozoic sedimentary deposits consisting predominantly of greenish-gray argillite (lithified shale) that has been deformed by Mesozoic mountain-building tectonics (Wilson et al., 2015). The area has the world's largest known zinc deposits consisting of stratiform massive sulfide bodies hosted in carboniferous shale and altered carbonates.

Comparison to Rainy River Withdrawal Application Area

The Red Dog Mine and Rainy River Withdrawal Application Area are both located in environmentally sensitive areas with strong local community reliance on resources including wildlife and water. Unlike the Rainy River Withdrawal Application Area, the geology in the Red Dog area is much younger (340 million years ago versus 1.1 to 2.7 billion years ago) and has not been subject to as much metamorphism. However, like the northern portion of the withdrawal area, the Red Dog deposits are sulfide deposits associated with marine volcanism.

Site Design

Red Dog Mine is a large open-pit, truck-and-loader mine operation, using conventional drill and blast mining methods. The mine produces zinc, lead, and silver and currently has an anticipated mine life through 2032. Facilities (including the mill, mine, tailings pond, housing and water supplies) are on a 22,176-acre parcel of land owned by the NANA Regional Corporation, Inc., an Alaska Native corporation. A purpose-built access road connects the mine to a port site on the Chuckchi Sea, traversing Cape Krusenstern National Monument.

Environmental Review Process

Establishment of the access road required compliance with specific requirements in Title XI of the 1980 Alaska National Interest Lands Conservation Act for acquiring a right-of-way across a National Monument. On November 7, 1983, Cominco's application was the first Title XI application to the National Park Service (NPS). Title XI applications were also filed with USEPA and the U.S. Army Corps of Engineers.

An EIS was prepared by the USEPA and NPS in 1984 for the proposed Red Dog Mine and associated transportation route. The Final EIS identified 12 issues of concern through the scoping process, including water quality and quantity, fish and wildlife habitat, socioeconomic resources, and others. The Preferred Alternative was predicted to result in a low risk to water quality; low impacts on fish and their habitat, wildlife and their habitat, coastal geologic resources, marine life and their habitat; traditional subsistence harvest activities, and cultural resources (USEPA and NPS, 1984).

A mine case study in 1992 concluded that inadequate information was collected on airborne particulates (see *Impacts to Environment* section below), surface water run-off, groundwater quality, and how permafrost affects these things. Deficiencies warranted the need for changes in design, additional costly environmental monitoring, and NPDES permit delays (Cocklan-Vendl and Hemming, 1992).

A fugitive dust risk assessment was conducted for the DeLong Mountain Transportation System (DMTS) servicing the Red Dog Mine and accepted by Alaska Department of Environmental Conservation (ADEC) in 2007. The assessment was prepared because of elevated metals concentrations in areas surrounding the transportation corridor. The assessment estimated potential risks and identified potential actions to reduce those risks (ADEC, 2007).

Impacts to the Environment

A 2001 moss study conducted found elevated concentrations of metals in tundra along the road and near the port, apparently resulting from escaping ("fugitive") dust from operations along the transportation corridor (Ford and Hasselbach, 2001). ADEC began work to determine the extent of contamination from this dust along the DeLong Mountain Regional Transportation System (DMTS), which includes the entire transportation corridor from the mine to the port, including the road, the port facilities, and the barges. ADEC's Contaminated Sites program is now overseeing that work and also addressing historic spills of petroleum products at the mine.

Non-Compliance and/or Litigation

The USEPA has filed 14 Civil Enforcement Cases against Red Dog Mine since 1993 for violating the CAA and CWA. Of those, one case was judicial while the others were administrative. Three cases resulted in

Federal Penalty, the most expensive of which was the 1993 that cost Cominco Alaska Inc. \$1,700,000 and concluded in 1997. The case summary noted, “The most significant violations at the mine are NPDES Permit effluent violations, mostly heavy metals. The violations are based largely on Discharge Monitoring Reports. There are about 198 effluent limit violations at the mine. There are also about 611 violations of the CWA for unpermitted discharges from a Tent Camp used by contractors in the Summer. Cominco never requested an NPDES Permit for that site. There are also about 196 unpermitted Winter discharges. Cominco's NPDES Permit only authorizes discharges from May through October to Red Dog Creek. However, USEPA program staff may have told the company it could discharge November through April, if it complied with a State-issued Winter discharge Permit. The company has been in almost constant violation of its NPDES Permit at the Port site since it began operations there in 1989. There are about 1186 Biological Oxygen Demand and TSS effluent violations shown on Discharge Monitoring Reports. There are also a number of lesser permit violations. The other major violation at the Port Site is diesel fuel spill that occurred there in July 1993. This spill was of about 20,000 gallons of diesel fuel onto the tundra. There are also several SPCC violations related to the storage of fuel at the Port site” (USEPA, 1997).

A report by Earthworks (Gestring, 2020) states that the Red Dog Mine was fined \$125,000 and received an Administrative Complaint by the EPA in 1991 based upon heavy metals contamination and water quality in the Ikalukrok Creek and the Wulik River. The Administrative Complaint cited 134 violations of effluent limitations for metals and pH and Red Dog Mine was required to construct a lined ditch to divert Red Dog Creek around the mine (Gestring, 2020).

As of April 2022, the USEPA ECHO database shows CAA High Priority Violations every quarter for the last 3 years, CWA violations in 5 quarters in the last 3 years, and two Safe Drinking Water Act violations in 2021.

Mitigation Measures / Corrective Actions and Their Effectiveness

The Fugitive Dust Risk Management Plan resulted in creation of a series of additional studies and plans, including a Communication Plan, Worker Dust Protection Plan, Monitoring Plan, Remediation Plan, Dust Emissions Reduction Plan, and Uncertainty Reduction Plan. Selected measures identified in these plans are listed and described below.

Test paving of the road

A 5-mile test strip of experimental road surface (Hi-Float) was placed at the port site during July 2002 after the roadbed sampling, recovery, and recycling program was completed. The test sections are being monitored for two years to evaluate 1) the durability of the Hi-Float road surfacing, 2) its suitability for controlling tracking and reducing fugitive dust from the DMTS road, and 3) whether road surface and equipment maintenance requirements are reduced.

Improvements to the Red Dog port site fugitive dust control system

Steps were taken to improve control of fugitive dust at the port, including a new truck unloading building, improvements at the concentrate storage buildings, at the conveyors and the surge silo between conveyors, at the barge loader, and on the barges. In spring of 2003, before the start of the shipping season, nearly \$4 million was invested in improvements to both the barge loader and the barges to control fugitive dust. A new bag house was installed and all of the seals on the conveyors that carry concentrate to the barges were upgraded. The barge loader conveyor was also enclosed to prevent escaping dust. The modifications were

completed on June 20, 2003 before shipping started. The barge dust control systems were modified in a similar manner.

Truck spill sites

Since the start of the Red Dog operation, a number of truck spills have occurred. While most of the spilled concentrate and fuel was recovered at the time of the incidents, data to document recovery efforts on older spills was sparse. A study characterizing these sites was completed during 2003. The mine has since been implementing a program to recover, recycle, and restore/revegetate the former spill sites.

Port site characterization and recovery efforts

The 2002 port site characterization was a significant program focused on defining the nature and extent of fugitive dust at the port. During 2002, recovery and recycling were conducted at numerous active and inactive areas of the facility that had elevated metals concentrations in soil. Characterization continued in 2003 and the 2003 information is included in Appendix A of the revised risk assessment work plan.

Ongoing monitoring program

Air monitoring at the port and along the DMTS road with dust fall jars. Road surface sampling is conducted every two months at eight monitoring stations. The near-shore marine sampling at the load-out facility also continued every two years. These monitoring efforts are intended to provide information necessary for evaluating the effects of control measures on fugitive dust emissions.

Air monitoring in Noatak and Kivalina

Teck Cominco has been monitoring the air in Noatak and Kivalina to determine the levels of lead in airborne dust in both villages. This monitoring addresses village concerns about air quality and also fulfills the requirements of a settlement agreement with DEC. Teck Cominco is required to conduct one year of monitoring at both villages. The Noatak monitoring was conducted between March 13, 2003 and March 13, 2004. Results for Noatak show lead levels about 80 times below the National Ambient Air Quality Standard for lead. Results for Kivalina had lead levels about 200 times below the National Ambient Air Quality Standard.

Mine Closure and Reclamation

State of Alaska law requires mines to develop and fund a comprehensive closure plan. In 2021, an updated Mine Reclamation Plan was submitted in preparation of closure and reclamation beginning in 2032.

Sudbury Mining District

Ontario, Canada

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level 1 Ecoregion</i>
District that includes mines such as the Coleman Mine, Copper Cliff North Mine, Copper Cliff South Mine, Creighton Mine, Frood Mine, Garson Mine, Murray Mine, Stobie Mine, and Totten Mine.	Began operations in mid-1880s	Currently Active	Northern Forests

Location

The Sudbury basin is located in central Ontario, Canada, about 400 kilometers north of Toronto. The City of Greater Sudbury is located approximately 35-40 miles from the Georgian Bay, with multiple lakes and ponds scattered in the immediate vicinity including the Ramsey and Kelly Lakes. Mines that are generally included in the Sudbury Area are Coleman Mine, Copper Cliff North Mine, Copper Cliff South Mine, Creighton Mine, Frood Mine, Garson Mine, Murray Mine, Stobie Mine, and Totten Mine. Commodities and minerals mined from the area include nickel, copper, cobalt, platinum, palladium, gold, and silver.

The Sudbury basin is located within the USEPA Level II Mixed Wood Shield ecoregion. The Mixed Wood Shield ecosystem is characterized by smooth to irregular plains and some low hills with high-quality glacial lakes and a large quantity of wetlands. Due to the areas thin, nutrient poor, soil the land does not support most agricultural practices, and instead the land is used primarily used for forestry, tourism, and mining. Forest types in the area are typically coniferous with red pine, white pine, and spruce trees or with hardwood forests of tulip poplar, oak, sugar maple, birch, and beech trees (USEPA 2022).

Geology of the Sudbury basin has been influenced by a meteorite or comet impact that occurred approximately 1.85 billion years ago. The resulting impact is believed to have breached the crust allowing upper mantel material of mafic composition to intrude into the fractured crust. The Sudbury basin is a part of the Southern Province of the Canadian Shield with the Superior Province to the northwest and the Grenville Province to the southeast. The basin itself consists of three major components: the Sudbury Basin, the Sudbury Igneous Complex which forms an elliptical collar around the basin and is geographically divided into north, east, and south ranges; and the outer layer of Sudbury Breccia footwall rocks (Ontario Geological Survey, 2009). The main rock types present in the district are granite, granite gneiss, gabbro and basalt.

Comparison to Rainy River Withdrawal Application Area

The Sudbury Mining District and the Rainy River Withdrawal Application Area, although separated by 500 miles, are at similar latitudes on the Canadian Shield, which is comprised of Precambrian age (older than 525 million years ago) igneous and metamorphic bedrock. The Rainy River Withdrawal Application Area and the Sudbury Mining District are both located within the USEPA Level II Mixed Wood Shield ecoregion of the Level I Northern Forests ecoregion. Landscapes in both areas include large amounts of surface water features and relatively close proximity to large freshwater bodies of water.

The copper-nickel and platinum group mineral deposits associated with the mafic intrusions in the Rainy River Withdrawal Application Area are similar to the mafic intrusive minerals mined in the Sudbury Mining District.

Site Design

The majority of the mines located in the Sudbury district are underground mines. Varying mining methods are employed at different mines due to factors such as infrastructure, geotechnical constraints and experience, and include cut-and-fill mining, mechanized cut-and-fill mining, underhand cut-and-fill mining, post pillar cut-and-fill mining, sublevel cave mining, blasthole stoping mining, vertical retreat mining, and uppers retreat mining.

Environmental Review Process

An April 2022 review of publicly available online information did not locate environmental review documentation for the mines associated with the Sudbury Mining District.

Impacts to the Environment

Mining in the Sudbury district began in the mid-1880s and, prior to the 1970s it was one of the largest nickel metal producers in the world. Historical pollution was associated with emissions of sulfur dioxide which can be transformed into sulfuric acid and create acid rain. Over years of smelting and refining, the Sudbury Mining District experienced degradation of the local environment which included a loss of vegetation, acidic and heavy metal polluted soils, polluted air, acidified lakes and bodies of water, and blackened rock (Sharer, 2017). Environmental remediation efforts began in the late 1960s and into the 1970s (Greater Sudbury, 2021).

Non-Compliance and/or Litigation

No mines located in the Sudbury district were listed on the Canadian Environmental Offenders Registry or on the enforcement notification database; however, most of the mines were listed under the National Pollutant Release Inventory with releases to air.

Based on an online search conducted in 2022, online news sources report that multiple health and safety violations have been filed against various companies and mines within the Sudbury Mining District.

On September 13, 2019, Glencore Canada Corporation was convicted of failing to immediately report a spill of sulfuric acid into the environment. The incident involved approximately 25,000 pounds of sulfuric acid that spilled when transferred from a rail car into a tanker truck. Three workers were injured during the

incident, one critically. Glencore was fined \$105,000 CAD (Ontario Environment, Conservation, and Parks, 2019).

Mitigation Measures / Corrective Actions and Their Effectiveness

In the 1970s INCO built the Superstack, a 1,250-foot-high chimney to disperse sulfur gases and other byproducts of the smelting process away from the City of Sudbury. Vale (formerly INCO) took the Superstack out of service in 2020, replacing it with two smaller more efficient stacks. The decision was made in part through compliance with the Vale Clean AER Project, which is projected to reduce greenhouse gas and particulate emissions by 40 percent and sulfur dioxide emissions by 85 percent (Vale 2017). In 2019, the city council of Sudbury developed a Community Energy and Emissions Plan (CEEP) to address climate change and target net-zero emissions by 2050. The CEEP's current 5-year plan follows the government of Canada's 2021 plan to plant two billion trees to address climate change and achieve net-zero greenhouse gas emissions by 2050.

In addition, since 1978, the City of Greater Sudbury has been actively working on regreening the landscape and conducting watershed rehabilitation. Over 3,400 hectares of land affected by mining have been limed and grassed and over 9.8 million trees and over 460,000 shrubs and understory trees have been planted (Greater Sudbury, 2021).

In 2008, the Sudbury Ecological Risk Assessment reported that seven chemicals of concern (arsenic, cadmium, cobalt, copper, lead, nickel, and selenium) were detected in terrestrial plant communities. The study found that these local plant communities were also affected by soil erosion, low nutrient levels, lack of soil organic matter, and soil acidity. These impacts were concluded to be influencing habitat quality of wildlife populations (Sudbury Area Risk Assessment Group, 2008). As a result of this study, a Biodiversity Action Plan was developed as part of the regreening effort to address the risks to vegetation and wildlife habitat.

Troy Mine

Northwest Montana, United States

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level 1 Ecoregion</i>
Underground silver and copper mine	Began operations in 1973	Closed in 2015 – Reclamation began in 2017	Northwestern Forested Mountains

Location

The Troy Mine is a closed mine currently in the reclamation process located 15 miles south of Troy, Montana, in the Cabinet Mountains of the Kootenai National Forest (KNF). It is in the USEPA Level II Western Cordillera ecoregion. The Western Cordillera is a region of high, rugged, mostly forested mountains with some wide, open valleys. Plants, animals, and water quality and quantity vary greatly with elevation in the region. Lower elevations are commonly grass or shrub covered, mid-elevations are mostly forest covered, and many alpine areas above the timberline are covered with snow and ice for much of the year. There are numerous high gradient perennial streams and rivers, as well as some areas of small glacial lakes, and lower elevation large lakes or reservoirs (USEPA, 2000). Bull Lake, Spar Lake, Cabinet George Reservoir, and Lake Pend Oreille are within ten miles of Troy Mine. Grazing, the leading land use in the valleys and lower elevations of the Western Cordillera, has had a major impact on streams. Additional land use activities include forestry, recreation and tourism, wildlife habitat, mining, some minor cropland in valleys. Larger cities in the area include Sandpoint and Libby. Several large ungulates (moose, elk, woodland caribou) can be found in the region along with grizzly and black bear, cougar, bald eagle, boreal owl, trout, and salmon (Wiken et al., 2011).

Geology in the Cabinet Mountains are composed of partially metamorphosed, folded, and faulted argillites, quartzites, and carbonates of the Precambrian Belt Series that have been intruded by Jurassic and Cretaceous age granitic plutons. These are well indurated sedimentary rocks that have very low primary porosity and permeability, but fractures and faults within these units allow the movement of water. The host rock for copper and silver mineralization is mainly fault gouge of the fractured quartzite bedrock.

Comparison to Rainy River Withdrawal Application Area

Topography aside, the area encompassing the Troy Mine is similar to the Rainy River Withdrawal Application Area in mine type, minerals extracted, nearby surface waters, and surface land ownership. Although bedrock in both areas is of Precambrian age (older than 525 million years ago), the geology is generally dissimilar in that the Troy Mine occurs in marine-deposited sedimentary rocks, whereas the geology of the Rainy River Withdrawal Application Area consists of marine volcanic-derived igneous and sedimentary rocks and mafic, as well as granitic, intrusive igneous rock.

Site Design

The closed facility is located on about 350 acres of a mix of National Forest System land and privately owned land. The mine facilities consist of an underground mine, a mill, and various office facilities; the tailings and reclaim water pipelines; a power line; a tailings impoundment; and associated support facilities. The tailings facility and associated disturbances are on approximately 430 acres of disturbed area on private land owned by Troy Mine, Inc. Both the tailings and reclaim water pipelines and the power line are on National Forest System lands, private, and patented land. The South Adit portal is located on patented land, while the North Adit portal and the mill and office/shop facilities are located on unpatented claims on National Forest System lands. There are approximately 15.6 acres of disturbed land at the portal patios and 34 acres of disturbed lands at the mill site. Associated roads, pipelines and other small, disturbed areas exist throughout the project area. The relatively flat lying strata-bound ore body lies under Mt. Vernon at an elevation of approximately 4,400 feet above sea level. Mine portals and facility buildings are perched on the steep northern slopes of Mt. Vernon. Vehicle access to the underground room and pillar workings was through two main adits. Extracted ore was crushed underground and conveyed to the surface mill for secondary crushing, grinding, and concentration of the silver-bearing and non-silver bearing copper minerals. Tailings generated through beneficiation of the ore were disposed of in a tailings impoundment located approximately six miles north of the mill in Lake Creek Valley. When active, waste rock generated was returned to the mine or used as road or base for facility construction. The copper/silver concentrate was shipped out of state for processing (US Forest Service and Montana DEQ, 2012).

Environmental Review Process

In 1978, KNF and the Montana Department of State Lands issued an EIS that addressed potential impacts from both the operation and reclamation of the Troy Mine, which is operated by Troy Mine, Incorporated (Troy Mine, Inc.). In the fall of 1999, the Montana Department of Environmental Quality (DEQ) and KNF initiated a review of the Troy Mine reclamation bond. DEQ and KNF notified the mining company that the approved 1978 Reclamation Plan needed to be revised and a substantial bond increase would be required. The mining company prepared a revised reclamation plan and the final draft was submitted in March of 2006. In 2012, the Forest Service and Montana DEQ completed an EIS for the Troy Mine Revised Reclamation Plan. The agencies' preferred alternative identified mitigation above and beyond the applicant's proposed action that were needed to minimize the potential for water quality violations, sediment delivery to streams, the effects of subsidence, and comply with agency noxious weeds and native species policies during revegetation (US Forest Service and Montana DEQ, 2012).

Impacts to the Environment

In 2009, a tailings pipe leaked 16,000 gallons of water and sand, some of which entered Thicket Creek, which flowed into Stanley Creek, and then Lake Creek. The mixture was reported to possibly contain trace amounts of copper or silver. The mine was shut down while the pipe was repaired (The Western News, 2009).

Stanley Creek was originally listed as "impaired" under Section 303d of the CWA in 2000 based on macroinvertebrate data indicating nutrient enrichment, but at the time the nutrient causing the impairment was unknown. In 2014, a Water Quality Improvement Plan for the Kootenai-Fisher Project Area was prepared by the Water Quality Planning Bureau. Stanley Creek was listed as "impaired" by copper; the only

nearby active mine at the time was Troy Mine. As of 2020, Stanley Creek was still listed as “impaired” and affecting aquatic life due to copper from mine tailings (Montana DEQ, 2020).

In 2007, a miner was killed when part of the mine’s roof collapsed. In late 2012, a series of underground rock falls occurred.

Non-Compliance and/or Litigation

No non-compliance or litigation issues were found for the Troy Mine. There have been five informal enforcement actions by the State under the RCRA in the past five years. The types of actions listed are “Verbal informal, Violation Letter – Intent to submit to DEQ ENF, Written Informal, Back in Compliance Letter, and Document Received.”

Mitigation Measures / Corrective Actions and Their Effectiveness

The Water Quality Improvement Plan for the Kootenai-Fisher District has not fully restored quality in Stanley Creek, as the creek is still listed as impaired by copper from mine tailings.

In 2017, mine reclamation efforts began. Following a plan developed by Montana DEQ, the company has placed over 500,000 cubic yards of soil and seeded over 350 acres of the site. A partnership with the Confederated Salish and Kootenai Tribes provided Hecla with more than 200,000 seedlings. Reclamation efforts are ongoing.

Zortman-Landusky Mines

North-central Montana, United States

<i>Type of Mine</i>	<i>Start Date</i>	<i>Status</i>	<i>USEPA Level 1 Ecoregion</i>
Open-pit gold mine	Began operations in 1899	Closed in 1998	Northwestern Forested Mountains

Location

The former Zortman-Landusky Mines are located in the Little Rocky Mountains of the USEPA Level II Western Cordillera Ecoregion. Both mines are near the southern boundary of the Fort Belknap Indian Reservation in the southwest corner of Phillips County, Montana. The Little Rocky Mountains are distinguished by rolling prairies dissected by intermittent drainages with small mountain ranges rising abruptly from the plains. The plains north of the Little Rocky Mountains slope gradually into the Milk River bottom which occupies the pre-glacial channel of the Missouri. To the south, the surface water drainage has carved steep narrow channels into a badlands-type topography. Southwest and south of the Little Rocky Mountains, the topography is strongly influenced by the post-glacial channel of the Missouri River. Intermittent streams form tributaries of the Missouri River, and the topography becomes more broken as the drainages easily incise through the relatively soft sedimentary rocks which make up most of this region (BLM and MT DEQ, 2001).

A fairly complete stratigraphic section, from Precambrian metamorphic rocks to Cretaceous (Bearpaw Shale), is exposed along the flanks of the mountains. Younger rocks of the current Cenozoic Era are felsic igneous intrusives that occur as syenite porphyries in the area. Emplacement of the Cenozoic intrusive rocks resulted in the uplifting of older Paleozoic and Mesozoic basement rock to form the Little Rocky Mountains. In addition, intrusion of the igneous rocks mobilized and deposited elements such as gold in sufficient concentrations to make mining them economic. Sulfide mineralization is associated with gold deposits, with the sulfide mineral pyrite occurring with native gold along fractures (BLM and MT DEQ, 2001).

Comparison to Rainy River Withdrawal Application Area

Both the Zortman-Landusky Mines areas and Rainy River Withdrawal Application Area have numerous surface water features including streams and rivers. There are indigenous communities in close proximity to both areas. However, the geology of the two areas is dissimilar: in the Zortman-Landusky Mines area, the emplacement of the gold deposits occurred at a relatively young geologic age of less than 65 million years ago (i.e., Cenozoic Period) whereas any gold deposits within the greenstone formation of the Rainy River Withdrawal Application Area would be around 2.7 billion years old, and originated from volcanic activity, and not a felsic igneous intrusive.

Site Design

Both mines were open-pit cyanide heap leach gold mines on a mix of BLM-administered land and private land. The Zortman permit included 406 acres and the Landusky Mine permit included 783 acres (Mitchell, 2004).

Environmental Review Process

The original EIS and supplemental EISs for construction and operation of the mines could not be located online.

The BLM's 2002 ROD for the 2001 Mine Reclamation Final EIS states that the reclamation bond for these two sites was not adequate to completely pay for the earthwork required during reclamation. Therefore, implementation of the decision was contingent on obtaining additional funds (\$5 million for the Zortman Mine, \$17.5 million for the Landusky Mine, and an estimated \$11 million for a long-term water treatment trust fund).

In 2004, both mine sites were registered as a Superfund Site under CERCLA. This allowed the USEPA to initiate reclamation activities (BLM, 2004).

An EA was published in 2022 for the withdrawal of public land from location or entry under the United States mining laws, subject to valid existing rights. The proposed withdrawal of 2,688 acres would lie within the larger footprint of Public Land Order (PLO) 7464, as extended, which expired October 4, 2020. PLO 7464 withdrew 3,530 acres from settlement, sale, location or entry under the general land laws, including the United States mining laws, to protect the reclamation and stabilization of the Zortman-Landusky mining area.

Impacts to the Environment

Extensive acid rock drainage problems at both mines were identified in the 1990s. Additional information is provided in the following sections.

Non-Compliance and/or Litigation

Between 1993 and 1995, litigation under the Water Quality Act was initiated in state and federal courts alleging unpermitted mine discharges to state waters. Settlement discussions resulted in the signing of a Consent Decree between Pegasus, the Montana DEQ, the USEPA, a citizen's group, and the Fort Belknap Tribes effective in September 1996. In January 1998, the operator filed for bankruptcy, and reclamation activities have since been coordinated through a Memorandum of Understanding and related assistance agreements between the BLM and Montana DEQ (Mitchell, 2004).

Mitigation Measures / Corrective Actions and Their Effectiveness

The 1996 Consent Decree provided for temporary technology-based water quality standards that Pegasus was required to meet pending the completion of the ground water and surface water collection systems and the construction of the water treatment plants at Zortman and Landusky. Following construction of the systems, Montana DEQ intended to issue Montana Pollution Discharge Elimination System (MPDES) permits to Pegasus that would have included more stringent effluent standards. Pegasus constructed the water collection and treatment systems, but the 1998 bankruptcy eliminated the existence of Pegasus as a MPDES permit applicant. Since then, the Montana DEQ has been maintaining and operating the water collection and treatment systems under the Consent Decree standards.

Restoration activities at these two sites were completed in the mid-2000s, precipitation runoff from both mines still flows into tributaries of the Milk and Missouri Rivers. Ongoing monitoring and maintenance activities include the maintenance of water capture and treatment systems that prevent excessive heavy metals, nitrates, selenium, and cyanide from being discharged into the surrounding streams.

In 2004, contaminated seeps were identified entering Swift Gulch from an unidentified source. Except for Swift Gulch, the DEQ believed that the surface and ground water resources in the area were being protected by the current and proposed mine reclamation and water treatment efforts (Mitchell, 2004).

A \$13.8 million water treatment trust fund was set up by the Montana DEQ to construct and operate three water capture and treatment systems. But due to excessive precipitation in the area, water treatment costs have exceeded available funds by more than \$1 million annually. This excessive precipitation also necessitated an additional water treatment system to treat waters flowing into the Swift Gulch, which flows onto the Fort Belknap Tribal Reservation.

With assistance from BLM, a water treatment plant for Swift Gulch was completed in 2011, along with a 225 kW wind turbine to help offset the approximately \$300,000 in annual power costs such treatment plants require. While remediation efforts continue, the four treatment plants established by the MT DEQ and BLM have successfully prevented contaminants from being discharged into nearby streams and tributaries, keeping the water safe for local populations and wildlife

As of June 2021, approximately \$83 million has been invested into reclamation at this site. The reclamation activities were funded by the reclamation bond from the previous operator and state, and federal sources. While the mine area reclamation is substantially complete, on-going monitoring and water treatment is expected to continue.

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