Alaska Metal Mines

The track record of impacts

to land and water from the failure to capture and treat mine pollution

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CONTRIBUTORS AND ACKNOWLEDGEMENTS

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Report available at earthworks.org/alaska-mines.pdf

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COVER PHOTOS AND DESIGN

Acid mine drainage from the Kensington Mine (photo from State of Alaska files)
Mine waste (tailings) stored behind the tailings dam at the Fort Knox Mine
Water pollution from the Red Dog Mine (photo from ADFG files)

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Earthworks is dedicated to protecting communities and the environment from the adverse impacts of mineral and energy development while promoting sustainable solutions.

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Introduction

Metal mining is the leading source of toxic releases in Alaska.[1] Uncontrolled mine waste, as well as the processing chemicals used to extract the ore, can be a significant source of pollution to the water, land and air. There are five major operating mines in Alaska: Red Dog zinc-lead mine, Fort Knox gold mine, Pogo gold mine, Kensington gold mine and Greens Creek silver mine. This report compiles the track record of spills and the failure to capture and treat wastewater and air pollution at all five mines, and documents associated water quality and other natural resource impacts.

Methods

This report is based on information gathered from an extensive review of state and federal documents, news reports and the federal National Response Center database. It focuses on documenting three failure modes over the life of all five major metal mines operating in Alaska in 2019:

1) Pipeline spills and/or other accidental releases of hazardous materials;[2]
2) Failure to capture and treat mine impacted water;[3] and
3) Failure to capture and treat fugitive dust and air emissions.

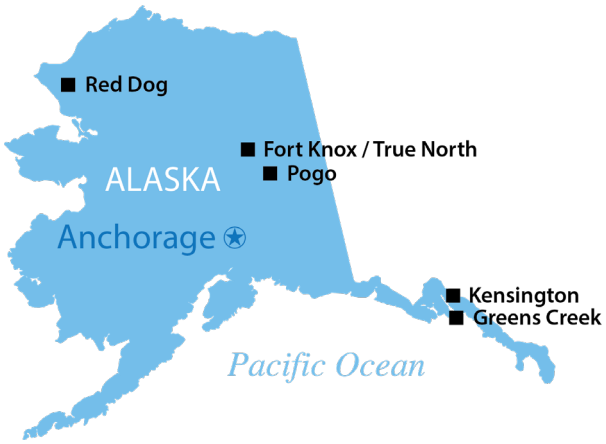
Where information is available, it documents the impacts of these failures on natural resources.

TABLE 1
Active major metal mine operations in Alaska in 2019

Mine	Type of Mine	Company
Kensington	Underground gold mine	Coeur Mining
Red Dog	Open-pit zinc and lead mine	Teck Resources
Greens Creek	Underground silver mine	Hecla
Fort Knox/True North	Open-pit gold mine	Kinross Gold
Pogo	Underground gold mine	Northern Star

Results

Our research found that water quality impacts resulting from spills and other accidental releases, and the failure to capture and treat waste water occurred at many operating Alaska metal mines. Contaminated soils and vegetation also occurred at some mines as a result of the failure to capture and treat fugitive dust and air pollution.



MINE LOCATIONS

100% (5 out of 5 mines) have experienced at least one major spill or other accidental release of hazardous materials such as mine tailings, cyanide solution, diesel fuel and ore concentrate. According to the most recent annual spill reports from the State of Alaska, the Red Dog Mine has been on the list of top ten spills in Alaska for the last four years (2015-2018). Recent truck accidents along the haul road through Cape Krusenstern National Monument include spills of 5,300 pounds of zinc concentrate in 2019, 140,000 pounds of zinc concentrate in 2016 and 18,125 gallons of zinc concentrate in 2015.

80% (4 of the 5 mines) failed to capture or control contaminated mine water, resulting in water quality violations that often occurred over an extended period. For example, in 2019 the EPA filed a Consent Order with the Kensington Mine to resolve Clean Water Act violations extending over a five-year period from 2013-2018. The consent order outlined 200 alleged wastewater violations, including discharges into Sherman Creek that exceeded limits for manganese, ammonia, sulfate, toxicity, pH, and turbidity, and discharges into East Fork Slate Creek that exceeded limits for cadmium, sulfate, manganese and TDS.

80% (4 out of 5 mines) have been identified as out of compliance with federal laws to protect clean air or water in the last 3 years. The Environmental Protection Agency's (EPA) online enforcement and compliance database identifies Clean Water Act (CWA) compliance violations within the last three years (2017-2019) at the Greens Creek, Kensington and Pogo Mines. It also identifies Clean Air Act (CAA) compliance violations at the Red Dog Mine, and Safe Drinking Water Act compliance violations at Greens Creek.

40% (2 out of 5 mines) have resulted in metals pollution on National Park Service lands designated as National Monuments. The most significant impacts are to Cape Krusenstern National Monument, where truck spills and fugitive dust from the Red Dog Mine have resulted in metals pollution of National Monument lands along the mine's 52-mile haul road.

80% (4 out of 5 mines) the Environmental Impact Statement (EIS) process underestimated water quality impacts. Violations of federal and state laws were not predicted in the impact statements developed during the permitting of these operations. Thus, the water quality and air quality impacts documented in this report by state or federal enforcement actions were underestimated in the EIS process.

TABLE 2
Spills and other accidental releases and failure to capture and treat wastewater or air pollution for major Alaska metal mines, with associated impacts to water quality and other natural resources.

Mine Operation	Major spills and other accidental releases*	Failure to capture and treat fugitive dust or air emissions	Failure to capture and treat wastewater	Impacts to water quality and other natural resources
Kensington	YES	None identified	YES	Acid mine drainage was released into Lower Slate Lake in violation of permit requirements. Freshwater monitoring has identified exceedances of water quality standards in Johnson, Slate, Sherman and Ophir Creeks. Johnson, Slate and Sherman Creeks have exceeded limits for pH, aluminum and manganese. Johnson Creek has exceeded limits for cadmium and iron. Slate and Sherman Creeks have exceeded standards for copper. Slate Creek has also exceeded standards for nitrate, cadmium, selenium, zinc and sulfate. Ophir Creek has exceeded sulfate, nitrate and dissolved solids standards. Johnson and Slate Creeks are anadromous salmon streams. An unidentified white substance has persistently coated the rocks in Sherman Creek over the last several years. Most recently, the EPA filed a Consent Order with the Kensington Mine to resolve Clean Water Act violations extending from 2013-2018, including 200 discharge violations recorded during that period. The final water cover and tailings dam will have to be maintained in perpetuity.
Red Dog	YES	YES	YES	Transportation spills and fugitive dust along the mine's haul road have resulted in metals pollution (lead, zinc and cadmium) on federal public lands in Cape Krustenstern National Monument, as well as State of Alaska and native corporation lands. The 52-mile haul road has been placed in the state's contaminated sites program. Most recently, the EPA's enforcement website identifies Clean Air Act violations in 2017 and 2018, and high-priority Clean Air Act violations from April - November 2019. Red Dog has been on ADEC's top ten spill list for the last four years (2015-2018). Releases of acid mine drainage have resulted in water quality violations in Red Dog Creek and Ikalukrok Creek. Mine concentrate has spilled into the Chukchi Sea from the mine's port. Water treatment will be required in perpetuity at the mine site to control long-term acid mine drainage.
Greens Creek	YES	YES	YES	Water quality violations for zinc and lead have occurred as a result of discharges into Greens Creek, and water quality violations have occurred as a result of discharges of diesel oil and drilling mud into Zinc Creek. Contaminated sediments in Hawk Inlet occurred as a result of a spill of ore concentrate. Groundwater has been degraded with sulfates. Surface waters in Further Creek, Further Seep and Duck Blind Drain have been degraded with sulfates, lower pH and zinc. Water treatment in perpetuity will be required for acid mine drainage. Fugitive dust from the tailings impoundment has resulted in metals contamination of public lands in the Tongass National Forest within Admiralty Island National Monument. Most recently, the EPA's enforcement and compliance history database identifies violations of the Safe Drinking Water Act and Clean Water Act occurring between 2016-2019.
Fort Knox/ True North	YES	None identified	None identified	No water quality or air quality impacts were identified.
Pogo	YES	None identified	YES	Water quality violations for manganese, cyanide, iron and pH have occurred for discharges into the Goodpaster River. The mine has repeatedly spilled and released untreated sewage, resulting in violations of water quality standards for fecal coliform. Most recently, a compliance letter from the State of Alaska alleged violations of its discharge permit for cadmium, copper and iron occurring between 2015 to 2018.

*Limitations in the data for accidental releases and pipeline spills make it difficult to determine, in some cases, whether water quality impacts resulted from the spill.

Individual Mine Data

Kensington Mine

The Kensington Mine, permitted in 2005, is an underground mine using flotation processes to recover gold. It is located in southeast Alaska on private and federal public lands in the Tongass National Forest, approximately 45 air miles north of Juneau.

Reports of spills and other accidental releases*	**2019:** Five large generators adjacent to Kensington's mill were decommissioned and removed in January 2019.[4] The site has been referred to the State of Alaska's Contaminated Sites Program due to contamination from past oil spills. According to the Alaska Department of Environmental Conservation (ADEC), proposed field activities in 2019 generally consist of excavation groundwater removal and treatment with granular activated carbon, temporary groundwater monitoring well installation, and groundwater sampling for laboratory analysis of diesel range organics.[5] **2014:** A fuel spill occurred on the ramp leading to Lynn Canal beach, resulting in contaminated soils which were excavated.[6] **2005:** A piece of drilling equipment fell and released drilling fluid into Slate Creek Cove.[7] Kerosene spilled at Comet Beach, and about 2 gallons of diesel spilled into Slate Creek Cove.[8]
Waste water collection and treatment failures	**2019:** Kensington agreed to pay three separate penalties totaling $534,500 for violations at the Kensington Mine.[9] The company signed a Consent Agreement and Final Order with the EPA resolving violations of the Clean Water Act including wastewater discharge violations, unauthorized discharge of acid rock drainage into Lower Slate Lake, multiple effluent sampling violations, and issues with the testing, sample handling and overall work practices.[10] The consent agreement included 200 alleged discharge permit violations including violations of permit limits for discharges of manganese, ammonia, sulfate, toxicity, pH and turbidity into Sherman Creek, and violations of permit limits for discharges of cadmium, sulfate, total dissolved solids (TDS) and manganese into East Fork Slate Creek extending over a 5-year period from 2013-2018.[11] As a component of the settlement agreement, the EPA found that during the winter of 2017-2018, the water elevation in the tailings treatment facility rose such that the acid rock drainage collection system because inundated and could not be operated, and the mine could not collect the acid rock drainage as required by the remediation plan.[12] As part of the settlement agreement with the EPA, Kensington signed an agreement to ensure that acid rock drainage would be collected and treated before discharge into Slate Lake.[13] However, starting August 1st, the State modified Kensington's permit to allow the release of residual acid rock drainage into the lake.[14] Sherman Creek flows to Lynn Canal and East Fork Slate Creek flows to Berners Bay. **2018:** A white residue in the Sherman Creek substrate sporadically occurs originating from the mine's discharge point and ending near the mouth of the Creek.[15] A 2015 study observed lower abundance of aquatic insects, suggesting that the residue may have a detrimental effect.[16] **2018:** The 2018 APDES annual water quality report for the Kensington Gold Project,[17] which contains the results of water quality monitoring in 2018 and graphical data from 2006-2018 for the Kensington Mine documents the following: Freshwater monitoring has identified exceedances of water quality standards in Johnson, Slate, Sherman and Ophir Creeks. Johnson, Slate and Sherman Creeks all have exceeded pH, aluminum and manganese. Johnson has also exceeded limits for cadmium and iron. Slate and Sherman Creeks have had exceedances in copper. Slate Creek also had exceedances for nitrate, cadmium, selenium, zinc and sulfate. Ophir Creek has exceeded sulfate, nitrate and dissolved solids standards. Johnson and Slate Creeks are anadromous salmon streams. **2013-2014:** Kensington received two Notices of Violation (NOVs) from ADEC. The first NOV was issued on June 18, 2013 for the unpermitted discharge of acid mine drainage seepage from graphitic phyllite to the tailings treatment facility. Of note: during mine permitting, Kensington was authorized to convert a freshwater lake, Lower Slate Lake, into a repository to store mine tailings (the tailings treatment facility).[18] The NOV reports that sampling of the acid mine drainage seepage found concentrations of aluminum, cadmium, manganese, zinc, copper and nickel at levels far above water quality standards. The NOV states that the seepage was not identified as a source in the application for the 2011 Alaska Pollution Discharge Elimination System (APDES) permit and, therefore, was not authorized. According to Kensington's 2017 APDES discharge permit, the company is currently in compliance with the remediation plan in the NOV.[19] During the application for permit reissuance, Kensington requested that discharges of seepage to the tailings facility be authorized. The second NOV was issued on July 24, 2014 for a delay in reporting and tampering with sampling equipment. Corrective actions were taken to prevent a recurrence.[20] CONTINUED NEXT PAGE

*Limitations in the data for accidental releases and pipeline spills make it difficult to determine, in some cases, whether water quality impacts resulted from the spill.

Kensington Mine CONTINUED	
Waste water collection and treatment failures, CONT.	**2013:** An inspection report identified acid mine drainage at the north end of Lower Slate Lake at the location of the concrete spillway.[21] The pH was usually 4 or 5, with one point as low as 2. The mine collected water samples and sent them to the lab for analysis. The acid mine drainage is coming from rock that was excavated during the second phase of dam construction. Some of the acid generating material was mixed with other fill for unknown reasons during the previous summer's construction of the second stage of the downstream dam raise, and placed into a non-lined area of the tailings facility.[22] Water quality tests showed that the resulting drainage from the area contained high levels of metals and a low pH.[23] Acid drainage was noticed by mine staff when the snow cover melted from the tailings facility in late spring 2013.[24] Acid generating material had been accidentally placed as fill at the north end of the tailings facility after being excavated from near the dam while preparing the foundation for the Stage II lift. Attempts to seal the seeping water from cracks and holes in the shotcrete were ineffective. A small water treatment plant was built to treat the water being collected from the seeps. However, a September inspection found that water quality was still being degraded in Lower Slate Lake, and speculated that not all the fill material had been removed.[25] **2010:** EPA issued a $170,000 fine to settle Clean Water Act violations over unpermitted mine discharges. According to the EPA, sediment and acid mine drainage were released into East Fork Slate Creek and Lower Slate Lake during construction between 2006 and 2010.[26] **2008:** ADEC issued a Notice of Violation to Kensington for exceeding discharge limits for manganese, zinc, aluminum and cadmium associated with releases of acid mine drainage.[27] According to a report in the *Juneau Empire* in 2008, the mine operator had records of water quality violations dating back to March 2007, but didn't inform the agencies until December of that year.[28] **2005-2007:** In 2005, Kensington Mine was cited for alleged water quality violations caused by sediment draining off the mine access road and the mine's future mill site.[29] The violation notice originated from a November inspection that noticed sediment in Johnson Creek that runs next to the mine's construction area. According to a news article, test results found turbidity results that in two places were respectively 720 and 1,600 times higher than the water quality standard for turbidity, or stirred up sediment.[30] In 2007, the mine agreed to pay $18,334 to the EPA to pay for violations of the Clean Water Act, and to spend $90,000 for wetlands property to be protected from development.[31]
Impacts to water quality and other natural resources	Releases of acid mine drainage into Lower Slate Lake were not authorized under the permit. Fresh water monitoring shows exceedances of water quality standards in all four creeks. Johnson, Slate and Sherman Creeks all have exceeded pH, aluminum and manganese. Johnson has also exceeded limits for cadmium and iron. Slate and Sherman Creeks have had exceedances in copper. Slate Creek also for nitrate cadmium, selenium, zinc and sulfate. Ophir Creek has exceeded sulfate, nitrate and dissolved solids standards. Johnson and Slate Creeks are anadromous salmon streams. An unidentified white substance coats the rocks in Sherman Creek persistently over the last several years. Most recently, the EPA filed a Consent Order with Kensington Mine to resolve Clean Water Act violations extending from 2013-2018, including 200 discharge violations recorded during that period.
*Limitations in the data for accidental releases and pipeline spills make it difficult to determine, in some cases, whether water quality impacts resulted from the spill.	

Red Dog Mine

Red Dog is a large, open-pit, zinc, lead and silver mine located in northwest Alaska about 170 kilometers north of the Arctic Circle. The mine site is located in the DeLong Mountains of the Western Brooks Range about 47 miles inland from the coast of the Chukchi Sea. It began operations in 1989.

Reports of spills and other accidental releases*	**2019:** A truck rollover spilled approximately 5,300 pounds of zinc concentrate onto the tundra.[32] The State of Alaska expressed concern over lasting harm due to the difficulty of rehabilitating tundra after spills are excavated. Another spill in 2019 reportedly dumped 2,200 gallons of mill slurry onto land, with on-site treatment.[33] **2018**: ADEC reports a spill of 7,083 gallons of acid rock drainage as a result of a line failure at the main pump house.[34] **2017:** ADEC reports a spill of 22,000 gallons of overburden wastewater at the mine.[35] **2016:** An estimated 140,000 pounds of zinc concentrate spilled onto the tundra from a mine truck that went off the road.[36] **2015:** An estimated 18,125 gallons of zinc concentrate spilled as a result of a truck rollover.[37] **2014:** An estimated 10,000 gallons of zinc concentrate spilled from a truck trailer.[38] **2012:** An estimated 250,000 pounds of zinc concentrate spilled.[39] **2009:** Teck agreed to pay a $120,000 civil penalty to the EPA for permit violations, including exceedances of the discharge permit effluent limits and discharges of unpermitted wastewater to the tundra near the port.40 The violations occurred from 2004-2006. The company said the violations involved two accidental spills and a 7-day period in 2005 when snowmelt runoff overwhelmed the mine's treatment plant.[41] **2005:** According to a 2005 ADEC report that provided a state-wide summary of spills over a ten-year period from 1995-2005, the Red Dog mine "was responsible for 1,190 of the 1,483 spills and 901,843 of the 1,105,220 gallons spilled in the Northwest Arctic subarea for the reporting period.[42] **2005:** ADEC reports a spill of an estimated 13,500 gallons of process water.[43] **2004:** 2,700 gallons of fuel oil spilled onto tundra from a truck accident along the mine haul road.[44] **2004:** An estimated 21,000 gallons of process water and 1,200 gallons of propylene glycol were released when a forklift operator hit and ruptured the fire protection line.[45] No water quality impacts were reported. **2003:** A 2003 report chronicles approximately 30 former spill sites along the haul road within Cape Krusenstern National Monument, and identifies two sites within the monument where unrecovered spill-related zinc concentrate was found at concentrations warranting additional recovery.[46] The cleanup thresholds for the Arctic Zone are 1,000 mg/kg lead, 41,000 mg/kg zinc and 140 mg/kg cadmium.[47] **2002:** The company agreed to pay $33,000 in fines to the EPA for ore that blew into the sea in 2002. Between mine records and a videotape supplied by a worker, EPA investigators found three instances of ore discharge.[48] **2001:** An estimated 6 tons of zinc concentrate were spilled over a 10 foot by 20-foot area of road gravel and tundra due to a truck rollover.[49] **2001:** ADEC reports spills of 10,000 and 29,000 gallons of reclaim water in June.[50] **2001:** ADEC reports a spill of 1,500 gallons of tailings.[51] **2000:** In December, a truck spill resulted in approximately 40 tons (80,000 gallons) of zinc concentrate spilled over a 100-foot section of the road embankment and 50 feet out onto the tundra.[52] **2000:** In October, the rear trailer of a tandem lead ore concentrate truck left the road and overturned spilling lead concentrate (60,000 gallons) over a 50-feet section of road and 20 feet out onto the tundra.[53] **2000:** ADEC reports that spills of 20,000 gallons of produced water, 5,000 gallons of water treatment plant sludge, 2000 gallons of process water, 20,000 gallons of process water and 1,500 of produced water occurred in March, May, July, August, and October respectively.[54] **1999:** ADEC reports that 20,000 gallons of reclaim water were spilled in February and 6,500 gallons of process water were spilled in November at the mine.[55] **1998:** 200,000 gallons of magnesium oxide (slurry) spilled,[56] and 36,000 gallons of process water.[57] **1997:** ADEC reports a spill of an estimated 3,000 gallons of produced water.[58] **1996:** ADEC reports that an estimated 10,000 gallons of tailings were spilled in June.[59] **1993:** An estimated 20,000 gallons of diesel fuel spilled onto the tundra at the port site.[60] CONTINUED NEXT PAGE

Red Dog Mine CONTINUED	
Waste water collection and treatment failures	**2018:** A compliance letter from the State of Alaska on October 25, 2018 alleges the Red Dog mine violated its discharge permit, exceeding standards for cadmium for its discharges into Middle Fork Red Dog Creek.[61] **2012:** According to a 2013 consent decree:[62] During the 2011 and 2012 discharge seasons (between the beginning of May and the end of September each year), Red Dog reported exceedances of their permit limits for selenium. Due to extremely heavy rains during August 2012 and Red Dog's decision to stop discharging to Middle Fork Red Dog Creek on June 8, 2012 for the remainder of the discharge season to avoid selenium effluent limit exceedances, the capacity of Red Dog's tailings impoundment experienced an approximately 50 percent increase in the volume stored in the tailings impoundment. Projections indicate that the freeboard limit of the tailings impoundment will be exceeded in early spring 2013 and, without discharge, it may overflow in summer 2014. The mine asserted that it must discharge in order to preserve the safe operating limits of the dam. ADEC and Red Dog recognized that during the 2013 discharge season the discharge from Outfall 001 (which discharges into Middle Fork Red Dog Creek) is expected to exceed the selenium limits in the permit. ADEC authorized Red Dog to modify the permit to allow a mixing zone (an area that allows for higher concentrations of selenium) on February 19, 2013. **2010:** A compliance order by consent was issued by the State of Alaska in conjunction with the Red Dog Mine.[63] In 2010, it was determined that the level of wastewater in the tailings impoundment will rise due to spring melt runoff and exceed a safe level by the end of June 2010, and increasing the risk of a "catastrophic uncontrolled discharge." As a result, the State of Alaska authorized a concentration of TDS that exceeds the limits established in the 1998 permit, which were set at 1/3 above background levels. The 1998 permit allowed a maximum limit of 196 milligrams per liter for TDS and a monthly average limit of 170 mg/l. The consent order authorized a site-specific criterion for TDS of 1,500 mg/l in the main stem of Red Dog Creek. **2009:** Teck agreed to pay a $120,000 civil penalty to the EPA for permit violations, including exceedances of the discharge permit effluent limits and discharges of unpermitted wastewater to the tundra near the port.[64] The violations occurred from 2004-2006. According to an article in the Anchorage Daily News, Teck said the violations involved two accidental spills and a period in 2005 when runoff overwhelmed the mine's treatment plant.[65] **2008:** Teck agreed to pay up to $120 million for a wastewater pipeline to settle a lawsuit with the residents of the Village of Kivalina for alleged water quality violations.[66] The settlement calls for the company to build a pipeline from the mine site to the ocean so that the mine will not discharge into the Wulik River or its tributaries. It also requires the company to pay a civil penalty of $8 million to $20 million if the pipeline is not built. The US District Court Judge identified 824 violations for which Teck could be liable and over 2,000 other alleged violations that would be the subject of a court trial, which became moot as a result of the settlement.[67] In 2014, Teck agreed to pay an $8 million civil penalty after determining that building the pipeline was infeasible.[68] **2004:** EPA assessed a $21,000 penalty for two unpermitted discharges of wastewater from the seepage pond to the tundra and the middle fork of Red Dog Creek.[69] The pollutants included lead, zinc and cadmium. **1997:** The mining company agreed to pay a $1.7 million civil penalty and spend more than $3 million on three environmental protection projects to settle allegations that it committed hundreds of federal Clean Water Act violations. The violations occurred at the mine and its Chukchi Sea port over a 4-year period. The most significant violations were effluent violations, mostly metals. According to the EPA, the company had been in almost constant violation of its discharge permit at the port site since it began operations there in 1989.[70] In addition, the lawsuit alleged more than a thousand violations from 1990-1993 at the mine's sanitary sewage treatment system at the port.[71] **1989-1991:** Fish and game biologists reported acidic and metal-laden waters emerging from the ore body as a major source of heavy metals contamination to Red Dog Creek in 1989 and 1990.[72] Orange, green and white water was observed throughout Ikalukrok Creek below the confluence with Red Dog Creek and as far downstream as the Wulik River.[73] In 1990, concentrations of zinc were as high as 1510 mg/l in Red Dog Creek below the mine effluent point and 76 mg/l in Ikalukrok Creek below the confluence with Red Dog Creek. Water quality was also degraded in the Wulik River, downstream of mainstem Red Dog Creek.[74] News reports state that dead fish were collected in the Wulik River and Ikalukrok Creek downstream from the mine.[75] These events resulted in an Administrative Complaint and penalty from the EPA on February 28, 1991.[76] The complaint cited 134 violations of effluent limitations for metals and pH. The company was penalized $125,000 for these violations.[77] The company was required to construct a lined ditch to divert Red Dog Creek around the mine, and isolate the creek from seepage. CONTINUED NEXT PAGE

Red Dog Mine CONTINUED	
Failure to control fugitive dust and air emissions	**2016-2019:** The State of Alaska sent warning letters to Red Dog concerning Clean Air Act issues from 2016-2018, and a Notice of Violation letter in February 2019.[78] The EPA's online enforcement and compliance database identifies Clean Air Act violations in 2017 and 2018 and high priority CAA violations from April - November 2019.[79] **2018:** According to the ADEC contaminated site chronology for the 52-mile access road and port site, the mine was putting together an updated Risk Management Plan to be submitted in 2018 to address the plan modifications requested by ADEC. Ecological clean up levels have not yet been proposed by the mine or established for this site. Additional ecological studies and sampling is being conducted at this site to aid in assessment of the ecological risks.[80] **2016:** Red Dog paid a penalty of $142,248 in a settlement agreement with the EPA over air quality violations.[81] **2006-2009:** Based on a vegetation assessment in 2006, vegetation in the vicinity of the Red Dog mine is being affected by fugitive dust deposition related to mine operations.[82] Further studies were planned to determine the specific cause of plant mortality and to test treatment options. The second report, prepared by a consulting firm for Red Dog in 2007, states that they suspect the major impacts to vegetation in the immediate mine area are due to deposition of acid-forming dust, and input of iron sulfate and zinc sulfate from fugitive dust.[83] The third report, released in 2009, found the treatment results to be inconclusive, reporting a lack of measurable improvements in soil characteristics despite modest improvements in vegetation cover.[84] **2002:** ADEC determined that the port facility and associated road was a contaminated site, and therefore subject to Alaska contaminated sites regulations.[85] **2001:** Teck agreed to an $827,000 settlement with the State of Alaska over eighteen violations of permit emissions limits on diesel generators and improper reporting. The company failed to notify agencies when the emissions exceeded limits and continued to operate the equipment while attempting to bring emissions down to permit limits.[86] **2001:** Fugitive dust from the transportation of ore concentrate between the mine and the port resulted in zinc, lead and cadmium contamination of those areas and along the 52-mile connecting road. The areas impacted by metals contamination include land owned by the NANA Regional Corporation and the State of Alaska, as well as federal public lands in Cape Krusenstern National Monument.[87] **2001:** A moss study performed by the National Park Service found elevated concentrations of metals in the tundra along the mine's haul road and near the port. The haul road traverses 24 miles of National Park Service lands in Cape Krusenstern National Monument. Ore trucks use the road to haul lead-zinc concentrate to the port site near the Chukchi Sea. According to the National Park Service report, "Highest levels near the Red Dog Haul Road equal or exceed (1.5-2.5 times) maxima reported for samples from severely polluted regions in Central European Countries."[88] Concentrations decreased rapidly with distance from the road, but remained elevated at transect endpoints (1000 m-1600 m from the road (Pb >30 mg/kg, Zn >165 mg/kg, Cd>0.6 mg/kg).[89]
Impacts to water quality and other natural resources	Spills of ore concentrate have occurred in the Chukchi Sea. Transportation accidents and fugitive air emissions from mining trucks have caused severe metals pollution (lead, cadmium and zinc) in the tundra along the haul road through Cape Krusenstern National Monument, and on NANA and Alaska state lands. ADEC determined that the port facility and the entire length of the 52-mile access road qualify as a contaminated site. Most recently, the EPA's online enforcement and compliance database identifies Clean Air Act violations in 2017 and 2018 and high priority CAA violations from April - November 2019.90 The Red Dog Mine has been on the Alaska Department of Environmental Conservation's top ten spill list for the last four years of reports (2015-2018).91Releases of acid mine drainage resulted in violations of standards in Red Dog and Ikalukrok Creeks. Water treatment in perpetuity will be required to treat acid mine drainage.92
*Limitations in the data for accidental releases and pipeline spills make it difficult to determine, in some cases, whether water quality impacts resulted from the spill.	

Greens Creek Mine Greens Creek, which started production in 1989, is an underground mine using flotation processes to recover silver, zinc and lead and gravity processes to recover gold and silver. It is located in southeast Alaska in the Tongass National Forest on Admiralty Island, 18 miles southwest of Juneau.	
Reports of spills and other accidental releases*	**2009:** The EPA issued a Notice of Violation to Greens Creek, which found that company drillers observed an unpermitted discharge of mud entering Greens Creek.[93] **2007:** EPA issued a Notice of Violation to Greens Creek for a 2005 stormwater monitoring report that showed numerous discharges from stormwater outfalls exceeding water quality standards for lead and zinc.[94] **2006:** Approximately 4,163 gallons of mine drainage discharged into Greens Creek due to a joint failure in a steel pipeline that normally transfers mine drainage from the mine to the Tailings Storage Facility Waste Water Treatment Plant. This event resulted in the Alaska Department of Environmental Conservation issuing an Notice of Violation to Greens Creek for discharging water with lead and zinc concentrations exceeding Alaska water quality standards.[95] **2004:** Greens Creek and its drilling contractor were fined $12,900 for two spills. The first water quality violation occurred when a bucket tipped over, spilling an estimated four gallons of diesel oil into upper Zinc Creek.[96] Greens Creek personnel tracked the diesel sheen for ½ mile downstream.[97] Drilling mud was also released into Zinc Creek due to an overflow of a mine pond. **2002:** ADEC reports an on-site spill of 8,000 pounds of zinc concentrate, which was recovered.[98] **1989:** The first attempt to load a barge with ore concentrate resulted in a major spill of approximately 95-100 pounds of lead sulfide and a total of approximately 1,000 pounds of concentrate into Hawk Inlet.[99] In 1995, efforts to use a suction dredge to clean up the spill occurred. However, a 2015 annual monitoring report states that concentrate is still present in the sediments.[100] Prior to the spill (pre-production), lead levels at Station 4 were approximately 50 mg/kg dw. Post concentrate spillage, between 1989-1994, resulted in drastic increase of lead concentration (around 200 mg/kg dw) at Station 4.[101] The site was listed as an impaired waterbody under the Clean Water Act in 2012. A comparison of monitoring results from 2011-2018 identifies that average lead levels in mussel tissue in Hawk Inlet are 2.5 times higher since production began.[102]
Waste water collection and treatment failures	**2019:** The EPA's online enforcement and compliance database identified violations of the Safe Drinking Water Act at the Greens Creek Mine between 2016 and 2019.[103] It also identified violations of the Clean Water Act between 2016 and 2019, including effluent violations, management practice violations, improper operation and maintenance, failure to report, and other issues.[104] The State of Alaska sent a Notice of Violation for Clean Water Act issues in February 2017 and November 2018.[105] **2013:** According to the Final EIS, acid mine drainage from the mine will require water treatment for hundreds of years, if not in perpetuity.[106] The Final EIS for expanding the tailings storage facility documents the following impacts to surface and groundwater: The water quality in Further Creek, Further Seep, and Duck Blind Drain is generally of lower quality than that of Greens Creek, Tributary Creek, and Cannery Creek.[107] In general, these drainages and seeps have elevated sulfate, lower pH, and elevated dissolved zinc as well as some other metals. The lower pH and elevated sulfate and metals in these drainage features were from other pyritic sources such as waste rock or production rock that were outside the slurry walls of the Tailings Disposal Facility.[108] Elevated metals levels in the North Fork of Further Creek were reported to be caused by a thin veneer of tailings residue at the toe of the West Buttress that accumulated from the removal of the temporary tailings cover in 1999, and from residual tailings found in the Northwest Diversion Ditch.[109] Water quality in some of these areas is improving. **2012:** According to the Final EIS, in 2006, groundwater in several bedrock wells had elevated sulfate concentrations and conductivity. These wells are down-gradient and in close proximity to the Tailings Disposal Facility (TDF). Tailings contact water from the old unlined portion of the TDF likely seeped into the bedrock aquifer. This is also shown by the increasing sulfate concentration in Monitoring Well 2S. Monitoring Well 2S is located in an area where groundwater has an upward gradient and bedrock water may discharge to the shallow aquifers and surface water. Since then, the northwestern part of the tailings facility was excavated to install a liner, before redepositing tailings. Sulfate concentrations increased in wells MW-T-04-14 and MW-T-05-04 in the most recent sampling event. It is possible that construction for the liner installation temporarily caused the increases.[110] **2007:** EPA issued a Notice of Violation resulting from a July 7, 2006 inspection and other violations including 2005 stormwater discharges from stormwater outfalls exceeding water quality standards for lead and zinc.[111] **1997:** Penalty of $300,000 was assessed for exceedance of discharge permit limits for pH, copper and zinc.[112] CONTINUED NEXT PAGE

Greens Creek Mine CONTINUED	
Failure to control fugitive dust and air emissions	**2013:** The Final EIS reports that elevated levels of metals have been found in lichens near the dry stack Tailings Disposal Facility, including sulfur, nitrogen, aluminum, barium cadmium, copper, iron, lead, silicon, titanium, vanadium, zinc, cobalt, lithium and nickel.[113] An audit conducted in 2018 confirmed that fugitive dust emissions from the TDF are a concern for surface water quality.[114]
Impacts to water quality and other natural resources	Water quality violations for zinc and lead have occurred as a result of discharges into Greens Creek and discharges of diesel oil and drilling mud to Zinc Creek. A large spill of mine concentrate, containing lead sulfide, has contaminated marine sediments in Hawk Inlet. Groundwater has been degraded with sulfates. Surface water in Further Creek, Further Seep and Duck Blind Drain has been degraded with sulfates, lower pH and zinc. Water treatment for acid mine drainage is expected to be required for 100 years, or possibly in perpetuity. Fugitive dust from the tailings impoundment has resulted in metals contamination of public lands in Tongass National Forest within Admiralty Island National Monument. Most recently, the EPA's enforcement and compliance history database identifies violations of the Clean Water Act and Safe Drinking Water Act occurring between 2016 and 2019.
*Limitations in the data for accidental releases and pipeline spills make it difficult to determine, in some cases, whether water quality impacts resulted from the spill.	

Fort Knox/True North Mines Fort Knox, originally permitted for construction and operation in 1994, is an open-pit heap leach gold mine located approximately 26 miles northeast of Fairbanks. True North is a satellite deposit. It is located primarily on State of Alaska lands and private land.	
Reports of spills and other unauthorized releases*	**2018:** During the early stages of commissioning, a thermal-fused weld failed and an estimated 6,000 gallons of untreated Tailings Storage Facility seepage water escaped containment of the catchment basin pond and flowed into the North Channel of the downstream wetlands complex.[115] According to the 2019 environmental audit, monitoring the downgradient wetlands complex did not indicate any adverse environmental impacts. Fort Knox filed a notice of noncompliance with the State of Alaska for the incident. **2015:** A 1,500-gallon diesel spill occurred at the Fort Knox fuel island located at the northeast corner of the Barnes Creek Waste Rock Dump. All the contaminated liquid was contained within a secondary containment system.[116] **2012:** Approximately 45,000 gallons of cyanide solution were released onto the mine roadway of the heap leach operation.[117] A heavy-equipment operator working in the area of a buried cyanide solution pipeline inadvertently damaged a 12-inch supply line with a bulldozer ripper blade.[118] **2010:** Fort Knox estimates 305,300 gallons of cyanide solution spilled within the ore processing facility as a result of a failure of the automated process control system. Approximately 270,000 to 275,000 gallons remained within the building, while the remaining 30,000 to 35,000 gallons spilled onto the gravel roadway and parking area, resulting in contaminated soils over an estimated area of 2 acres.[119]
Waste water collection & treatment failure	**2019:** In the last three years, the EPA's online enforcement and compliance database identified two compliance violations for releases of cyanide above water quality standards: one in 2016 and another in 2019.[120] In response to the 2016 measurement, another sample was immediately submitted for analysis and determined in compliance.[121] The 2019 noncompliance is too recent to determine whether follow-up measures are necessary to determine compliance. **2012:** There was uncertainty about whether seepage from the True North waste rock dump was affecting surface water. According to a 2012 audit, "it appears that pit runoff as well as non-contact stormwater is collecting behind a portion of the reclaimed Zeppelin/Hindenburg dump in the upper Spruce Creek drainage. As a result of reclamation grading activities in that area, the upper reach of Spruce Creek has been blocked by waste material. Water, containing elevated total dissolved solids and sulfate concentrations, is ponding on the up-gradient side of the waste dump. The exact nature of this water is currently unknown, but could be water infiltrating/flowing from the pits. According to site records, a pit lake existed in the Central Pit in 2005 and 2006, but suddenly disappeared in 2007. Coincidentally, a new spring appeared in the upper reaches of Spruce Creek; a spring which ADNR believes did not exist prior to mining. It is this spring that is currently feeding the aforementioned pond. The probability is high that this water is permeating through the waste rock dump, exiting at the toe, and may be contributing to ambient water quality impacts in Spruce Creek."[122] However, upon review of the water quality in Spruce Creek by ADEC, the agency concluded (in their findings letter dated February 5, 2010) that a correlation between the water quality in Spruce Creek and water quality effects from FGMI's mining and reclamation activities could not be established at this time."[123] Subsequent monitoring in 2012 found no correlation.
Impacts to water quality and other natural resources	No impacts to water quality were identified.
*Limitations in the data for accidental releases and pipeline spills make it difficult to determine, in some cases, whether water quality impacts resulted from the spill.	

Pogo Mine The Pogo Mine is an underground gold mine located 38 miles northeast of Delta Junction, near the Goodpaster River. The mine was permitted in 2003, and it is located primarily on lands owned by the State of Alaska.	
Reports of spills and other accidental releases*	**2016:** Pogo reported a release of approximately 3,500 gallons of paste tailings at the #2 Paste Line from the plant to the 2150 portal.[124] Secondary containment occurred. **2015:** A spill of 90,000 gallons of paste backfill occurred, releasing a mix of mine tailings and cement containing three parts per million cyanide.[125] The spill occurred as a result of a ruptured line.[126] Approximately 36,000 gallons were released outside of the secondary containment system onto the portal bench.[127] No water quality impacts were identified. **2007:** The EPA reported concerns about the number and frequency of unauthorized releases at Pogo, including the following spills listed below from 2005-2007:[128] The improper operation and maintenance of treatment facilities is a violation of the permit.[129] **2007:** A release of 25 gallons of raw sewage during the transfer of raw sewage from one truck to another. **2007:** A release of up to 50 gallons of raw sewage when an equalization tank overflowed. **2007:** A release of 30 gallons of raw sewage when the lift station overflowed. **2007:** A release of 10 gallons of raw sewage when the Sequential Batch Reactor tank overflowed. **2007:** A release of 475 gallons of raw sewage due to an imbalance between influent and effluent rates. **2007:** A release of 450 gallons due to an imbalance between influent and effluent rates. **2007:** A release of 50 gallons of raw sewage at a lift station. **2006:** A release of 50 gallons of raw sewage at a lift station. **2006:** A release of 1,000 gallons of recycled tailings pond water from a 6-inch pipeline near the 1690 portal. **2006:** A release of 400 gallons of raw sewage near the mine dry lift station. **2006:** A release of 4,500 gallons of untreated mine drainage. **2006:** A release of 60 gallons of raw sewage at a lift station. **2006:** A release of 800 gallons of partially-treated mine drainage and recycled tailings pond (RTP) water. **2006:** A release of 20,000 gallons of storm water due to catastrophic failure of welded flange adaptor. **2005:** A release of 5,000 gallons of drill water due to overturned truck, including 15 gallons of diesel. **2005:** A release of 500 gallons of untreated mine water. **2005:** A release of 52 gallons of raw sewage from a vacuum truck. **2005:** A release of 3,000 gallons of raw sewage from an underground domestic wastewater line. **2005:** A release of 17 gallons of raw sewage from a damaged sewer line. **2004:** Release of 150 gallons of raw sewage during transfer from the pumper truck. **2004:** Release of 200 gallons of raw sewage from newly installed and not yet operating lift station. **2004:** Release of 10,000 gallons from buried wastewater line. CONTINUED NEXT PAGE

Pogo Mine CONTINUED	
Waste water collection and treatment failures	**2019:** The EPA's online enforcement and compliance database identifies CWA violations between 2016 and 2019.[130] **2015-2018:** The State of Alaska issued a compliance letter alleging that between November 17, 2015 and November 16, 2018, the Pogo Mine "did unlawfully fail to comply with conditions of its discharge permit," including violations of its discharge permit for cadmium, copper and iron that were identified during an inspection in November 2018.[131] **2018:** In 2018, the annual activity and monitoring update states that groundwater downstream of the RTP seepage collection system shows chloride, nitrate and sodium levels above trigger limits at one well and nitrate and sodium remain elevated at two other wells.[132] Dam containment of the RTP water is under evaluation as part of a current correction action investigation with ADEC. As part of the corrective action, additional wells were placed in the Liese Creek Valley below the RTP dam. One well was above the groundwater water quality standards in nitrates. Another well had elevations above the groundwater water quality standard in arsenic, manganese and nitrates. **2011-2012:** On December 1, 2011, the State of Alaska issued a Notice of Violation to Pogo alleging that between November 1, 2010 and continuing up to September 30, 2011, the mine "did fail to comply" with its permit limits. The NOV identified violations for discharges of pH, manganese, fecal coliform, iron and cyanide above permit limits.[133] During that year, fecal coliform was measured at a maximum daily value of 30,000, 34,000 and 200,000#/100mL, which is 75, 85, and 500 times the amount allowed (maximum daily limit of 400#/mL) for that discharge point.[134] A compliance order by consent was finalized in May 2012. The company paid a penalty for the violations, and was required to substantially increase the capacity of its wastewater treatment plant and sewage treatment plant in response.[135] **2011:** According to a 2011 inspection report, Alaska Department of Environmental Conservation files (WPC 121.62.003) show that since ADEC's receipt of primacy for CWA mine permitting and compliance on October 31, 2010, the Pogo Mine had reported 19 non-compliance events, including a sewage spill and numerous effluent limit exceedances (predominantly fecal coliform).[136] The compliance history also showed that two Notices of Violations and a formal enforcement action have been issued to the mine by the EPA since 2009. These enforcement actions were based upon inspections which documented the following violations: effluent limit exceedances (predominantly that of WAD cyanide), failure to properly operate and maintain systems of treatment, monitoring and reporting issues, and failure to allow entry to the facility.[137] **2011:** According to the mine's 2011 annual update, investigations also found that the RTP dam was experiencing seepage.[138] Three wells located below the dam (MW12-500, MW12-501, and MW12-502) monitor groundwater downstream of the RTP seepage collection system. Chloride, nitrate, selenium, sodium and potassium levels in groundwater were measured above the trigger limits in 2012.[139] The company was required to conduct additional grouting in 2012 to control seepage, but excess precipitation delayed the mitigation. Eight sampling events occurred in 2013 for MW12-500 when water was present in the well.[140] Chloride and sodium were detected above the trigger limits on all sampling events, and nitrate was detected above the trigger limits during seven sampling events. Two sampling events occurred in 2013 for MW12-501 when water was present in the well. Chloride and sodium were detected above the trigger limits on all sampling events. Nitrate was detected above the trigger limits during one sampling event. Other parameters were also analyzed and compared to the water quality standards.
Impacts to water quality and other natural resources	Water quality violations for manganese, cyanide, iron and pH have occurred for discharges into the Goodpaster River. The mine has repeatedly spilled and released untreated sewage, resulting in violations of water quality standards for fecal coliform. Most recently, a compliance letter from the State of Alaska alleged violations of its discharge permit for cadmium, copper and iron occurring between 2015 to 2018.
*Limitations in the data for accidental releases and pipeline spills make it difficult to determine, in some cases, whether water quality impacts resulted from the spill.	

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[110] Id., p. 3-78

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